FACULTY
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DOCTORAL THESIS:

ARCHITECT'S ROLE IN DESIGN PROCESS OF BUILDINGS USING BIM METHOD

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Abstract

The Doctoral Thesis provides orientation in contemporary problematics of BIM method and offers the information how to improve quality and effectivity of architect's design. The work meaningfully setting architect's activities in the context of the design process using BIM models. This thesis describes the way how to improve architect's work with application of integrative and sustainable design and explains which benefits can bring using the BIM models regarding that.

Research is based on own 10 years' experience at BIM projects, some of them were awarded.

The work contains practical templates for project processes management with the respect to BIM specificizes and to the Lifelong cycle of the buildings.

Abstrakt

Doktorská práce poskytuje orientaci v současné problematice metody BIM a nabízí informace, jak zlepšit kvalitu a efektivitu architektonického návrhu. Práce smysluplně zasazuje činnosti architekta do kontextu procesu navrhování pomocí BIM modelů. Práce popisuje způsob, jak zlepšit práci architekta s využitím integrativního a udržitelného navrhování, a vysvětluje, jaké výhody může přinést využití BIM modelů v této oblasti.

Výzkum je založen na vlastních desetiletých zkušenostech s BIM projekty, z nichž některé byly oceněny.

Práce obsahuje praktické šablony pro řízení projektových procesů s ohledem na specifika BIM a na celoživotní cyklus budov.

Annotation

The Doctoral Thesis deals with the role of architect in the design process of buildings using BIM method.

The thesis defines architect's key activities, field of his work, legal and professional requirements for his ability to work as a chartered architect.

The work describes the architect's role in the creation of the complex Digital Building Information Model or Architectural BIM Sub model. This helps to improve quality and effectivity of architect's design by positioning the architectural activities in the complex context of the project documentation elaboration by generating from Digital Building Information Model.

The architect's position as a Principal Designer of the entire project documentation is analysed and described as well.

The Doctoral Thesis supports architect in the orientation in current BIM problematics method to improve the quality of his design process and to make the proper decisions.

The work brings wide viewpoint at the BIM problematics and does not focus on the architect's design activities only, i.e., the development of the architectural design of the building constructions using the BIM method but presents to architect creative approach to management of the entire design team today. All of this is particularly important with the emphasis on integrated design with a view to sustainable building design.

The research part of this work evaluates data of twenty-eight projects processed by the BIM method in past 10 years and is based on author's own experience in the position as Project Head Engineer and/or Project Director.

The goal of the survey is to structure evaluated data and to specify current demands on architect's design works using the BIM method.

And, since the architect is the contract holder at the substantial part of his projects, the thesis helps him to be properly oriented in the contractual aspects, administrative and technical management of the entire design process with the respect to BIM specifics. The thesis also contains practical templates for the organisation of the project processes linking to the Contract for Work.

Whereas, there is currently no binding legislation, the implementing decrees for the new Construction Act are not ready, the Chamber Standards are only partially ready, it is not possible to adopt foreign regulations in their entirety due to the different legal and professional environment, no comprehensive evaluation of BIM-based civil engineering projects is available, no Czech methodology for architects working with BIM has been developed, so the doctoral thesis will provide the architect with the comprehensive information necessary for the qualified performance of his key activities in the fast developing BIM environment.

Anotace

Doktorská práce se zabývá rolí architekta v procesu navrhování budov metodou BIM.

Práce vymezuje klíčové činnosti architekta, oblast jeho činnosti, právní a profesní požadavky na jeho způsobilost pracovat jako autorizovaný architekt.
Práce popisuje roli architekta při tvorbě komplexního digitálního informačního modelu budovy neboli architektonického BIM submodelu. Pomáhá zvýšit kvalitu a efektivitu projektování architekta tím, že umisťuje architektonické činnosti do komplexního kontextu zpracování projektové dokumentace generováním z Digitálního informačního modelu budovy.
Analyzována a popsána je také pozice architekta jako hlavního projektanta celé projektové dokumentace.

Disertační práce podporuje architekta v orientaci v současné metodice problematiky BIM, aby zkvalitnil svůj projekční proces a mohl se správně rozhodovat.
Práce přináší široký pohled na problematiku BIM a nezaměřuje se pouze na projekční činnost architekta, tj. na zpracování architektonického návrhu stavebních konstrukcí metodou BIM, ale představuje architektovi kreativní přístup k řízení celého projekčního týmu v současné době.
To vše je důležité zejména v souvislosti s důrazem na integrované navrhování s ohledem na udržitelné navrhování budov.

Výzkumná část této práce vyhodnocuje údaje o dvaceti osmi projektech zpracovaných metodou BIM za posledních deset let a vychází z vlastních zkušeností autora v pozici vedoucího inženýra projektu a/nebo ředitele projektu.
Cílem průzkumu je strukturovat vyhodnocené údaje a specifikovat současné požadavky na projekční práce architekta metodou BIM.

A protože architekt je u podstatné části svých projektů nositelem zakázky, pomáhá mu práce správně se orientovat ve smluvních aspektech, administrativním a technickém řízení celého procesu projektování s ohledem na specifika BIM. Práce obsahuje také praktické vzory pro organizaci projektových procesů s vazbou na smlouvu o dílo.

Vzhledem k tomu, že v současné době neexistuje závazná legislativa, nejsou připraveny prováděcí vyhlášky k novému stavebnímu zákonu, Komorové normy jsou připraveny pouze částečně, zahraniční předpisy není možné přebírat v plném rozsahu vzhledem k odlišnému právnímu a profesnímu prostředí, není k dispozici komplexní hodnocení stavebních projektů založených na BIM, není zpracována česká metodika pro architekty pracující s BIM, tak disertační práce poskytne architektovi komplexní informace potřebné pro kvalifikovaný výkon jeho klíčových činností v rychle se rozvíjejícím prostředí BIM.

Content

Abbreviations and Keywords

AED	AED project, a.s.
AIA	American Institute of Architects
ASD	Architect's Service Standards and Documentation for Building Design
BA	Building Act
BDS	Building Data Standard
BEP	BIM Execution Plan
BIM	Building Information Modeling and Management
BIMo	Building Information Model
CAS	Czech Standardization Agency
CCA	Czech Chamber of Architects
CCAET	Czech Chamber of Authorized Engineers and Technicians
CDE	Common Data Environment
CFW	Contract for Work
COB	Classification of buildings
CR	Czech Republic
DBMC	Digital Building Model Creation
DBS	Data Buildings Standard
DiBM	Digital Building Model
DT	Doctoral Thesis
DTM	Digital Technical Map
EIR	Exchange Information Requirements
Ge/GrD	Geometric and Graphic Detail
GIS	Geographic Information System
GTC	General Technical Codes
IFC	Industry Foundation Classes
MEP	Mechanical Electrical Plumbing
MIT	Ministry of Industry and Trade
MRD	Ministry of Regional Development
NGI	Non-Graphic Information
PaBDiM	Partial Building Digital Model
PBC	Prague Building Code
RIBA	Royal Institute of British Architects

1. The goal

My work solves the status of design process using the BIM[1] method and its effects on architects' work in his key activities in area of building construction.
The aim of the dissertation is:

1. to define the current state of knowledge on the subject, including a summary of the literature and documents relevant to the dissertation topic
2. to define the key activities of an architect in the design process and his role in it
3. to define and summarize current level of knowledge that the BIM method brings to the design preparation of buildings
4. to complement the existing requirements with new demands on the architect's activities, including specification of the new job positions in the architectural office
5. to structure the requirements according to selected typological representatives of the field of civil engineering
6. to summarize and structure the requirements according to the different phases of the architect's services regarding the life cycle of the building
7. to define the differences in architect’s work plans in different countries
8. to elaborate, critically analyze and evaluate data based on personal involvement in twenty-eight projects processed by the BIM according to the following criteria:
    a. reason for choosing the BIM method
    b. role and contribution of the architect in design process using the BIM method
    c. parameters of the projects processed by the BIM method
    d. definition of key terms

To answer the above requirements, it is necessary to first describe:

1. the role of the architect
2. the project preparation process
3. building construction extent
4. the BIM method

[1] Building Information Modeling and Management

2. The current state of knowledge

2.1 The BIM method brief

BIM design is simply here and there is no way getting away from it.
BIM is just a tool, but a very handy tool.

I consider of BIM method in two equivalent ways:

1. Building Information Modelling
2. Building Information Management

I further consider the following three aspects to be essential aspects of good building design, including architectural design:

1. the architectural design of the building, including the design of the external spaces
2. the structural design of the building, including the design of the technical equipment of the building
3. the use value of the building throughout its life cycle

In principle, I am basing the design on the ancient requirements[2]:

1. firmitas - static strength and stability of the building
2. utilitas - the practical purpose of the building
3. venustas - aesthetic objective

The actual aspects of building design allow in the present:

1. Integrated design, including sustainable design
2. Digitalization, including expert assessment

This is absolutely in line with the BIM philosophy, as evidenced by the similarity of the cycles and curves of BIM method and integrated design.

The BIM design method is the creation of a building information model and the sharing of this information model by all participants in the construction process throughout the life of the building, i.e., the creation of the design documentation, the permitting of the building, its expert review, the implementation of the building, its commissioning, the management of the building and even its eventual removal.
This method has been used in the private sector for several years and, following a government resolution, will be required for the preparation and implementation of over-limit projects since July 1, 2023.
Therefore, this fact will have to be accepted by a part of the architectural professional community, the state administration, and construction companies, which still have no experience with this method, either theoretically or practically.

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[2] MARCUS VITRUVIUS POLLIO. *Ten Books on Architecture*, 1st century BC

The profession of the architect is indispensable in this process and in most cases the architect is the contract holder in the Czech Republic in the scope of preparation of complete project documentation, procurement of all necessary permits and authorial supervision over the implementation of the construction, it is necessary that the architect works properly with this method so that his role is respected by all other participants in the construction.

The main roles of the architect in BIM design process:

1. Executive / practicing architect is the contract holder in the scope of preparation of complete project documentation, procurement of all necessary permits and authorial supervision of the construction.
2. Further, architects work in building development, public administration, construction companies, building management, and other positions in construction business.

Architects' goal, when designing with BIM, is to make BIM design fit the rational design process as it is currently practiced and not complicate the architect's work.

As the most important changes in the work of an architect’s transition to BIM, I consider:

1. Change of the current processes, particularly in terms of communication, data transfer and sharing.
2. Implementation of new technologies that will enable BIM models to be created, used, and effectively support the change in communication and processes implemented throughout the construction lifecycle.
3. Emphasis on life-cycle assessment of building quality.

The most important benefits of using BIM regarding architectural design I consider:

1. Improving the quality and efficiency of all design activities
2. Productivity increase which brings shortening of the design processes and time and cost savings
3. Quality increase of the designed buildings, including sustainability

Highlighting the building design with the respect to the whole life cycle of the construction supporting following figures:

1. Improving the quality and efficiency of all design activities
2. Savings from using BIM are approx. 20% of the total life cycle cost of the construction[3]
3. The basic breakdown of the life cycle costs of a building is about:
    a. the cost of the design phase is about 2%
    b. 34% for the construction phase
    c. management and maintenance costs 64%

[3] Different surveys in European countries

2.2 State of Digitalization in the Czech Republic

Description of the current environment in Czech Republic, requirements, and reasons for digitalising: The environment for the designing of buildings is changing in CR due *Digital Czechia*[4] and in the construction business due *Construction Industry 4.0*[5]. This process is based on the decree of the government dated 20 March 2013 and the method of its implementation according to The Report on the *Implementation of the Program Digital Czechia*[6].

Main reasons for digitalization are:

1. The broad digitalisation will make entire construction industry more effective and will decrease the industry's lacking behind other industrial segments in terms of low innovativeness and productivity.
2. The digitalisation will bring better quality and higher effectivity for all participants of the whole lifecycle of a building through all its stages: the project preliminaries, the design process including the approvals to build, operation of the building including facility management, maintenance, and modernisations to their possible ecological removal.
3. The digitalisation allows the development of cities *(SMART Cities)* and regions *(SMART Regions)*[7] [10]).
4. To support sustainable design including the decreasing of energy performance using energy-efficient technologies in the design as well as construction phases.

The digitalisation concerns the following main areas of BIM explicitly:

1. Electronic permitting processes including the provision of documents[8]
2. The provision of a standardised machine-readable format IFC[9] of BIM model for construction departments and state administration bodies allowing to algorithmize the entire permitting process using the artificial intelligence in the future provided the public interest is clearly defined
3. The interconnection of information on the area: GIS[10] models and Building Information Models including the Real Estate Register, Land Use Plans, including the verification of parameters of built projects upon their commissioning (BIM model for the Certificate of Use), and resulting updates of DTM[11] as binding and verified project source documents
4. The enforcing of 4.0 technologies in the construction industry: the implementing of the BIM method, virtual reality (digital twin), smart buildings, 3D printing and prefabrication[12]
5. The aim is also to promote the reduction of energy consumption by using energy efficient technologies, especially in the design phase of the building, but also in its implementation.

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[4] Digital Czechia v. 2.0, The Road to the Digital Economy, MPO, March 12, 2020
[5] 7th meeting of the Government Council for Construction of the Czech Republic, October 18, 2017
[6] The Government Committee for Information Society, 3 October 2018
[7] Analysis of the current level of involvement of the Czech Republic in the concept smart city and smart region in the context of new trends, including proposals for action, Mendelova univerzita v Brně, 22.10.2018
[8] 7th meeting of the Government Council for Construction of the Czech Republic, October 18, 2017
[9] Opinion on the use of the IFC format following Measure 7 UV No 682, Czech Agency for Standardization, March 2019
[10]Geographic Information System
[11] Digital Technical Map
[12] Based on the Policy Declaration of the Government of the Czech Republic, draft May 2018: Impact of tasks given to government departments on the construction industry

2.3 Literature and documents overview

The base of this academic thesis is a research and analysis of:

1. Available literature, hard copies and/or web documents
2. Current and forthcoming legal documents and other publicly available records relevant to the topic of this thesis:
3. The research of available literature[13]
4. Documents sources usable for architectural design with the BIM method:
    a. Legal documents, according to paragraph 2.4 of Doctoral Thesis (DT)
    b. Chartered Chambers:
        i. Czech Chamber of Architects[14] (CCA)
        ii. Czech Chamber of Authorized Engineers and Technicians[15] (CCAET)
        iii. American Institute of Architects[16] (AIA)
        iv. Royal Institute of British Architects[17] (RIBA)
    c. State administration and organisations:
        i. Ministry of Industry and Trade[18] (MIT)
        ii. BIM Conception[19] of Czech Standardization Agency (CSA)
        iii. Ministry of Regional Development[20] (MRD)
5. Corporate documents of AED project, a.s.[21] (AED)

2.4 State of legislation and documents regarding BIM

Current laws and implementing decrees:

1. The novelty of the Building Code, Act No. 225/2017 changing Act No. 183/2006 Coll. (Building Code), December 3, 2017
2. The novelty of Regulation No. 499/2006 Coll. on project documents in the wording of Regulation No. 62/2013 Coll., December 7, 2017
3. Act No. 47/2020 Coll., Amending Act No. 200/1994 Coll., On Surveying and on Amendments to Certain Acts Related to Its Implementation, as amended, Act No. 183/2006 Coll., On Territorial planning and building regulations (Building Act), as amended, and other related laws, February 26, 2020, will be legally effective on July 1, 2023
4. CSN ISO 19650-1, CSN ISO 19650-2

Current laws and documents concerning public commissions:

1. Regulation No. 169/2016 Coll. on the definition of the scope of documents for public construction works commissions and the list of construction works and deliverables and services with a BOQ, December 7, 2017

[13] Annex D to Doctoral Thesis
[14] https://www.cka.cz/cs
[15] https://www.ckait.cz/
[16] https://www.aia.org/
[17] https://www.architecture.com/
[18] https://www.mpo.cz/cz/stavebnictvi-a-suroviny/bim/
[19] https://www.koncepcebim.cz/
[20] https://mmr.cz/cs/ministerstvo/stavebni-pravo
[21] https://www.aedproject.cz/en/

2. The concept of introducing the BIM method in the Czech Republic, Ministry of Industry and Trade, September 2017
3. The imposing of a duty to use BIM for above-limit commissions for construction work from Jan 2022; Government Decree, 25.9.2017, legal effectivity will be changed to July 1, 2023

Furthermore, the development of construction law must also be taken into consideration, that is the new Building Code currently being prepared to be submitted to the Parliament of the Czech Republic.
Legislation under preparation:

1. The New Building Code is legally valid and will be effective since July 1, 2023
2. The Implementation Regulation No. 499/2006 Coll. must be modified/added based on the analysis of Regulation No. 268/2009 Coll. (OTP in the wording of Regulation No. 20/2012 in the wording of Regulation No. 323, 26 September 2017, including standards (CSN, ISO) and must be legally effective since July 1, 2023.
3. The Act on building information modelling and digital modelling of the built environment and the change of some acts (Act on information and digital modelling), draft / version dated 29.7.2020, Assumed resolution of the Parliament, 2021

All current and prepared laws must be coordinated in terms of materiality and time.

2.5 Defining the area of architect's key activities

As the source for the answering of research questions, I selected the following areas I analyse as a basis which I shall use to answer the research questions:

1) The architect’s activity area: I selected the segment comprising the construction building including the connections to the technical infrastructure and roads plus related landscaping.
2) Architects' key activities: I consider the following documents concerning chartered architect’s activities in the segment of building construction:
    1) Principles of providing a license for the individual performance of architectural practice[22]
    2) Act No. 360/1992 Coll., on the exercise of the profession of authorized architects and on the exercise of the profession of authorized engineers and technicians active in construction[23]
    3) Standard of architects' services and their documents for architectural design[24]

and core architect’s activities in compliance with above mentioned documents I am specifying as follows:

1) General job management including administrative and technical steering of design works
2) Performance of the position of architect-in-charge and providing complete architectural design for the whole project
3) Management and coordination of a design team including ensuring all necessary permissions to build and including procurement of involved authorities’ statements
4) Performance of an architect's supervision

[22] Czech Chamber of Architects, April 10, 2014
[23] Last change pursuant to Act No. 459/2016 Coll., effective from January 1, 2017
[24] Czech Chamber of Architects, April 2018

From the perspective of chartered architect's activities, I divided these activities, based on *Service Phases* [18] (SP), into three stages, and I specified them as follows:

1. Pre-project preliminaries:
   a. SP 1 Project Initiation
   b. SP 2 Preliminary – Concept Design
2. Project design:
   a. SP 3 Land Zone Permit Design
   b. SP 4 Building Permit Developed Design
   c. SP 5 Detailed Design
   d. SP 6 List of Works and Deliverables
3. Execution phase:
   a. SP 7 Architect's Supervision

Each SP includes standard services (SS) and non-standard (NSS) ones. Services related to BIM activities I consider as NSS and are split according to SP as described below:

1. SP 1: preparation of contract annexes, i.e., *EIR* [19], *BIM protocol* [20] and *BEP* [21] *templates*
2. SP 2 to SP 7: BEP elaboration for each SP, BIM model development, installation, and operation of CDE
3. SP 3 and SP 4: Acquisitional: electronic submittal of the proposal to permit the project, including the project documents in digital format IFC
4. SP 6: preparation of the digital basis for the Bill of Quantities and the Schedule of Works and Supplies
5. SP 7: creation of the IMS of the actual design for the approval of the building permit and for future modifications of the building (digital twin)

All NSS have effects on all major part of Architect's Work Contract, i.e., the subject matter of the performance, the fee, and the Time Plan.
There are currently two basic types of Contracts for Work to be considered:

1. Design-Bid-Build[25]
2. Design-Build[26]

However, the above SP must also be addressed in the context of the other phases of the life cycle of a building, i.e., the operational phase of the building, which includes the management and operation of the building, and the removal phase, including the possible re-use of materials or parts of the building.

2.6 The sequence of activities of architects using the BIM method

An architect must be aware of the fact using BIM design method has certain special consequences in all SPs:

Architect will use digital project source documents:

[25] https://fidic.org/node/747
[26] https://fidic.org/books/plant-and-design-build-contract-2nd-ed-2017-yellow-book

1. DTM, GIS models, BIM models of related constructions, Real Estate Register, land-use plans, etc.

BIM model allows the architect to:

1. use another software for e.g., expert models for special simulations e.g., environmental analysis, robotic control (Grasshopper in Rhino 6), parametric / computational design (Rhinoceros, Dynamo Studio), review of model coordination and identify / resolve clash and interference problems, clash detections/collision checking, to combine models and files into a single building information model, building simulation/planning and quantification. (Navisworks).
2. apply electronically for building permit(s) in IFC format[27]
3. cooperate and share sub-models with Main Contractor and Sub-contractors, Asset and Facility Managers, etc.

for all above mentioned purposes the conversion of BIM model to machine-readable IFC standard is necessary.

2.7 The field of building construction

The field for this dissertation work covers these building objects classified according to KSO[28]:

801 Buildings of civil construction

802 Halls of civil construction

803 Buildings for housing

811 Buildings for manufacturing and services

812 Buildings for manufacturing and services

Based on the listed processed projects I divided types of buildings as follows:

1. Residential buildings
2. Buildings for accommodation
3. Office buildings, which includes administrative buildings also
4. Other buildings, i.e., buildings for other functional use in civil construction

2.8 The principles of the design process

By project preparation I mean the preparation of project documentation, according to the individual service phases, and other related activities and is not defined in the Building Act[29].

The technical content of the project documentation is based on the General Technical Codes[30] (GTC) and the norms and other regulations listed therein. In the territory of the capital city of Prague the GTC are replaced by the Prague Building Code[31] (PBC).

[27] Industry Foundation Classes

[28] Classification of buildings, https://www.cs-urs.cz/tridniky-a-ciselniky/kso-jkso/?801_802_803_811_a812

[29] Project Initiation and Preliminary – Concept Design

[30] https://www.zakonyprolidi.cz/cs/2009-268

[31] https://www.iprpraha.cz/psp

The use of the BIM method does not bring any changes in the content of the activities, because it is a tool without the use of artificial intelligence (it uses only algorithms), then BIM only brings changes to the work process of project documentation.

However, there are emerging requirements for the quality of design documentation: sustainable design, based on the principle of integrated design, and the requirement that the design considers the life-cycle requirements of the building[32]

However, these requirements, i.e., the requirements of integrated design, 'surprisingly' overlap with the requirements for BIM design, both in terms of time and in terms of the quality of information, graphical and non-graphical, at each stage of the project.

A time for the development of the Building Information Model (BiMo)[33] and Digital Building Information Model (DiBM)[34] model of the IMS building is inserted before the preparation of the Building Permit Developed Design documentation mostly.

2.9 The basic terms explanation

Below I explain the most important terms based on Building Act (BA) related to the field of doctoral thesis.

1. Preparation of documentation or design documentation:
    a. Project documentation is the documentation prepared by the designer[35].
    b. The content and scope, and/or other requirements concerning the preparation of documentation or project documentation are set out in Decree No. 499/2006 Coll., on documentation of buildings, as amended.
2. Creation of Building Information Model (BIMo) and Digital Building Information Model (DiBM):
    a. The detail and information level are based in each design phase with relevant annex of Decree No. 499/2006 Coll.
3. Building constructions:
    a. Building construction means all construction works, which are created by construction or assembly of technology packages[36].
    b. Public infrastructure means especially transport and technical infrastructure, civic amenities, and public spaces[37].
4. Architect’s key activities:
    a. A designer is a natural person authorized under the Authorization Act to carry out design activities in construction[38].

[32] see Appendix C to DT, TheLife-Long Cycle of Construction
[33] see Appendix C to DT, The BIMo Scheme
[34] see Appendix C to DT, The DiBM Scheme
[35] § 110 (2), (4) and § 158 (2) of the Building Act
[36] § 2 of the Building Act
[37] § 2 of the Building Act
[38] § 22(4) of the Building Act

b. Principal designer means the designer entrusted by the builder with the coordination of the project documentation prepared by several designers and/or the coordination of the author's supervision[39],[40].

2.10 The documentation of buildings[41]

A summary of the need for specific documentation or project documentation at various design phases of the construction process[42], in relation to the condition of its preparation by the designer, i.e., by a authorized person[43].

Only authorized persons can elaborate with reference to the topic of dissertation following types of (project) documentation:

a) Documentation for the issuance of a zoning decision[44], zoning consent[45], zoning decision[46] and public law contract[47]
b) Project documentation of construction for the issuance of a building permit[48] and for the implementation of the construction[49]

If the designer is not able to prepare any part of the project documentation himself, he is obliged to invite a person with a license for a specific field or specialization to prepare it. The designer's responsibility for the design documentation of the construction is not affected.

2.11 The copyright

Design activities in construction[50] must be provided by a designer, i.e., an authorized person with a license under Copyright Act (CA)[51]. According to the Trade Licensing Act, it is a bound trade "Design activity in construction".

1. Authorized persons are:
    a. authorized architect
    b. authorized engineer,
    c. an authorized technician[52]
2. Authorized Architects are for the following fields:
    a. civil engineering,
    b. urban planning,
    c. garden and landscape design[53]

[39] § 113(2) of the Building Act
[40] Author's supervision is subject to § 2 and § 11 of the Copyright Act
[41] https://profesis.ckait.cz/dokumenty-ckait/a-3-19/
[42] Act No. 183/2006 Coll., Building Act
[43] Act No. 360/1992 Coll., Authorization Act (AA)
[44] § 76 - § 90 Building Act
[45] § 96 and § 96a Building Act
[46] § 92 SZ Building Act
[47] § 78a SZ Building Act
[48] § 115 Building Act
[49] § 134 (7) Building Act
[50] 158 and § 159 of the Building Act
[51] Act no. 121/2000 Coll.
[52] § 3 Law No. 360/1992 Coll. as ameded
[53] § 4(2) Law No. 360/1992 Coll. as ameded

3. For the preparation of documentation and design documentation for the typology of buildings, considered in the dissertation, the especially following authorizations are required for the disciplines granted by CAET[54]:
    a. building constructions
    b. transport constructions
    c. water management and landscape engineering structures
    d. bridges and civil engineering structures
    e. technological equipment of buildings
    f. environmental engineering of buildings
    g. statics and dynamics of buildings
    h. urban engineering
    i. geotechnics
    j. fire safety of buildings
    k. buildings for the forest function
4. For the activities and building typology considered in the dissertation topic, all the above-mentioned authorization fields and authorization disciplines are mostly needed. Key persons in design process and (project) documentation elaboration is however:
    a. authorized architect,
    b. authorized engineer

2.12 The digitization of construction processes

The digitization of following processes will be effective since July 1, 2023[55]:

1. National Planning Geoportal
2. Electronic acts
3. Builder's Portal
4. Provision of information by the owner of technical infrastructure
5. Records of planning and construction procedures and other procedures
6. Records of electronic documentation
7. Access to records of planning and construction procedures and other procedures and records of electronic documentation
8. Building identification number information system

These processes will be included in the forthcoming new Construction Act, which is also due to come into force on 1 July 2023.

[54] § 5 of the Copyright Act
[55] Amendment No. 47/2020 Coll. to Act No. 200/1994 Coll., on Surveying

2.13 The principles of digital building model creation

As I am co-author of Principles of Digital Building Model Creation - DiBM[56] (DBMC) published in the Professional Performance Standards (PPS)[57] of Czech Chamber of Authorized Engineers and Technicians Active in Construction (CCAET)[58] in 2021, this chapter is based on this document and explains and highlights its important information.

This document specifies the principles of DiBM development and forms an annex to the PPS.

It is prepared based on the experience practically verified during the preparation of project documentation by the BIM method and own cooperation within the construction implementation phase. This document is a substantial guideline for architects and engineers through all design phases.

Content of is Principles of Digital Building Model Creation is as follows and I am highlighting important information of this document:

1. Preamble:
    a. Creation of DiBM is based on CSN EN ISO 19 650-1:2019.
    b. Specification of contractual aspects of BIM, see chapter Contractual aspects related to BIM design.
2. Introductory Provisions:
    a. An integral part of the document is Annex DS Non-graphical properties table and coding principle. Tables, contained in this document, specify Table of information model element properties for the Detail Design phase, and are splitted to sections:
        i. Architecture and Construction
        ii. Structures
        iii. Mechanical Electrical Plumbing (MEP)
    b. Architectural part is divided according to building parts and elements how it is usual in design practices and copying with Decree 499/2006 Coll.
3. Base used pro DiBM:
    a. Reference to documents emerging according to Concept of BIM implementation in the Czech Republic[59] which are produced in coordination with both Chambers, i.e., CCA and CCAET, and both Chambers also approve theme.
    b. Explanations of terms concerning text and diagrams, included in DBMC, should be used in communication to prevent misunderstanding and confusion, despite the fact some of these terms would be updated.
    c. Data Building Standard (DBS) is unfinished currently. Published was DBS for Building Permit Documentation and DBS for Planning Permit should be approved shortly. Although DBS for all design phases is planned to be finished by the end of 2022, I consider these data standards very useful basic platform for BIM annexes attached to architect's Contract for Work (CW).
4. Explanatory Notes and Terminology:

[56] https://profesis.ckait.cz/dokumenty-ckait/a-4-3/#26
[57] https://www.ckait.cz/sites/default/files/cast_2_projektovani_staveb_0.pdf
[58] https://www.ckait.cz/
[59] https://www.koncepcebim.cz/koncepce

   a. Proposal of BIM sub-models dividing goes with common practice of construction parts and copes with structure of Decree 499/2006 Coll. And finally, this division is in conformity with fields of authorization[60].
5. Determination of Objectives:
   a. Objectives are set up for:
      i. Project Information Model (PIM)
      ii. Building Information Model (BIMo)
      iii. Digital Building (Information) Model (DiBM)
      iv. And presented template proposes way, how to arrange BIM project objectives, which must be part of CW.
6. Software Tools and Data Forms:
   a. Important criteria for software (SW) choose is ability to transfer data in IFC form
   b. There is no necessity to use the same SW for all sub-models
   c. The BIM SW could be supplemented by CAD SW
   d. All chosen SW for project must be specified in BEP
7. Basic Principles of DiBM Creation:
   a. Sub-models are preferably divided by construction objects, construction parts and functional systems, each part and system are usually divided further functional units, as reasonable according to design, construction, and bidding criteria
   b. Sub-models division must be specified in BEP
8. DiBM location, Interconnections and Continuities
   a. All these criteria must be specified in BEP:
      i. Geographical and altitude, S-JTSK and BPv in CR
      ii. Used basic units: SI metric units
      iii. The basic point of the project: x, y, z coordinates
      iv. Sub-models link in DiBM
9. DiBM Data Standard:
   a. The principal standard must be specified in contract annex Exchange Information Requirements (EIR) and be precise, with the boundaries of EIR, prior to each design phase in BEP[61]
   b. EIR must follow up Decree 499/2006 Coll. and/or CCA Standards for each design stage
10. Requirements for Bill of Quantities and Costing:
    a. Demands, exceeding scope of SP6 of CCA Standards must be specified in EIR
11. Detail of DiBM:
    a. Principal requirements for information per each design phase must be specified in EIR and are split in two parts:
       i. Graphical information “G”
       ii. Non- Graphical information “I”
12. DiBM in Concept Design Phase:
    a. According to CCA Standards

[60] Authorisation Act no. 360/1992 Coll.
[61] BIM Execution Plan

13. DiBM in Land Zone Permit Phase:
    a. According to Decree 499/2006 Coll., Annex no. 1
14. DiBM in Building Permit Developed Design Phase:
    a. According to Decree 499/2006 Coll., Annex no. 12 and other related
15. DiBM in Detailed Design:
    a. According to Decree 499/2006 Coll., Annex no. 13
16. DiBM Coordination:
    a. Is ensured by an architect through all design phases
    b. Clash Detections are divided to:
        i. Crucial: collisions that lead to the infeasibility of the proposed solution
        ii. Substantial: collisions that have a demonstrable solution and be remodeled in a subsequent stage
        iii. Irrelevant: collisions, by their nature, relevant to the construction stage or production detail
        iv. Specification in BEP
17. DiBM Checking:
    a. Must be specified in EIR for all design phases
18. DiBM in Construction Stage:
    a. Detailed Design elaborated by architect
    b. Compliance of the DiBM with the construction is ensured by the contractor
19. As Built Documentation:
    a. Is ensured by the contractor
20. Common Data Environment (CDE)
    a. Operation of CDE is primarily due of the Builder
    b. Specification, and/or other arrangement, must be specified in EIR and BEP
21. Documentation and Hard Copies:
    a. Documentation is primarily printed from DiBM
    b. Irrelevant formal graphic deviations from normal practice are not a defect preventing the use of the documentation
22. Data Check and Compatibility Ensuring:
    a. According to EIR and consequently to BEP
23. Data Parameters:
    a. According to EIR and consequently to BEP
24. Time Schedule Milestones for DiBM Handover:
    a. Must be specified in EIR and consequently precise in BEP
25. Summary:
    a. Target: Use of DiBM / PIM as a base for consequent stages of building life cycle
26. Annex:
    a. DBS_Table-non-graphical-properties-PIM_DiBM-and-encoding-principle

2.14 The contractual aspects related to BIM design

BIM Protocol must deal with the specifics of the BIM method only. The other arrangements concerning the project must be a content of the main Contract for Work (CFW).

There are two main types of CW:

1. Design-Bid-Build
2. Design-Build

BIM Protocol must respect type of CW, but its annexes must have this structure for both types:

1. License Agreement
2. Special Terms and Conditions:
    a. BIM protocol:
        i. Exchange Information Requirements (EIR):
            1. Data Buildings Standard (DBS)
            2. Common Data Environment (CDE)
        ii. BIM Execution Plan (BEP) Templates:
            1. Data Buildings Standard (DBS)
            2. Common Data Environment (CDE)

3. The research method

3.1 The motto

Modern science differs from previous traditions of knowledge in three essential ways. It is:

1. The willingness to admit ignorance. *Modern science is based on the admission of ignorance. Assumes that we don't know everything. Not only that, even acknowledges that further research might disprove, what we think we already know. No concept, idea or theory is not sacred and irrefutable.*

2. The central importance of observation and mathematics. *Modern science admits ignorance and trying to get new knowledge. Collects empirical, comparable facts and combines them by mathematical method into a general theory.*

3. Development of new abilities and possibilities. *Modern science is not satisfied with the formulation of theories. It uses them to acquire new technologies.*[62]

3.2 The main data specification

The main source of my dissertation is my own experience design practice and the implementation of 28 buildings using the BIM method.

The principal structure of research data is:

9. to structure the requirements according to selected typological representatives of the field of civil engineering
10. to summarize and structure the requirements according to the different phases of the architect's services regarding the life cycle of the building
11. to define the differences in architect's work plans in different countries
12. to elaborate, critically analyze and evaluate data based on personal involvement in twenty-eight projects processed by the BIM according to the following criteria:
    a. reason for choosing the BIM method
    b. role and contribution of the architect in design process using the BIM method
    c. parameters of the projects processed by the BIM method
    d. definition of key terms

3.3 The BIM experiences

The main source of my dissertation is my own experience design practice and the implementation of 28 buildings using the BIM method.

The starting point is my experience practically verified during the preparation of project documentation by the BIM method and my own cooperation within the construction implementation phase.

[62] HARARI, YUVAL NOAH. *Sapiens Stručné dějiny lidstva*, str. 306, Leda, 2018, ISBN 978-80-7335-569-2

The principles of creating a digital building model I have coordinated, as the chairman of the CCA Digitization Working Group[63], with the CCA Performance and Documentation Standards[64], I've worked on before.

The same coordination I have performed with the Ministry of Industry and Trade (MIT)[65], where I am a member of the Working Committee for the Implementation of the BIM method in the Czech Republic (WC BIM)[66].

Finally, as a member of the Technical Commission and a member of the Coordination Group for the Building Data Standard (BDS), I participated in the commenting and approvals of the BDS for the project phases SP3 Land Zone Permit Design and SP4 Building Permit Developed Design.

3.4 The research and data processing method

Generally:

1. Definition and specification:
    a. the field of architect's key activities
    b. architect's key activities
    c. architect's role in design process
2. Setting up criteria, i.e., data structure for research
3. Data:
    a. Collection
    b. Analysis
    c. Evaluation
4. Summary
    a. Setting up criteria for assessment

Specifically:

1. I analysed and assessed architect's activities areas intersection in reference to BIM.
2. I collected the data and assessed the knowledge according to my experience from working in the following fields:
    a. Design practice:
    b. In the position of a Project Engineer, Head Project Engineer and Project Manager during thirty-two years of designing using the CAD software and ten years of designing using the BIM method.
    c. The assessment of the project the Headquarters of the CSOB[67] in Prague 5-Radlice that was awarded the title Building of the Year 2019 regarding BIM design where all Service Phases were carried out using the BIM method.

[63] https://www.cka.cz/cs/cka/kontakty/pracovni-skupiny/ps-digitalizace
[64] file:///C:/Users/AlesMarek/Downloads/standard-sluzeb_EN_2018.pdf
[65] https://www.mpo.cz/cz/stavebnictvi-a-suroviny/bim/
[66] https://www.mpo.cz/cz/stavebnictvi-a-suroviny/bim/sesel-se-pracovni-vybor-pro-zavadeni-metody-bim-v-cr--261698/
[67] Czechoslovak Commercial Bank

d. My activities in workgroups Digitalization (Chairperson) and Standards and Fees (member) established by the CKA.
e. My work in committees and boards at MPO [25], MMR [26], CKA, ČKAIT [27] dealing with issues and preparation of legislation regarding the built environment and designing using the BIM method.

3.5 The starting point

The starting points is my experience in following activities:

1. practically verified experience of the preparation of 28 BIM projects documentation, including cooperation within the construction implementation phase.
2. creating the part of CCAET Standards concerning creation of a (Digital) Information Building Model and elaboration of Data Building Standards
3. Coordination and approvals of BIM documents in:
   a. CCA Digitization Working Group[68],
   b. Ministry of Industry and Trade (MIT)[69], Working Committee for the Implementation of the BIM method in the Czech Republic (WC BIM)[70].
   c. Technical Commission and Coordination Group for the Building Data Standard (BDS)
4. To validate the data collected from the projects, I conducted a survey among architects, designers (head engineers, engineers in charge and designers) and builders.

[68] https://www.cka.cz/cs/cka/kontakty/pracovni-skupiny/ps-digitalizace
[69] https://www.mpo.cz/cz/stavebnictvi-a-suroviny/bim/
[70] https://www.mpo.cz/cz/stavebnictvi-a-suroviny/bim/sesel-se-pracovni-vybor-pro-zavadeni-metody-bim-v-cr--261698/

4. The data analysis

4.1 The list of projects

I established following assessment of criteria for BIM projects evaluation with respect to the main topic.
For breakdown of the figures see tables and graphs in Annex B.
For detail architect's opinion see Annex B, Questionnaire, Architects.

1. All projects:

1.1. Projects processed in AED project, a.s., Aleš Marek Division, in the years 2011-21

Main data extract:

Total number of projects: 128

1.2. Standard Design Process vs. BIM Method Design

Main data extract:

Total number of projects / Standard process:	128	
Total number of projects / BIM method:	28	22%

Evaluation: The number of BIM projects was 22% of total in past 10 years. The % part of BIM projects to standard projects is growing since 2017 and is approx. 40% today.
Resume: The reasons are different, but BIM is an unmissable part of design process today and all participants of design process must have at least knowledge of BIM today, especially architects.
BIM became even a part of private and public architectural competitions (SZ Headquarters).

1.3. Contract Holder

Main data extract:

Architect:	56	44%
Engineer:	66	52%
Joint Venture:	6	5%

Evaluation: Architect was holder of approximately 40% of all rated projets, i.e., he kept the role of the General Designer here.
Regarding the contract arrangement three types were experienced:

1. Architect was a contract holder and subcontracted to Engineer all responsibilities excluding architectural design. In a legal way architect cannot give up his responsibility as a contract keeper and he must control all activities of the project. To be possible to control it he must understand the principals of contract management in all aspects:
    a. Legal responsibilities
    b. Way of project authorization
    c. Technical design aspects
2. Engineer was a contract holder, and it means Engineer was responsible for overall performance of the contract, excluding architectural design.

3. Architect and Engineer established the association, i.e., joint venture, and in their contract, they established split of the contract responsibilities and the way of management.

Resumé: Architect must have the ability to control all contractual activities.

The architect must have knowledge not just as a Head Architect, but as General Designer as well.

2. BIM projects:

2.1. Contract Holder

Main data extract:

Architect:	15	54%
Engineer:	12	43%
Joint Venture:	1	4%

Evaluation: Architect was a contract holder on 49% (incl. joint ventures) of standard projects, but on 58% of BIM projects.

Resume: The trend seems to be stable, but its necessary architect will have to deal, soon, with the contract steering position on 50% of his BIM projects at least. The knowledge of contractual aspects related to BIM is more than necessary for an architect, to be possibly for him to steer the entire design team.

2.2. Type of Construction: New Built vs. Reconstruction

Main data extract:

New built:	23	82%
Reconstruction:	5	18%

Evaluation: 18% of all BIM projects is reconstruction and/or refurbishment. The use of BIM on these projects is the same as on standard projects and the 18% seems a little low, but the reason is going with the quality of surveys (3D intelligent scanning) and not with the type of construction.

The pressure for city recovery, incl. brownfields, is obvious, and therefore, when 3D intelligent scanning and Digital Technical Map (DTM) will become standard parts of surveys, the number of reconstruction projects will increase. Or the reconstruction will be part of entire project and there is problematic to combine different way of design at one project.

Resume: Architect must know BIM use on both types of projects.

2.3. Functional Use

Main data extract:

Residential:	12,5	45%
Accommodation:	0,9	3%
Office:	5,8	21%
Others:	8,8	31%

Evaluation: The % split is not driven by the function of the building, but by the position of the architectural studio on the market.

Resume: BIM method suits to all type of projects concerning functional usage.

2.4. Gross Floor Area (GFA) of Buildings

Main data extract:

Residential:	382 400 sqm
Accommodation:	9 000 sqm
Office:	142 300 sqm
Others:	174 000 sqm
Total:	902 800 sqm

above 100 000 sqm:	1	4%
100 000 - 80 000 sqm:	3	11%
79 900 - 60 000 sqm:	1	4%
59 900 - 40 000 sqm:	1	4%
39 900 - 20 000 sqm:	8	29%
19 900 - 10 000 sqm:	4	14%
9 900 - 5 000 sqm:	4	14%
4 900 - 2 000 sqm:	5	18%
below 1 900 sqm:	1	4%

Evaluation: The spread of GFA of the buildings is steady and is depends on jobs type acquisition.

Resume: There is no reason not to use BIM on any size of the project.

2.5. Type of a Builder

Main data extract:

Private:	22	79%
Public:	6	21%

Evaluation: The number of public projects is influenced by the of researched company, in other companies' data will be probably different.

Resume: The pressure on public over-limit projects is very expected since July 1, 2023, when the new Construction Law will be effective. The decision whether to use BIM, or not, is not influenced by the functional use of the building.

2.6. Use of the Sub Models

Main data extract:

Architectural Sub model:	5	8%
Construction Sub model:	28	44%
Structural Sub model:	11	17%
MEP Sub model:	14	22%
Sub model of Technologies:	6	9%

Evaluation: Architectural Sub model was used on every project, Structural and MEP sub models on approx. half of them. Problematic is very low, 8 %, architect's involvement in creation of Architectural Sub model.

Resume: Architect must create a BIM Sub model in relevant design phases, i.e., Concept Design and Planning Permit Design phase, in every project. Without this the collaboration between architects and engineers losing BIM benefits.

2.7. Modelling of Construction Objects

Main data extract:

Building and Landscape:	2	7%
Building:	26	93%

Evaluation: BIM model of landscape and infrastructure was developed in 2 projects of 28 only. The reason is missing suitable software.

Resume: Architect must find, and engineers as well, the way how to model external spaces, because without this the BIM approach to design is not complete.

Architects' opinion: No such question was asked to architect in Questionnaire.

2.8. Service Phases Processed by the BIM method

Main data extract:

SP1 Project Initiation:	9	10%
SP2 Preliminary – Concept Design:	4	4%
SP3 Land Zone Permit Design:	4	4%
SP4 Building Permit Developed Design:	26	28%
SP5 Detailed Design:	23	25%
SP6 List of Works and Deliverables:	21	23%
SP7 Architect's Supervision:	5	5%

Evaluation: It is obvious the BIM method is currently used in the design phases, where its contribution is the most explored.

Resume: To increase the benefits of BIM it is necessary to spread BIM use in beginning design phases, especially in Concept Design with huge engagement of architect.

2.9. Relative Time Consumption of Individual Service Phases

Main data extract [% CCA and % mean of all BIM project]:

SP1 Project Initiation + SP2 Preliminary – Concept Design:	14%	7%
SP3 Land Zone Permit Design:	15%	14%
SP4 Building Permit Developed Design:	22%	30%
SP5 Detailed Design + SP6 List of Works and Deliverables:	37%	40%
SP7 Architect's Supervision:	12%	6%

Evaluation: I made a comparison between percentage time donation according to CCA Standards and explored data of processed BIM projects. It is clearly visible the following: in the design phases, where BIM was not used, time according to CCA calculator is sufficient. In BIM design phases the time donation is low, but the overall time consumption of all phases is about 3 % less.

Resume: If design team, incl. architect, is skilled in BIM method, the total time allowance is sufficient, but, in the case, there will be no time addition in CCA calculator regarding BIM use, the percentage split for design phase must be redistributed. The underestimated phases are Building Permit, where most of BIM models are created, and Detailed Design, incl. Specifications, but this is caused by the excessive requirements of builder. In Building Permit phase approx. 30 % is missing, compared to ordinary time donation, and in Detailed Design, incl. specifications, approx. 10 % is missing. On the other hand, one of the BIM benefits is obvious: for the same time, you can do better work. This is valid for the architectural design as well.

2.10. Reasons for Using BIM Method

Main data extract:

Design Process:	28	64%
Construction Realization:	9	20%
Maintenance and Building Operation:	7	16

Evaluation: The research was executed in BIM oriented company and the BIM use at all projects is given. Demand to use BIM was raised on at the only one third of the projects by contractors and building owners.

Resume: It is expected the demand for BIM use will substantially increase, in the case of contractors because of better construction management and requirements for faster realization, and in the case of building owner because of more efficient maintenance and building operation. Architect must be prepared for future changes, i.e., BIM models preparation for construction stages after design phases.

2.11. Use of the CDE by Construction Process Participants

Main data extract:

Builder:	8	30%
Architect:	7	26%
Engineers:	12	44%

Evaluation: The surprising finding is the CDE is used more less equivalently by all participants of construction process since 2018.

Resume: Architects are quite familiar with CDE use today, but they must learn, how to establish and operate CDE as well. Or to hire other company, which will provide these services for them. The reason is missing knowledge and capacities of builders in CDE establishment and operation and demand for this appears more and more in architect’s contracts currently.

2.12. Requirement for BIM in Contract

Main data extract:

Required: 10 36%

Evaluation: The missing annexes related to BIM, i.e., BIM protocol, in architects' contract is one of the most contemporary problematic aspects concerning the BIM use in project design.
Resume: Architect must have the principal contractual knowledge regarding BIM method to prevent the problems caused by the missing rules for BIM use. The Exchange Information Requirements (EIR) must be annex to architect's contract for work.

2.13. Builder's Ability to Define BIM Requirements

Main data extract:

Builder was able to define requirements for BIM: 10 36%

Evaluation: The knowledge of builders regarding BIM is very low still. Only 36 % was able to define project BIM requirements. Builders know mostly, they would like to do project in BIM, and more less they do not know why and how.
Resume: Architect must know how to define project BIM objectives and he would help builder with this issue. Regarding that he must have the knowledge to prepare Exchange Information Requirements (EIR) proposal in the preparation phase of the project.

2.14. Construction Data Standard Defined in the Contract

Main data extract:

Construction Data Standard were defined in the contract: 4 14%

Evaluation: Builders are not able to define proper Building Data Standards (DBS) mostly. The reason is a lack of this specifications in Czech Republic and foreign DBS does not copy with local construction habits and building legal requirements.
Resume:

2.15. The Ability of the Customer to Establish and Operate CDE

Main data extract:

Builder was able to establish and operate CDE: 2 7%

Evaluation: Builders are not able to establish and operate CDE, despite the fact keeping the project information is one the most important dues of theirs.
Resume: Architects must learn, how to establish and operate CDE instead of a builder.

2.16. CDE use

Main data extract:

CDE used:	9	32%
CDE not used:	19	68%

Evaluation: 32 % of all BIM projects used CDE, despite the fact the BIM method id based on two equal principles: Building Information Modelling and Building Information Management.
Resume: The use of CDE improve project data management and therefore architect should demand the use of CDE, if speaking about BIM method, because sharing information via CDE with all participants will help him substantially in his work.

2.17. Completed International Cooperation

Main data extract:

Architect:	6	21%
Engineer:	0	0%
Builder:	2	7%

Evaluation: Here is mentioned collaboration with 6 architects from Slovenia, Netherlands, France, Sweden, UK, and USA, and with 2 builders from Israel and Greece.
Resume: Local architect has enough knowledge to collaborate with foreign partners caused by his education and local practice. Nevertheless, he must expand his knowledge about scope of foreign design stages, incl. BIM models specification, and find a mutual way how to split the work and responsibilities with foreign architect.

4.2 Questionnaires: Architects

Question #1:
Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

answer	*no. of answers*	*% of answers*
Yes	8	47%
Rather yes	6	35%
Rather not	2	12%
No	1	6%
total	*17*	

Question #2:
I consider BIM a helpful design tool:

answer	*no. of answers*	*% of answers*
Yes	12	67%
Rather yes	5	28%
Rather not	1	6%
No	0	0%
total	*18*	

Question #3:

I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):

answer	*no. of answers*	*% of answers*
Yes	15	88%
Rather yes	2	12%
Rather not	0	0%
No	0	0%
total	*17*	

Question #4:

If BIM is used, architects must also employ the BIM information model:

answer	*no. of answers*	*% of answers*
Yes	11	61%
Rather yes	6	33%
Rather not	1	6%
No	0	0%
total	*18*	

Question #5:

If BIM is used, architects must also employ the CDE (common data environment):

answer	*no. of answers*	*% of answers*
Yes	8	44%
Rather yes	9	50%
Rather not	1	6%
No	0	0%
total	*18*	

Question #6:

The scope of a project does not matter if BIM is used:

answer	*no. of answers*	*% of answers*
Yes	4	22%
Rather yes	2	11%
Rather not	5	28%
No	7	39%
total	*18*	

Question #7:

If the BIM method is used, the project typology does not matter:

answer	*no. of answers*	*% of answers*
Yes	7	39%
Rather yes	4	22%
Rather not	1	6%
No	6	33%
total	*18*	

Question #8:

The BIM method suits the following project types:

to selection	*no. of answers*	*% of answers*
residential	4	15%
office	5	19%
hotels	5	19%
the type does not matter	13	48%
total	*27*	

Question #9:

Indicate the project stages in which developing a digital building information model makes sense:

1 – CCA (CR):

code	*service phase*	*indication*	*% of indication*
SP1	Project Initiation	2	25%
SP2	Preliminary – Concept Design	6	75%
SP3	Land Zone Permit Design	6	75%
SP4	Building Permit Developed Design	8	100%
SP5	Detailed Design	8	100%
SP6	List of Works and Deliverables	7	88%
SP7	Architect's Supervision	6	75%

2 – AIA (USA):

code	*service phase*	*indication*	*% of indication*
AIA.0	Pre-Design	1	13%
AIA.1	Schematic Design	4	50%
AIA.2	Design Development	8	100%
AIA.3	Construction Documents	5	63%
AIA.4	Building Permitting	5	63%
AIA.5	Bidding & Negotiation	5	63%
AIA.6	Construction Administration	5	63%

3 – RIBA (UK):

code	*service phase*	*indication*	*% of indication*
RIBA.0	Strategic Definition	0	0%
RIBA.1	Preparation and Briefing	0	0%
RIBA.2	Concept Design	6	100%
RIBA.3	Spatial Coordination	4	67%
RIBA.4	Technical Design	3	50%
RIBA.5	Manufacturing and Construction	3	50%
RIBA.6	Handover	0	0%
RIBA.7	Use	0	0%

Question #10:

Indicate the project stages in which using the common data environment (CDE) makes sense:

1 – CCA (CR):

code	*service phase*	*indication*	*% of indication*
SP1	Project Initiation	5	56%
SP2	Preliminary – Concept Design	8	89%
SP3	Land Zone Permit Design	9	100%
SP4	Building Permit Developed Design	8	89%
SP5	Detailed Design	8	89%
SP6	List of Works and Deliverables	8	89%
SP7	Architect's Supervision	6	67%

2 – AIA (USA):

code	*service phase*	*indication*	*% of indication*
AIA.0	Pre-Design	1	13%
AIA.1	Schematic Design	5	63%
AIA.2	Design Development	8	100%
AIA.3	Construction Documents	6	75%
AIA.4	Building Permitting	5	63%
AIA.5	Bidding & Negotiation	6	75%
AIA.6	Construction Administration	6	75%

3 – RIBA (UK):

code	*service phase*	*indication*	*% of indication*
RIBA.0	Strategic Definition	0	0%
RIBA.1	Preparation and Briefing	2	40%
RIBA.2	Concept Design	5	100%
RIBA.3	Spatial Coordination	5	100%
RIBA.4	Technical Design	4	80%
RIBA.5	Manufacturing and Construction	4	80%
RIBA.6	Handover	1	20%
RIBA.7	Use	1	20%

Question #11:

Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

suggestion	*indication*	*% of indication*
architect, all designers, investor	6	33%
architect, all designers	12	67%
all designers	0	0%
I do not know	0	0%
total	*18*	

Question #12:

Indicate who must use the common data environment (CDE) for a meaningful design process:

suggestion	*indication*	*% of indication*
architect, all designers, investor	11	61%
architect, all designers	7	39%
all designers	0	0%
I do not know	0	0%
total	*18*	

Question #13:

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

suggestion	*indication*	*% of indication*
project development	0	0%
project development and construction	5	28%
project development and construction, building operation	13	72%
I do not know	0	0%
total	*18*	

Question #14:

Using BIM, the information details in individual stages differ from those used in the conventional design process:

answer	*no. of answers*	*% of answers*
Yes	9	50%
Rather yes	7	39%
Rather not	2	11%
No	0	0%
total	*18*	

Question #15:

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

answer	*no. of answers*	*% of answers*
Yes	6	33%
Rather yes	4	22%
Rather not	5	28%
No	3	17%
total	*18*	

Question #17:

I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).

answer	*no. of answers*	*% of answers*
Yes	10	59%
Rather yes	4	24%
Rather not	0	0%
No	3	18%
total	*17*	

Architects' Questionnaire Summary:

1. Design Work Contract must contain requirements for BIMo, DiBM and CDE.
2. BIM is a helpful design tool.
3. BIM is a method for the creation of an information model and data sharing via CDE.
4. If BIM is used, architects must employ the BIM model.
5. If BIM is used, architects must employ the CDE.
6. The scope of a project does matter in BIM.
7. The typology does not matter in BIM.
8. BIM fits the project typology in the following order: the type does not matter, hotels and offices, residential projects.
9. It makes the most sense to use BIM in the following design phases:

   a. CCA: Building Permit Developed Design and Detailed Design
   b. AIA: Design Development
   c. RIBA: Concept Design
10. It makes the most sense to use CDE in the following design phases:
    a. CCA: Land Zone Permit Design
    b. AIA: Design Development
    c. RIBA: Concept Design and Spatial Coordination
11. BIM model must use architects, designers, and builder.
12. CDE must use architects, designers, and builder.
13. The BIM brings the biggest advantage if used in all stages of the lifelong cycle of the construction.
14. Using BIM, the information details in design phases differ from those used in the standard design process.
15. Using BIM architects must provide more detailed information than those requested during the standard design process.
16. Architects use the digital BIM model for expert assessment.

5. The overall evaluation

5.1 The defining the quality of the research

The credibility of the data is based on the following aspects:

1. Analyzed company, AED project, a.s.:
    a. has the 29 years history of private practice regarding design of building construction
    b. belongs among the best and biggest architectural/engineering companies in Czech Republic (CR) more than 15 years
    c. AED was rated in ABF Rating[71] for the 2nd time as the best architectural/engineering company in the Czech Republic in the years 2015-2019 and in the year 2020 AED project, a.s. took the 2nd place[72].
    d. participated at the biggest civil engineering projects in the Czech Republic
    e. has experience working with foreign architects, engineers, and builders
    f. realized couple of projects abroad
    g. processing projects in CAD for 29 years and BIM project for 10 years
    h. obtained many awards regarding architectural and technical quality concerning design and realization of the realized buildings
2. Author of the doctoral thesis:
    a. was personally involved in the analyzed projects in the role of Project Director and Authorized Person
    b. actively works in working groups in Architects' and Engineers' Chambers and committees of Ministries concerning the BIM method
3. Data:
    a. are objective and were directly derived from company database
    b. structure is based on long lasting best practice
    c. questionnaires were submitted not only to architects, but also to other participants of the building construction process
4. Method:
    a. Compares the research data from AED company system with opinion, of practicing architects, engineers, and builders, obtained by structured questionnaires

5.2 The defining the new information

The doctoral thesis provides following substantial new information:

1. publish for the first-time hard data of professional architectural/engineering studio regarding 10 years practical experiences designing by the BIM method

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[71] http://rabf.cz/wp-content/uploads/2020/04/Rating_Ateliery_2020-04-23.pdf
[72] https://www.aedproject.cz/aed-opet-excelentni

2. presents the data evaluation in readable and understandable charts and graphs, including the 10 years' timelines, for easy and proper understanding of the survey results to architects for their possible immediate implementation into design practice
3. describes actual and structured information of BIM method concerning the latest development in legislation, CCA and CCAET design standards, current and under preparation
4. based on data analysis and evaluation updates, confirms, and verifies theoretical hypothesis regarding the BIM method presented in professional public
5. provides contemporary template charts for architects' everyday practice in design process in BIM, including:
    a. BIM performance specification according to design phases
    b. Comparison of European and selected world-selected Architects' Work Plans, including collation of design stages
    c. Works Scope Split between architects and engineers/consultants
    d. Design Team Matrix with specification of digital and nondigital part of BIM model, assembly of BIM sub models and the need for their authorization according to Authors' Act
    e. Schemas of Building Information Model and Digital Building Information Model
    f. Project organizational schema of the project with set up border between builder's and architect's design team and the way, how contractual, technical, and administrative issues crossing this boundary
    g. Lifelong Cycle of Constructions scheme and implementation of design phases, BIM models and project documentation specification into this scheme
6. compares time donation of projects processed by standard method and BIM method and calculated demand for percentage redistribution of the architects' consideration
7. provides professional base for implementation of BIM method specifics for update of the Architect's Service Standards and Documentation for Building Design[73].
8. setting up the substantial imperatives for architects' work using BIM method:
    a. architects must have a knowledge of the BIM method not just because of their design works, but because of management of entire design team and administration of the Contract for Works as well
    b. to be possible to speak about the full implementation of BIM method into architect's performance in design stages all members of design team and builder's team must work with BIM model and must share information via CDE
    c. architects must continuously develop his knowledge concerning BIM method to be competitive in local and global projects market

[73] https://www.cka.cz/cs/pro-architekty/legislativa/standardy-vykonu-a-dokumentace

5.3 The summary of benefits

The doctoral thesis supports architects with the orientation in contemporary problematics of BIM method and provides them information how to improve quality and effectivity of their design process and how to make proper decisions in the right time.

The doctoral thesis brings wide viewpoint at the BIM problematics, does not focus on the architect's design activities only, but gives overall information how to steer creatively design team and how to prevent problems cause by lack of BIM specification in architect’s Contract for Work.

The doctoral thesis meaningfully placing the architectural activities in the context of the whole creation process of architectural design using BIM models.

This thesis helps to improve results of architect’s work by application of integrative design, incl. sustainable design, and describes which benefits can bring him using the BIM models regarding that.

And, since the architect is the contract holder in at least half of the contracts, it helps him to be properly oriented in the contractual aspects of the whole contract and in the administrative and technical management of the whole project process with BIM method.

The doctoral thesis highlights the architectural specifics that the BIM method brings.

The work also contains practical examples of some templates for the steering the project processes with respect to BIM and Lifelong cycle of the buildings.

Whereas:

1. there is currently no binding legislation
2. the implementing decrees for the new Construction Act are not ready
3. the Chamber Standards of both Chambers are only partially ready
4. it is impossible to adopt foreign regulations in their entirety due to the different legal and professional environment
5. no comprehensive evaluation of BIM-based civil engineering projects is available
6. Czech methodology for architects working with BIM is not completed yet

so, my work will provide the architect with the information necessary for the quality performance of his key activities in the era of BIM method.

Annex A
Publications Related to the Dissertation Topic

Publication List:

1. MAREK, ALEŠ. *Architect's role in the period of digitalization of the construction industry*, In: 9th Annual Conference on Architecture and Urbanism, Brno: Brno University of Technology, 2020, p. 81-86. ISBN 978-80-214-5903-8. 2020
2. MAREK, ALEŠ. *Summary of the practice of using BIM models in different phases of design, construction, and operation of the building*, In: reVision Typology 2020 - Operational Evaluation. Prague: CTU. Faculty of Architecture, 2020. p. 25-34. ISBN 978-80-01-06828-1. 2020
3. MAREK, ALEŠ. *The role and the responsibility of the architect in the current and future sustainable design of buildings,* In: 10th Annual Conference on Architecture and Urbanism, Brno: Brno University of Technology, 2021, will be published after Conference on November 10, 2021

Topic: Innovations in the design process and construction

Name: Architect's role in the period of digitalisation of the construction industry

Theme: Architecture education

Abstract:

This paper deals with the changing role of architects in the era of digitalisation in the construction industry and resulting new demands on their key activities during the design process. The goal of this paper is to summarise and structure these new demands introduced by the designing using the BIM[1] method in individual phases of architects' services in the preliminary, project, and execution phases, and for the sharing of this model in the CDE[2] mutual data environment by all participants in the process. The starting point is a design practice and the development of new legislation in the Czech Republic and abroad.

Keywords:

BIM; CDE; EIR; BIM protocol; BEP

1) The goal:

My work solves the current development of the digitalisation of the construction industry, including BIM designing, and its effects on architects' work in their key activities in area of construction engineering.

2) Research questions:

The area of digitalization in construction industry is very wide, so I have decided to narrow it and I addressed the following selection of areas for work focus:

a) Architectural education activities at the FA CVUT[3]:
   - i) University education in two degrees: Bachelor study program and Master study program
   - ii) Ph.D. study program includes including research and innovations
   - iii) CZV[4] in two courses: basic and advanced

   ii) Key professional activities of authorized architects in the field of building design according to the SASS[5] of the CKA[6]

   iii) The state of legislation and its expected future development

   iv) Experiences in BIM design in an architectural / engineering studio

b) Based on the above division of objectives, I asked myself the following research questions:

   i) Re. i) how does the process of education respond to current requirements; how should the present university education be modified, and how should the CZV for practising architects be prepared?

[1] Building Information Modeling and Management
[2] Common Data Enviroment
[3] Faculty of Architecture CVUT in Prague
[4] Lifelong Education
[5] Standards of Architects‘ Scope of Services, Czech Chamber of Architects, April 2018
[6] Czech Chamber of Architects

ii) Re. ii) what are architects' core activities affected by the digitalisation of the construction industry and BIM designing and how does Standards have to be modified or extended?

iii) Re. iii) where architects' key activities are specified in legislation documents and how do these documents have to be modified or extended?

iv) Re. iv) How could experiences in private studio be us in education process?

3) Digitalization in Czech Republic

Description of the current environment in Czech Republic, requirements, and reasons for digitalising:

a) The environment for the designing of buildings is changing in CR due *Digital Czechia*[7] and in the construction business due *Construction Industry 4.0*[8].

b) This process is based on the decree of the government dated 20 March 2013 and the method of its implementation according to *The Report on the Implementation of the Program Digital Czechia*[9]

c) Main reasons for digitalization:

   i) The broad digitalisation will make entire construction industry more effective and will decrease the industry's lacking behind other industrial segments in terms of low innovativeness and productivity.

   ii) The digitalisation will bring better quality and higher effectivity for all participants of the whole lifecycle of a building through all its stages: the project preliminaries, the design process including the approvals to build, operation of the building including facility management, maintenance, and modernisations to their possible ecological removal.

   iii) The digitalisation allows the development of cities *(SMART Cities)* and regions *(SMART Regions*[10]*)*.

   iv) To support sustainable design including the decreasing of energy performance using energy-efficient technologies in the design as well as construction phases.

d) The digitalisation concerns the following main areas of BIM explicitly:

   i) Electronic permitting processes including the provision of documents[11]

   ii) The provision of a standardised machine-readable format IFC[12] of BIM model for construction departments and state administration bodies allowing to algorithmize the entire permitting process using the artificial intelligence in the future provided the public interest is clearly defined

   iii) The interconnection of information on the area: GIS models and Building Information Models including the Real Estate Register, Land Use Plans, including the verification of

[7] Digital Czechia v. 2.0, The Road to the Digital Economy, MPO, March 12, 2020
[8] 7th meeting of the Government Council for Construction of the Czech Republic, October 18, 2017
[9] the Government Committee for Information Society, 3 October 2018
[10] Analysis of the current level of involvement of the Czech Republic in the concept smart city and smart region in the context of new trends, including proposals for action, Mendelova univerzita v Brně, 22.10.2018
[11] Act No. 47/2020 Coll.
[12] Opinion on the use of the IFC format following Measure 7 UV No 682, Czech Agency for Standardization, March 2019

parameters of built projects upon their commissioning (BIM model for the Certificate of Use), and resulting updates of DTM[13] as binding and verified project source documents

iv) The enforcing of 4.0 technologies in the construction industry: the implementing of the BIM method, virtual reality (digital twin), smart buildings, 3D printing and prefabrication[14]

4) Defining the area of architect's crucial activities

As the source for the answering of research questions, I selected the following areas I analyse as a basis which I shall use to answer the research questions.

a) The architect's activity area:

I selected the segment comprising the construction building including the connections to the technical infrastructure and roads plus related landscaping.

b) Architects' key activities:

I consider the following documents concerning chartered architect's activities in the segment of building construction:

i) Principles of providing a licence for the individual performance of architectural practice[15]

ii) Act No. 360/1992 Coll., on the exercise of the profession of authorized architects and on the exercise of the profession of authorized engineers and technicians active in construction[16]

iii) Standard of architects' services and their documents for architectural design[17]

and core architect's activities in compliance with above mentioned documents I am specifying as follows:

1) General job management including administrative and technical steering of design works
2) Performance of the position of architect-in-charge and providing complete architectural design for the whole project
3) Management and coordination of a design team including ensuring all necessary permissions to build and including procurement of involved authorities' statements
4) Performance of an architect's supervision

From the perspective of chartered architect's activities, I divided these activities, based on Service Phases[18] (SP), into three stages, and I specified them as follows:

1) Pre-project preliminaries:
   1. SP 1 Project Initiation
   2. SP 2 Preliminary – Concept Design
2) Project Design:
   1. SP 3 Land Zone Permit Design
   2. SP 4 Building Permit Developed Design
   3. SP 5 Detailed Design

[13] Digital Technical Map
[14] Based on the Policy Declaration of the Government of the Czech Republic, draft May 2018: *Impact of tasks given to government departments on the construction industry*
[15] Czech Chamber of Architects, April 10, 2014
[16] Last change pursuant to Act No. 459/2016 Coll., effective from January 1, 2017
[17] Czech Chamber of Architects, April 2018
[18] According to Standards of Architects' Scope of Services, Czech Chamber of Architects, April 2018

4. SP 6 List of Works and Deliverables
3) Execution phase:
    1. SP 7 Architect's Supervision

Each SP includes standard services (SS) and non-standard (NSS) ones. Services related to BIM activities I consider as NSS and are split according to SP as described below:

1) SP 1: preparation of contract annexes, i.e., EIR[19], BIM protocol[20] and BEP[21] template
2) SP 2 to SP 7: BEP elaboration for each SP, BIM model development, installation, and operation of CDE
3) SP 3 and SP 4: Acquisitional: electronic submittal of the proposal to permit the project, including the project documents in digital format IFC

All NSS have effects on all major part of Architect's Work Contract, i.e., the subject matter of the performance, the fee and the Time Plan.

5) State of legislation and documents regarding BIM:

a) Current laws and implementing decrees:
    i) The novelty of the Building Code, Act No. 225/2017 changing Act No. 183/2006 Coll. (Building Code), December 3, 2017
    ii) The novelty of Regulation No. 499/2006 Coll. on project documents in the wording of Regulation No. 62/2013 Coll., December 7, 2017
    iii) Act No. 47/2020 Coll., Amending Act No. 200/1994 Coll., On Surveying and on Amendments to Certain Acts Related to Its Implementation, as amended, Act No. 183/2006 Coll., On Territorial planning and building regulations (Building Act), as amended, and other related laws, February 26, 2020, will be legally effective on July 1, 2023
b) Current laws and documents concerning public commissions:
    i) Regulation No. 169/2016 Coll. on the definition of the scope of documents for public construction works commissions and the list of construction works and deliverables and services with a BOQ, December 7, 2017
    ii) The concept of introducing the BIM method in the Czech Republic
    iii) The imposing of a duty to use BIM for above-limit commissions for construction work from Jan 2022; Government Decree, 25.9.2017, legal effectivity will be changed to July 1, 2023

Furthermore, the development of construction law must also be taken into consideration, that is the new Building Code currently being prepared to be submitted to the Parliament of the Czech Republic.

c) Legislation under preparation:
    i) The New Building Code will be legally valid during spring 2021 and will be effective since July 1, 2023
    ii) The Implementation Regulation No. 499/2006 Coll. must be modified/added based on the analysis of Regulation No. 268/2009 Coll. (OTP in the wording of Regulation No. 20/2012 in the wording of Regulation No. 323, 26 September 2017, including standards (ČSN, ISO) and must be legally effective since July 1, 2023.

[19] Employer's Information Requirements
[20] Czech Agency for Standardization, October 12, 2018
[21] BIM Execution Plan

iii) The Act on building information modelling and digital modelling of the built environment and the change of some acts ("*Act on information and digital modelling*"), raft/ version dated 29.7.2020, Assumed resolution of the Parliament, 2021

All current and prepared laws must be coordinated in terms of materiality and time.

6) A sequence of activities of architects using the BIM method:

a) An architect must be aware of the fact using BIM design method has certain special consequences in all SPs:
   i) Architect will use digital project source documents:
      i) DTM, GIS[22] models, BIM models of related constructions, Real Estate Register, land-use plans, etc.
      ii) BIM model allows the architect to:
         (a) use another software for i.g. expert models for special simulations i.g. environmental analysis, robotic control (Grasshopper in Rhino 6), parametric / computational design (Rhinoceros, Dynamo Studio), review of model coordination and identify / resolve clash and interference problems, clash detections (Navisworks)
         (b) apply electronically for building permit(s) in IFC format
         (c) cooperate and share sub-models with Main Contractor and Sub-contractors, Asset and Facility Managers, etc.
         (d) for all above mentioned purposes the conversion of BIM model to machine-readable IFC standard is necessary

7) The research and data processing method:

I analysed and assessed architect's activities areas intersection in reference to BIM.

I collected the data and assessed the knowledge according to my experience from working in the following fields:

a) Design practice:
   a. In the position of a Project Engineer, Chief Project Engineer and Project Manager during thirty-two years of designing using the CAD software and ten years of designing using the BIM method.
   b. The assessment of the project the Headquarters of the CSOB[23] in Prague 5-Radlice that was awarded the title Building of the Year 2019 regarding BIM design where all Service Phases were carried out using the BIM method.
b) Lecturing at the FA CVUT:
   a. I established a new subject *DC1*[24] which is part of Master study programme focusing on the BIM method.
   b. I established a platform to develop baccalaureate projects using the BIM method.

[22] Geographic information system
[23] Czechoslovak Commercial Bank
[24] Design Computing 1

c) I founded a program of *CZV* for practising architects in all segments of the construction industry that is part of the CKA's program of CZV in two courses: for beginners and advanced students.
d) My activities in workgroups *Digitalization* (Chairperson) and *Standards and Fees* (member) established by the CKA.
e) My work in committees and boards at MPO[25], MMR[26], CKA, ČKAIT[27] dealing with issues and preparation of legislation regarding the built environment and designing using the BIM method.

8) Results of my work and recommendations for further practice:

The basis for my recommendations is these facts:

i. The BIM method is currently an inseparable part of design practice in the global context. That is why the crucial matter is not whether this method should be used at all, but the need to define its adequate use for design practice to make it a useful tool for designing buildings.
ii. The designing using the BIM has still only been a tool without artificial intelligence.
iii. IMS is the primary and only source of information about any project throughout its lifecycle.

Above mentioned facts resulting to my recommendations for the future according to the areas of architectural practise:

a) Architectural design practice:
    i) To define new work positions for the BIM designing (BIM manager, BIM coordinator, BIM modelmaker) and determine their workload and responsibilities
    ii) The assessment of the pilot project *The Headquarters of the CSOB - SHQ*
b) Legislation:
    i) The development and modifications of current legislation must be influenced so that it would support architects' activities
    ii) BIM model must be defined as the only and binding source of information for all participants in the process
    iii) Requirements on CDE must be set up including the determination of the subject responsible for its establishment and management – operation, and requirements on version control (source control) and documents time footprints, and registration and hierarchising of persons authorised to enter CDE and processes for working with CDE.
    iv) The DDS[28] must be specified in its graphic and non-graphic form for each PS stage; standard sub-models must be defined including a system of classification for individual building segments' elements
    v) Requirements on the specific wording of new legislation and modification or development of subordinate legislation (implementation regulations) and standards (ČSN, ISO) must be set up
    vi) The requirements on phases must be defined in which digitalisation and computerisation will be introduced, including requirements on time

[25] Ministry of Industry and Trade
[26] Ministry of Regional Development
[27] Czech Chamber of Authorised Engineers and Technicians in Construction
[28] Building Data Standard

vii) Legislation must be coordinated even in terms of time planning, including the specification of a transition period allowed to prevent some authorised persons from discrimination

c) CKA:
   i) Intense cooperation with the MMR and MPO and CAS[29] to develop new or modify the current legislation and documents regarding the built environment and the BIM designing
   ii) The modification of specifications of services phases in the "*Standards*" for the BIM designing
   iii) The time allowed for individual for BIM designing in the *Calculator for buildings*[30]
   iv) To educate and train in the BIM method focusing on the key activities of chartered persons (architects) using knowledge gained from the best practice and showing benefits of BIM from the architects' perspective (higher quality of designs, faster implementation of alterations, quicker and better communication).

d) Lecturing at FA CVUT in Prague:
   i) To define requirements on the extending of architects' qualification, those study and practising; these requirements must be implemented into the FA ČVUT curriculum and the structure of CZV
   ii) Based on experience from the pilot year of the subject *DC1* and the baccalaureate project, the form and content of these subjects must be adequately modified
   iii) The knowledge from the tuition must be implemented into CZV
   iv) In the framework of CZV, the requirements on architects' qualification must be defined according to their positions (architect, architect-in-charge, principal architect, project manager)
   v) The requirements must be defined on software literacy (ability to use the software in the design process, allowing the development of digital information models) of graduates from the Baccalaureate study Programme.

9) Work context:

This work was developed within the context of the development of the design practice in the Czech Republic and around the world based on the "best practice" principles and the development of legislation in the Czech Republic with a particular accent on the coordination with EU legislation.

[29] Czech Standardization Agency
[30] https://www.cka.cz/cs/pro-architekty/kalkulacky/pozemni-a-krajinarske-stavby

Topic: Operational assessment

Title: Summary of the practice using BIM[1] models in different project, construction, and building operation phases

Annotation:

The paper deals with requirements on the *Building Data Standard* (DSS) in individual *Architect Service Phases* regarding when and how this DSS is set up, how the required data are added to the *Building Information Model* (IMS), and how IMS data are used in building management/operation and modernisation of these buildings.

It defines the requirements put on architects during the design process employing the BIM method and the method of determining the DSS.

The starting point of my paper is my own design practice in AED Project, a.s. and activities in Working Groups of ČKA[2], ČKAIT[3], MPO[4], ČAS[5] related to BIM issues.

Keywords:

BIM, CDE, EIR, BIM protocol, BEP, IFC, DSS, IMS, DMS

1. Introduction:

Although the CAD[6] systems introduced digitalisation into the field of building design at the end of the 1980s, the current global development of digitalisation in the entire society also brings increased pressure on the development of digitalisation of the construction industry (Digitální Česko[7], Stavebnictví 4.0[8]); this development implies an effort of all parties involved in construction to maximally exploit data gained using the BIM method not only for private projects but also for public buildings in their entire life cycle.

The BIM method affects architects' work in all their key activities[9] in the segment of the building design and, therefore, the following questions are asked:

1) What data on buildings are collected after the buildings are commissioned?
2) Who collects data, how and for what purpose?
3) How are the collected data assessed and reused for further operation, commissioning new buildings and their design?

[1] Building Information Modelling and Management
[2] Czech Chamber of Architects
[3] Czech Chamber of Engineers
[4] Ministry of Industry and Trade
[5] Czech Standardization Agency
[6] Computer Aided Design
[7] Digitální Česko v.2.0, Cesta k digitální ekonomice, MPO, 12.3.2020
[8] https://svetprumyslu.cz/2019/09/16/do-stavebnictvi-pronika-digitalizace/
[9] Standardy ČKA

2. Basic BIM method parameters:

BIM or „*Building Information Modelling and Management* ", must be understood in meanings of both words, i.e. „*Modelling*" and „Management":

1) Developing a digital building model (DIMS) containing graphic and non-graphic (alphanumeric) data; DIMS is part of the IMS (Building Information Model).
2) Sharing of this DIMS model in the CDE[10] („*Data Management* ") where more data are added into this model (2D drawings, expert models, papers, documents, and similar) and where this sharing is executed based on specified processes.

   Data generated during the development of the IMS are, thus, graphic and non-graphic, generated during project preliminaries according to the pre-set "*architecture"* of the data standard and continuously complemented into the IMS or refined during construction and its completion.

When the building is completed and handed over to its user, the as-built IMS is produced, mainly used for the following purposes:

1) IMS for:
   a. compiling a source document for generating a hard or digital copy of project documents (PDF) if the approved documents were substantially altered during construction as necessary for the Permit of Use.
   b. verification/updating; but that refers to the future, the approved building parameters (data) according to the actually built state and their re-inserting/updating into the DTM[11] and other project source documents, for instance, parameters/data in the local section of the Municipal Land Use Plan.

   The as-built IMS will use the new implementing decree to the new Building Code as the source document.
2) The IMS for building management (also called the AIM – operational information model); this model's requirements on the level of graphic information are "reduced" but include all data in the alphanumeric form necessary to manage, operate, and maintain the building.

   In the future, this model should also be used to tune-up and optimise the building's operation, particularly the MEP systems.

   Requirements on exact data of this IMS or AIM cannot be unambiguously specified because they are based on different types of buildings and software used to operate them.
3) The IMS for future modernisations and, if necessary, also the demolition of buildings. This model is a "*digital twin*" (building's digital twin – so it is the digital form of the building and very digital processes leading to the acquisition and updating, keeping it permanently a twin of an actual building) of a built project. Its graphic precision/fidelity is high.

[10] Common Data Environment
[11] Digital Technical Map

3. Basic requirements put on DSS (Building Data Standard)

The graphic level of detail of the IMS is currently based on mostly the British Standards LOD[12]. LOD 100 to LOD 200 are used for project phases (FS) *Building Design* and *Planning Procedure; LOD 200 is used for Building Permission* service phase and LOD for the *Execution* service phase or *as-built IMS* in the detail level of the "digital twin".
This specification does not, however, fit into the Czech environment. So, in the framework of the *Memorandum on Cooperation* between ČKA, ČKAIT and ČAS, the DSS is produced referring to the implementation *Regulation No. 499/2006 Coll.* to the Building Code[13] in its valid wording[14].
The Model Informational Details tagging syntax is usually based on the current version of SNIM[15], but it is necessary to modify it separately for each project due to its incompleteness.
Due to the requirements for the processing of project documents according to the Regulation No. 499/2006 Coll., different designers' professional responsibility for individual sections of the planned building and user-friendly size of files, the general/coordination IMS must be divided into individual partial models/systems called "*professions*" structured the same way as any standard project documentation; its elements must be unambiguously identified in each such a partial model.
This specification is also being updated in the framework of the "*Memorandum*" following individual supplements to Regulation 499/2006 Coll.
The DSS architecture must, thus, be unambiguous and cover standard types of buildings; it must, nevertheless, in its firm structure, allow for some variability. Furthermore, the durability of this structure through the building's entire life cycle is another necessity needed to enable smooth development of in all life cycle's phases.

4. Architects' key activities

I consider that designing buildings in the selected segment of civil structures, including related municipal technical and traffic infrastructure and landscaping and roads, is the architects' fundamental activity.
Architects' activities in the area of building construction are specified by the "*Standard of architects' services and their documentation for building design"*[16] (further referred to as „Standard") for individual service phases (FS); they can be divided into three phases:

1. Project preliminaries:
    a. FS1 Project preparation
    b. FS2 Building design
2. Project:
    a. FS3 Project for the positioning of the building
    b. FS4 Project for building permission

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[12] Level of Detail
[13] Novelty of the Building Code, Act 225/2017 changing Act 183/2006 Coll. (Building Code), dated 31.7.2017
[14] Novelty of Regulation No. 499/2006 Coll. on project documentation as amended by Regulation No. 62/2013 Coll., dated 7.12.2017
[15] Standard Negrafických informací 3D Modelu, czBIM
[16] ČKA, April 2018, https://www.cka.cz/cs/cka/kontakty/pracovni-skupiny/ps-honorare/2017-standard-sluzeb-architekta

c. FS5 Execution project
d. FS6 List of works and deliverables
3. Execution phase:
a. FS7 Architect's supervision

When developing the IMS in the correct DSS corresponding with the given service phase (FS), the architect must also carry out the following Above-standard Activities (NS) beyond the Standard Services requested by the BIM designing method:

1) In Phase 1 it means that the architect must cooperate with the client to produce a BIM protocol as a separate Supplement to the Work Contract[17]; this protocol specifies requests on the DSS IMS and contains the client's requirements on the following:
    a. The exchange of EIR[18] information:
        i. On the model's graphics and alphanumeric information:
            1. Data requirements on project source documents
            2. On the structure of the general coordination model, including the division in individual models and their internal structure of elements for separate service phases
    b. The use and operation of the CDE in the form of a template
    c. For the development of the BEP[19] during the execution of the Work Contract in the form of a template.
2) A BEP must be produced in Phase 2, including the DSS specification for developing DIMS[20] in the IMS framework [21] for each service phase, and create an IMS according to it for the given service phase. Architects are, furthermore, often requested to establish and procure the operation of the CDE. I consider this solution incompatible with the overall scheme because most principals are not sufficiently qualified to run the CDE.
3) In Phase 3, it is a requirement that the architect produces an as-built IMS, which is again a solution incompatible with the overall scheme, but often applied in practice due to the practical ignorance of the BIM method by most construction contractors.

5. Knowledge gained from the design practice:

I build on my own experience:

1) As the Project Manager or the Chief Project Engineer designing in CAD software in AED Project, a.s.[22] for 30 years, and using the BIM method for the last 10 years.
2) With the development of project documents, including the development of IMS in all service phases for the project *Centrála ČSOB – SHQ in Prague 5-Radlice* that was awarded the title *Building of the Year 2019* for the implementation of the BIM method; because the building

[17] Work Contract
[18] Exchange Information Requirements
[19] BIM Execution Plan
[20] Building Digital Model
[21] Building Informational Model
[22] https://www.aedproject.cz/

including the as-built IMS for facility management and the "*digital twin*" were finished in 2019, there has not been any operational data assessment available so far.

6. Conclusion:

My elementary knowledge is:

a) A systematic and standardised format of design data linked to building operational data does not exist.

b) Current design practice, i.e., without designing using the BIM method and using the CDE, does not allow effective developing/processing and archiving of graphic and alphanumeric data.

c) Design data generated during the design process and continuously updated up to the as-built IMS are not re-evaluated in practice.

d) The BIM method has currently been used chiefly for operation and facility management only in the segment of office buildings if their facility manager is sufficiently qualified and able to transform data into appropriate software for facility management and use them.

e) Assessing operational data used to optimise building's operation does not generate any savings for building owners since the dynamic simulation is used from the beginning of the design process optimising the operation of MEP systems in its specific way, and because running costs of MEP systems are negligible to other costs of operation and maintenance of the building constitute approximately 2/3 of total building costs in its life cycle.

f) The Association of Unit Owners (SVJ) form prevails in housing projects; these owners do not request operational data evaluated and the building operation optimised because it causes higher facility management costs, although it could generate savings in the long-term perspective.

g) A systematic method to obtain feedback from the building's operation to be used for design activities, collected either from building owners or owners and operators of technical infrastructure, does not exist; owners or operators have operational feedback but do not coordinate or provide these data.

7. Recommendation for further practice:

a) The IMS must be the primary and sole source of information on buildings in all phases of their life cycle.

b) Requirements on the CDE must be set, including the subject responsible for its establishment and facility management in the future.

c) Processes for data communication, handing over and sharing by all participants in the construction must be defined.

d) Legislation and standards for designing with the BIM method must be modified.

e) Information on the area must be standardised and interconnected with information on buildings, and parameters of constructed buildings must be verified.

Theme of dissertation: The role of the architect in the process of project preparation of buildings by the BIM method

Title of the proceeding: The role and the responsibility of the architect in the current and future sustainable design of buildings.

Theme: B.3. Sustainable architecture, vernacular architecture, and ecology

Abstract:

Paper deals with role and responsibility of the architect in the sustainable design of buildings in their lifelong cycle: in construction, operation, modernization, and removal. The aim is to analyse and define requirements for activities of architect in design stages. Paper discusses demands and methods of integrated design, digitization and robotics in construction industry and use of BIM. Starting point is design practice and international requirements for complex evaluation of buildings.

Keywords:

sustainability, integrative design, LEED, BIM, Building Information Model, Digital Building Information Model, Common Data Environment

1) The goal

The aim of this paper is highlighting the main points how an architect can influence the sustainability of the building during the design process.

2) Starting point

My paper is based on:

1. my own experience in design practise for more than 30 years, including 10 years of BIM use, and earning two LEED Platinum certificates on *my* projects:
   1.1. Main Point Karlín[1], Prague 8, 38.000 sqm above ground, certified 2012, where was used flushing channel from the Vltava River for cooling of the building.
   1.2. CSOB Headquarters - SHQ[2], Prague 5, 67.400 sqm above ground, certified 2019 (6. - 8. place in Europe), where was designed and realized the biggest drilling field in the Czech Republic (177 drills, 150m long) which cover all needs for cooling and heating supply, which is 60% lower than the LEED reference building.
2. Evaluation of 28 BIM projects I have processed in the years 2011-21.

[1] DAM ARCHITEKTI
[2] CHALUPA ARCHITEKTI

3) The Hypothesis

There is no difference between design process concerning the *green* building and the *normal* one.

The change is certification, or rather pre-certification, needs to have certain data earlier than usual, i.e., in Concept Design stage, to be possible to prepare the certification process, but what is the key, to implement certification demands into overall design also.

4) The Methodology

Regarding the format of the paper, I decided to address main design demands only with the focus on the architect's key activity, i.e., steering the entire design team, and to briefly describe the design processes' milestones which go not only to the architect's way of design, but suit to the entire design team as well.

The conclusions are based on an internal evaluation of the quality of design processes in AED project, a.s., but mainly on recent design experience, when requirements for sustainable design appear already in architectural competitions, e.g., SZ Headquarters in Prague[3].

5) Contemporary architectural design highlights

The one thing all humans share is that we all inhabit the same limited amount of real estate, which is Planet Earth.[4]

Architectural design must be elaborated in accordance with the principles of economic, social, and environmental sustainability.

I consider the following design points as the most important ones:

1. seek harmony among the architectural design, *venustas – aesthetic objective*, the construction and technical equipment of the building, *firmitas – static strength and stability*, and the use value of the building, *utilitas – practical objective*[5], throughout its life cycle
2. seek harmony between indoor and outdoor parts of the projects
3. apply philosophy of integrated design, including sustainable design requirements
4. reap the benefits of digitization and BIM in the design process to verify the design via expert assessments (dynamic simulation etc.) since early design phases
5. use score chart of any registered international sustainability certification system to find the *positive compromise* in building design itself and between design and certificate target, if required, as well

This approach brings the following benefits:

1. maximizing the exploitation of the site potential, including the use of local materials and greenery for construction and project integration into local public transport services
2. minimizing energy consumption and maximizing use of renewable energy sources, including water conservation, rainwater harvesting and minimal operating and maintenance costs
3. reducing global overheating by avoiding the creation of heat islands
4. creating a high-quality indoor environment to improve the health and psychological well-being of its occupants

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[3] https://www.spravazeleznic.cz/web/en/headquarters
[4] INGELS, BJARKE
[5] MARCUS VITRUVIUS POLLIO: *Ten Books on Architecture*, 1st century BC.

6) Architect’s approach to integrative design

Architect, as the leader of the entire design team, has a moral and professional responsibility for the design quality of the building during, because design stage substantially affects all related stages of building life cycle[6].

He must know the whole issue of design of building, *to understand the whole you must understand the pieces,* but given to his capacity he must make sure that he does not dive too deeply into partial problems. He must keep his energy and time capacity to be able to find a positive compromise in the overall design.

Architect’s main task is to balance all architectural, operational, and technical requirements.

At the beginning of the design process architect must assemble a complete design team, i.e., all key professions, specialists, and consultants, for all design phases.

During the design process, the architect must honestly consider all suggestions and proposals from the design team, even if they seem at first sight either unfeasible or obvious.

The same approach must be applied to suggestions that do not correspond to the development phase of the project at that time.

The architect is responsible for evaluating all the suggestions of each design phase and for setting goals for the next phase. This should be repeated at each phase.

This process, with the same demands, is equal as in the proper BIM design methodology.

7) Architect's design using the certification system

Certification assesses the impact on the environment, water and energy consumption, materials used, quality of the indoor environment and the user qualities required to work efficiently.

As a showcase I am presenting herewith the LEED Project Checklist which can help architect to develop a project design balanced in all aspects.

Below are selected credits in which architect can substantially influence result of sustainability of the building.

LEED v4.1 for BD+C: New Construction and Major Renovation: Project Checklist[7]:

- Integrative Process
- Location and Transportation: Sensitive Land Protection, Bicycle Facilities
- Sustainable Sites: Open Space, Heat Island Reduction, Light Pollution Reduction
- Water Efficiency: Outdoor Water Use Reduction
- Energy and Atmosphere: Minimum Energy Performance
- Materials and Resources: Construction and Demolition Waste Management
- Indoor Environmental Quality: Low-Emitting Materials, Interior Lighting, Daylight, Quality Views, Acoustic Performance
- Innovation

[6] Life-long Cycle
[7] https://www.usgbc.org/leed/v41

The certification system has no artificial intelligence to design building on behalf of you but provides you with the reasonable guidelines how to organise, steer and balance design process in the complex view.

8) BIM

I have evaluated 28 BIM projects according to the following criteria:

a) Use of the Sub Models:

Architectural Sub model:	*5*	*8%*
Construction Sub model:	*28*	*44%*
Structural Sub model:	*11*	*17%*
MEP sub model:	*14*	*22%*
Sub model of Technologies:	*6*	*9%*

b) Service Phases Processed by the BIM method:

SP1 Project Initiation:	*9*	*10%*
SP2 Preliminary – Concept Design:	*4*	*4%*
SP3 Land Zone Permit Design:	*4*	*4%*
SP4 Building Permit Developed Design:	*26*	*28%*
SP5 Detailed Design:	*23*	*25%*
SP6 List of Works and Deliverables:	*21*	*23%*
SP7 Architect's Supervision:	*5*	*5%*

The design data for certification, comparing to non-certified buildings, are supplemented according to final checklist score chart.

For certification process is crucial to have data structured according to the certification system at the right time, i.e., Concept Design stage, to be possible to make a fully informed decision - value engineering - regarding the next project phase specification.

BIM method helps you to extract required data from the Information model easily.

It is clear from the above tables that there is a need for architects, and all consultants, to use the BIM method at all projects where green certification is required, and therefore the information modelling must start at the Concept Design stage.

9) Summary

"Integrity is the essence of everything successful.[8]

10) Annex

Life-Long Cycle of Construction Chart

[8] FULLER, BUCKMINSTER

Annex B

Research Data and their Evaluation

1. List of Projects
2. Questionnaires

Annex B
Research Data and their Evaluation

1. List of Projects

1. All Projects:
1.1. Projects Processed in AED project, a.s., Aleš Marek Division, in the Years 2011-21

Serial No.	Project No.	Project Code	Project Name
1.	11-001	MBTR	New Transformer Station 110/22 kV, Mladá Boleslav
2.	11-004	STAC	Apartment Building "Stará cesta", Prague 4
3.	11-013	VIBU	Residential Villas "Bubeneč", Prague 6
4.	11-015	RDHO	Family House, Prague 4
5.	11-018	KKCG	Redesign of Office Building "KKCG", Prague 10
6.	11-022	PAPA	Office Park "Prague Airport", Prague 6
7.	11-029	ZADV	Residential Area "Zámecký dvůr", Brandýs nad Labem
8.	11-037	KPTE	Reconstruction of Premonstratensian Monastery, Teplá
9.	11-044	MEDI	Hotel "Praga", Prague 7
10.	11-048	TRVL	Turkish Embassy, Prague 6
11.	11-054	KAFI	Office Buildings "AFI City", Prague 9
12.	11-056	VILP	Residential Villa, Prague 6
13.	11-065	RPKK	Modernization of the Lock Chamber, Chrášťany
14.	12-007	DAPA	Residential Building Reconstruction, Dačice
15.	12-008	PDRU	Mixed Use Building, Prague 1
16.	12-019	HOHI	Hilton Hotel, Ulaanbaatar
17.	12-022	ECRW	Embassy of the Czech Republic, Washington D.C.
18.	12-042	PANU	Science and Technology Park "Nupharo", Libouchec
19.	12-043	WALT	Residential project "Waltrovka", Prague 5
20.	12-046	MEML	Hotel "Metropole", Mariánské Lázně
21.	12-051	NAPR	Mixed Use Building "Na Příkopě 9 a 11", Prague 1
22.	12-052	VOKO	"Evropská Business Centre AFI", Prague 6
23.	13-004	MSAT	Laboratories "Lonza Biotec", Kouřim
24.	13-014	PABR	Residential Center "Partizanska - Bradlianska", Bratislava
25.	13-015	REZL	Residential Project "TRIO", Prague 5
26.	13-016	RDTE	Family House, Prague 6
27.	13-022	TRSU	Family Houses "Top Residence", Prague 6
28.	13-023	KONE	Mixed Use Building, Prague 3
29.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12
30.	13-034	FLVW	Fit-Out "Florentinum - Veolia", Prague 1
31.	13-035	OP46	Office Building Reconstruction, Prague 1
32.	13-037	OSK2	Residential Complex "CTR", Prague 8
33.	13-041	FLPE	Fit-Out "Florentinum - Penta", Prague 1
34.	13-042	FLSE	Fit-Out "Florentinum - Servier", Prague 1
35.	13-045	NKVA	Hotel Reconstruction "National House", Karlovy Vary
36.	13-048	VSE3	Attic Refurbishment, Prague 1
37.	13-052	CSM2	Mixed Use Building, Prague 9
38.	13-054	KIND	Mixed Use Building "Karlin Park", Prague 8
39.	13-055	GAZO	Reconstruction "Gaston Restaurant", Prague 7
40.	13-056	RADA	Office Complex, Prague 5
41.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5
42.	14-003	CISC	Fit-Out "Cisco Systems", Prague 1
43.	14-006	RPMO	Residence Project "Zahálka", Prague 12
44.	14-009	FLDA	Fit-Out "Florentinum - Dalkia", Prague 1
45.	14-010	ERAP	Office and Development Centre "ERA", Pardubice
46.	14-014	UZIC	Housing Project, Úžice
47.	14-016	VRA4	Residential Villas, Černošice
48.	14-028	RGZ4	Office Building "River Gardens West", Prague 8
49.	15-003	VIHR	Residential Villa, Prague 5
50.	15-004	GATE	High School "Open Gate II", Prague 6
51.	15-005	MASK	Castle Refurbishment, Malá Skála
52.	15-009	HDBR	Hotel Reconstruction "Chateau", Dolní Břežany
53.	15-012	LIHO	Mixed Use Project "Zlatý Lihovar", Prague 5
54.	15-023	BDPE	Apartment Building, Prague 6
55.	15-024	NSCH	Elementary School, Chýně
56.	15-026	MILO	Health Center, Milovice
57.	15-028	RAP5	Zoning Plan "Radlická Street", Prague 5
58.	15-036	VRC8	Residential Building, Prague 5
59.	15-043	MIHR	Residential Villa Refurbishment, Prague 6
60.	15-045	BESM	Hotel "Belveder", Špindlerův Mlýn
61.	15-046	STHV	Residential Villa, Prague 6
62.	15-047	USBA	Zoning Plan "Barrandov", Prague 5
63.	16-006	KDUB	Dominican Monastery Reconstruction, Uherský Brod
64.	16-010	SEBE	Retirement House, Šeberov
65.	16-013	TELC	Retirement House, Telč
66.	16-020	MICO	Residential Building Reconstruction "Vanguard", Prague 12
67.	16-021	BLOB	Residential Building "Block B", Prague 8
68.	16-022	JIKL	Refurbishment "Jiřský Monastery", Prague 1
69.	16-024	UJVI	Apartment Building Reconstruction, Prague 1
70.	16-027	DDOP	Refurbishment "Dejvické Theater", Prague 6
71.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10
72.	16-030	OPUK	Philosofical Faculty Refurbishment and Completion, Prague 1
73.	16-033	HO26	Residential Complex, Prague 5
74.	16-034	SPML	Apartment Refurbishment, Špindlerův Mlýn
75.	16-040	FOMY	Shopping Unit Refurbishment, "Myslbek", Prague 1
76.	16-044	LAND	Office Building "Landmark", Brno
77.	16-045	RDZB	Family House, Zbuzany
78.	16-049	MAGS	Restaurant Refurbishment "Marina Grosseto", Prague 1
79.	16-054	PPFG	Pavilion "Fragner Gallery", Prague 1
80.	16-055	SKAD	Administrative Complex, Postřižín
81.	16-060	POME	Residential Villas "Top Residence", Prague 5
82.	16-061	KASE	Office Space Refurbishment, Prague 1
83.	17-002	KOST	Elementary School Extension and Reconstruction, Kostelec/Labem
84.	17-003	DOBR	Apartment Buildings, Prague 16
85.	17-007	HOHO	Residential Building, Prague 5
86.	17-012	RRMV	Residential Project "Relax", Prague 5

87.	17-015	SARG	Apartment Building, Sargans
88.	17-019	MEPA	Mixed Use Complex " Mendel Plaza", Brno
89.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5
90.	17-021	KOBR	Residential Building, Prague 5
91.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7
92.	17-024	FLOR	As Built Project Documentation "Florentinum", Prague 1
93.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7
94.	17-038	VITA	Retirement House "Sacre Coeur III", Prague 5
95.	17-046	JURY	Extension and Reconstruction "Botanique Hotel", Prague 8
96.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12
97.	18-001	BDKA	Apartment Building, Prague 3
98.	18-002	NORA	New Townhall, Mníšek pod Brdy
99.	18-004	ANPA	Mixed Use Complex "Palmovka", Prague 8
100.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5
101.	18-014	SDAE	Landscaping, Transport and Infrastructure "Smichov City South", Prague 5
102.	18-015	RSKB	Office Building "Košířská brána", Prague 5
103.	18-017	ERA2	Office Building "ERA", Pardubice
104.	19-004	MIPE	Residential and Mixed Use Complex "Michelské pekárny", Prague 4
105.	19-009	MANI	Gastronomy Project "Manifesto Market", Prague 5
106.	19-010	HODK	Residentail Complex, Prague 4
107.	19-015	CINA	Reconstruction and Extension "Embassy of the PRC", Prague 6
108.	19-020	IBCP	Office Complex Refurbishment "IBC", Prague 8
109.	19-021	FENX	Residentail Complex "Papírny", Prague 6
110.	19-022	BAAR	Residential and Mixed Use Complex "Park Baarova II", Prague 4
111.	19-024	JIHL	Multifunctional Arena, Jihlava
112.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6
113.	19-028	BLUE	Office Project "Blue Building", Prague 11
114.	20-002	PRIK	Mixed Use Building Reconstruction, Prague 1
115.	20-005	LAN2	Office Building "Landmark 2", Brno
116.	20-006	NAVE	Railway Station "Veleslavín", Prague 6
117.	20-007	JIZI	Sport Center, Jihlava
118.	20-009	MAAN	Gastronomy Project "Manifesto Market - Anděl", Prague 5
119.	20-012	CIHL	Residential Villa, Prague 5
120.	20-013	TERM	Traffic Terminal "Smichov", Prague 5
121.	20-014	BDKB	Residential Building "Košířská brána", Prague 5
122.	20-018	VIML	Residential Villa, Kondrac
123.	20-019	PODE	Family House Reconstruction, Poděbrady
124.	21-002	HORN	Mixed Use Centre, Prague 10
125.	21-003	KOTV	Department Store Reconstruction "Kotva", Prague 1
126.	21-007	PZDO	Fire Station, Dobřichovice
127.	21-011	KESN	Residential Villas, Prague 5
128.	21-012	SVPJ	Family House Reconstruction, Světlá pod Ještědem
128			**Total number of projects**

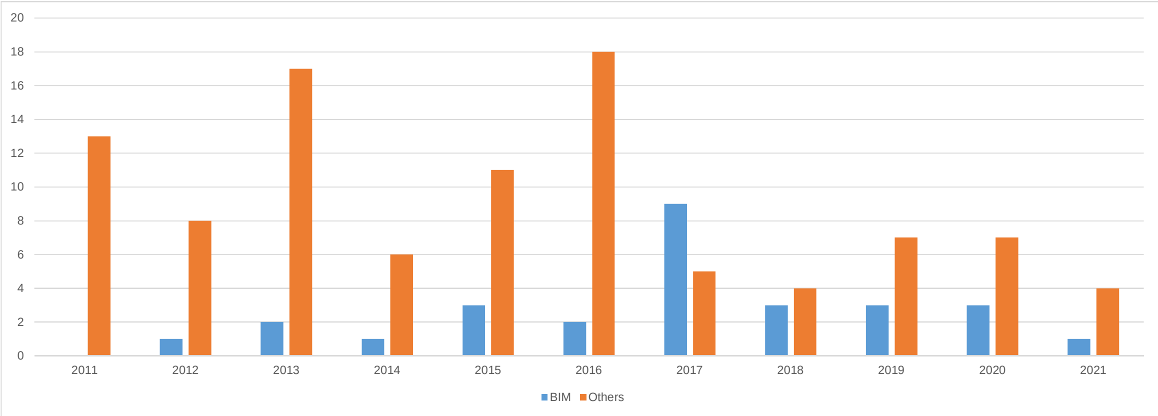
1. All Projects:
1.2. Standard Design Process vs. BIM Method Design

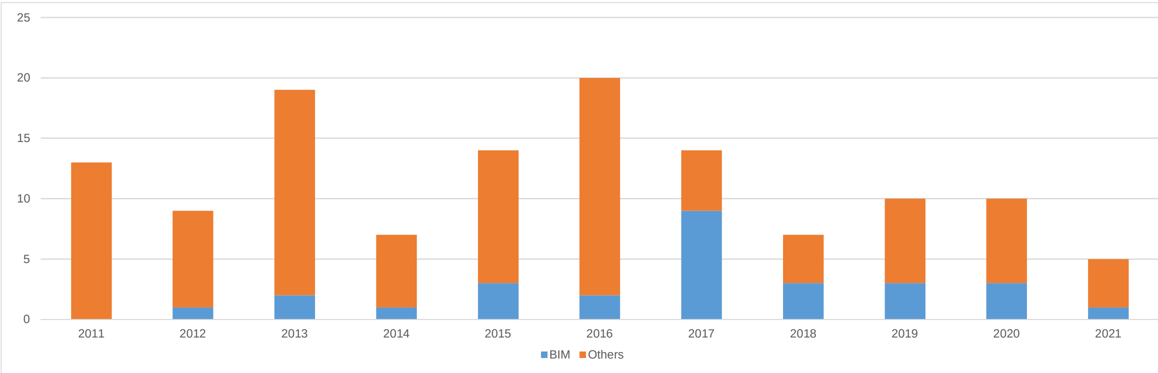
Serial No.	Project No.	Project Code	Project Name	Standard	BIM
1.	11-001	MBTR	New Transformer Station 110/22 kV, Mladá Boleslav	1	0
2.	11-004	STAC	Apartment Building "Stará cesta", Prague 4	1	0
3.	11-013	VIBU	Residential Villas "Bubeneč", Prague 6	1	0
4.	11-015	RDHO	Family House, Prague 4	1	0
5.	11-018	KKCG	Redesign of Office Building "KKCG", Prague 10	1	0
6.	11-022	PAPA	Office Park "Prague Airport", Prague 6	1	0
7.	11-029	ZADV	Residential Area "Zámecký dvůr", Brandýs nad Labem	1	0
8.	11-037	KPTE	Reconstruction of Premonstratensian Monastery, Teplá	1	0
9.	11-044	MEDI	Hotel "Praga", Prague 7	1	0
10.	11-048	TRVL	Turkish Embassy, Prague 6	1	0
11.	11-054	KAFI	Office Buildings "AFI City", Prague 9	1	0
12.	11-056	VILP	Residential Villa, Prague 6	1	0
13.	11-065	RPKK	Modernization of the Lock Chamber, Chrášťany	1	0
14.	12-007	DAPA	Residential Building Reconstruction, Dačice	1	0
15.	12-008	PDRU	Mixed Use Building, Prague 1	1	0
16.	12-019	HOHI	Hilton Hotel, Ulaanbaatar	1	0
17.	12-022	ECRW	Embassy of the Czech Republic, Washington D.C.	1	0
18.	12-042	PANU	Science and Technology Park "Nupharo", Libouchec	1	0
19.	12-043	WALT	Residential project "Waltrovka", Prague 5	0	1
20.	12-046	MEML	Hotel "Metropole", Mariánské Lázně	1	0
21.	12-051	NAPR	Mixed Use Building "Na Příkopě 9 a 11", Prague 1	1	0
22.	12-052	VOKO	"Evropská Business Centre AFI", Prague 6	1	0
23.	13-004	MSAT	Laboratories "Lonza Biotec", Kouřim	1	0
24.	13-014	PABR	Residential Center "Partizanska - Bradlianska", Bratislava	1	0
25.	13-015	REZL	Residential Project "TRIO", Prague 5	1	0
26.	13-016	RDTE	Family House, Prague 6	1	0
27.	13-022	TRSU	Family Houses "Top Residence", Prague 6	1	0
28.	13-023	KONE	Mixed Use Building, Prague 3	1	0
29.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	0	1
30.	13-034	FLVW	Fit-Out "Florentinum - Veolia", Prague 1	1	0
31.	13-035	OP46	Office Building Reconstruction, Prague 1	1	0
32.	13-037	OSK2	Residential Complex "CTR", Prague 8	1	0
33.	13-041	FLPE	Fit-Out "Florentinum - Penta", Prague 1	1	0
34.	13-042	FLSE	Fit-Out "Florentinum - Servier", Prague 1	1	0
35.	13-045	NKVA	Hotel Reconstruction "National House", Karlovy Vary	1	0
36.	13-048	VSE3	Attic Refurbishment, Prague 1	1	0
37.	13-052	CSM2	Mixed Use Building, Prague 9	1	0
38.	13-054	KIND	Mixed Use Building "Karlin Park", Prague 8	1	0
39.	13-055	GAZO	Reconstruction "Gaston Restaurant", Prague 7	1	0
40.	13-056	RADA	Office Complex, Prague 5	1	0
41.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	0	1
42.	14-003	CISC	Fit-Out "Cisco Systems", Prague 1	1	0
43.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0	1
44.	14-009	FLDA	Fit-Out "Florentinum - Dalkia", Prague 1	1	0
45.	14-010	ERAP	Office and Development Centre "ERA", Pardubice	1	0
46.	14-014	UZIC	Housing Project, Úžice	1	0
47.	14-016	VRA4	Residential Villas, Černošice	1	0
48.	14-028	RGZ4	Office Building "River Gardens West", Prague 8	1	0
49.	15-003	VIHR	Residential Villa, Prague 5	1	0
50.	15-004	GATE	High School "Open Gate II", Prague 6	0	1
51.	15-005	MASK	Castle Refurbishment, Malá Skála	1	0
52.	15-009	HDBR	Hotel Reconstruction "Chateau", Dolní Břežany	1	0
53.	15-012	LIHO	Mixed Use Project "Zlatý Lihovar", Prague 5	1	0
54.	15-023	BDPE	Apartment Building, Prague 6	1	0
55.	15-024	NSCH	Elementary School, Chýně	0	1
56.	15-026	MILO	Health Center, Milovice	1	0
57.	15-028	RAP5	Zoning Plan "Radlická Street", Prague 5	1	0
58.	15-036	VRC8	Residential Building, Prague 5	1	0
59.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0	1
60.	15-045	BESM	Hotel "Belveder", Špindlerův Mlýn	1	0
61.	15-046	STHV	Residential Villa, Prague 6	1	0
62.	15-047	USBA	Zoning Plan "Barrandov", Prague 5	1	0
63.	16-006	KDUB	Dominican Monastery Reconstruction, Uherský Brod	1	0
64.	16-010	SEBE	Retirement House, Šeberov	1	0
65.	16-013	TELC	Retirement House, Telč	1	0
66.	16-020	MICO	Residential Building Reconstruction "Vanguard", Prague 12	0	1
67.	16-021	BLOB	Residential Building "Block B", Prague 8	1	0
68.	16-022	JIKL	Refurbishment "Jiřský Monastery", Prague 1	1	0
69.	16-024	UJVI	Apartment Building Reconstruction, Prague 1	1	0

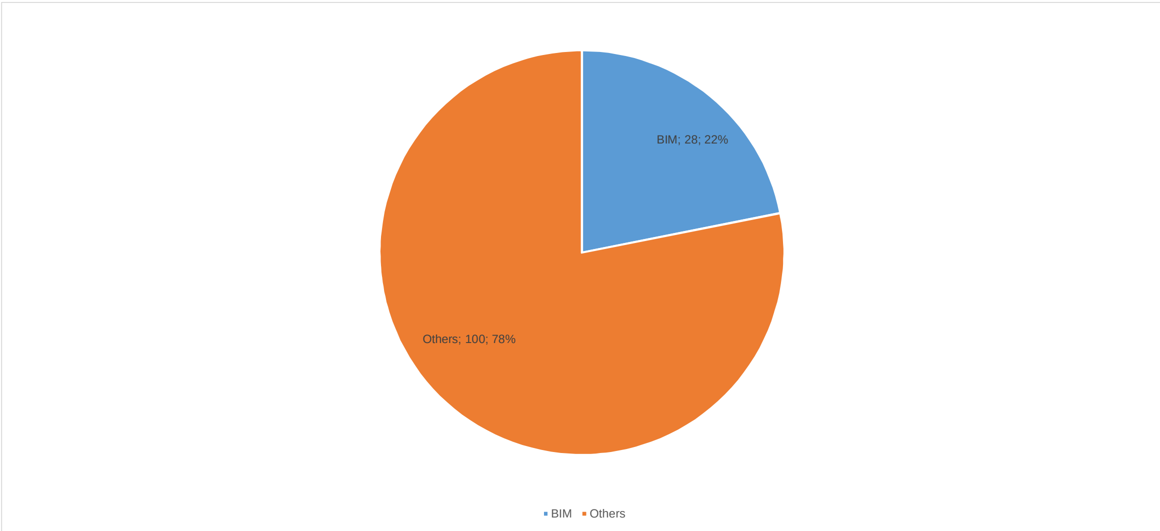
70.	16-027	DDOP	Refurbishment "Dejvické Theater", Prague 6	1	0
71.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0	1
72.	16-030	OPUK	Philosofical Faculty Refurbishment and Completion, Prague 1	1	0
73.	16-033	HO26	Residential Complex, Prague 5	1	0
74.	16-034	SPML	Apartment Refurbishment, Špindlerův Mlýn	1	0
75.	16-040	FOMY	Shopping Unit Refurbishment, "Myslbek", Prague 1	1	0
76.	16-044	LAND	Office Building "Landmark", Brno	1	0
77.	16-045	RDZB	Family House, Zbuzany	1	0
78.	16-049	MAGS	Restaurant Refurbishment "Marina Grosseto", Prague 1	1	0
79.	16-054	PPFG	Pavilion "Fragner Gallery", Prague 1	1	0
80.	16-055	SKAD	Administrative Complex, Postřižín	1	0
81.	16-060	POME	Residential Villas "Top Residence", Prague 5	1	0
82.	16-061	KASE	Office Space Refurbishment, Prague 1	1	0
83.	17-002	KOST	Elementary School Extension and Reconstruction, Kostelec/Labem	1	0
84.	17-003	DOBR	Apartment Buildings, Prague 16	0	1
85.	17-007	HOHO	Residential Building, Prague 5	0	1
86.	17-012	RRMV	Residential Project "Relax", Prague 5	0	1
87.	17-015	SARG	Apartment Building, Sargans	1	0
88.	17-019	MEPA	Mixed Use Complex " Mendel Plaza", Brno	0	1
89.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0	1
90.	17-021	KOBR	Residential Building, Prague 5	0	1
91.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0	1
92.	17-024	FLOR	As Built Project Documentation "Florentinum", Prague 1	1	0
93.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0	1
94.	17-038	VITA	Retirement House "Sacre Coeur III", Prague 5	1	0
95.	17-046	JURY	Extension and Reconstruction "Botanique Hotel", Prague 8	1	0
96.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	0	1
97.	18-001	BDKA	Apartment Building, Prague 3	1	0
98.	18-002	NORA	New Townhall, Mníšek pod Brdy	1	0
99.	18-004	ANPA	Mixed Use Complex "Palmovka", Prague 8	1	0
100.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	0	1
101.	18-014	SDAE	Landscaping, Transport and Infrastructure "Smichov City South", Prague 5	1	0
102.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0	1
103.	18-017	ERA2	Office Building "ERA", Pardubice	0	1
104.	19-004	MIPE	Residential and Mixed Use Complex "Michelské pekárny", Prague 4	1	0
105.	19-009	MANI	Gastronomy Project "Manifesto Market", Prague 5	1	0
106.	19-010	HODK	Residentail Complex, Prague 4	1	0
107.	19-015	CINA	Reconstruction and Extension "Embassy of the PRC", Prague 6	1	0
108.	19-020	IBCP	Office Complex Refurbishment "IBC", Prague 8	1	0
109.	19-021	FENX	Residentail Complex "Papírny", Prague 6	1	0
110.	19-022	BAAR	Residential and Mixed Use Complex "Park Baarova II", Prague 4	1	0
111.	19-024	JIHL	Multifunctional Arena, Jihlava	0	1
112.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	0	1
113.	19-028	BLUE	Office Project "Blue Building", Prague 11	0	1
114.	20-002	PRIK	Mixed Use Building Reconstruction, Prague 1	1	0
115.	20-005	LAN2	Office Building "Landmark 2", Brno	0	1
116.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0	1
117.	20-007	JIZI	Sport Center, Jihlava	1	0
118.	20-009	MAAN	Gastronomy Project "Manifesto Market - Anděl", Prague 5	1	0
119.	20-012	CIHL	Residential Villa, Prague 5	1	0
120.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	0	1
121.	20-014	BDKB	Residential Building "Košířská brána", Prague 5	1	0
122.	20-018	VIML	Residential Villa, Kondrac	1	0
123.	20-019	PODE	Family House Reconstruction, Poděbrady	1	0
124.	21-002	HORN	Mixed Use Centre, Prague 10	0	1
125.	21-003	KOTV	Department Store Reconstruction "Kotva", Prague 1	1	0
126.	21-007	PZDO	Fire Station, Dobřichovice	1	0
127.	21-011	KESN	Residential Villas, Prague 5	1	0
128.	21-012	SVPJ	Family House Reconstruction, Světlá pod Ještědem	1	0
128			**Total number of projects**	**100**	**28**
100%			**% split of projects**	**78%**	**22%**

1. All Projects:
1.2. BIM Projects vs. Other Projects

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
BIM	0	1	2	1	3	2	9	3	3	3	1	28
Others	13	8	17	6	11	18	5	4	7	7	4	100
Total	**13**	**9**	**19**	**7**	**14**	**20**	**14**	**7**	**10**	**10**	**5**	**128**







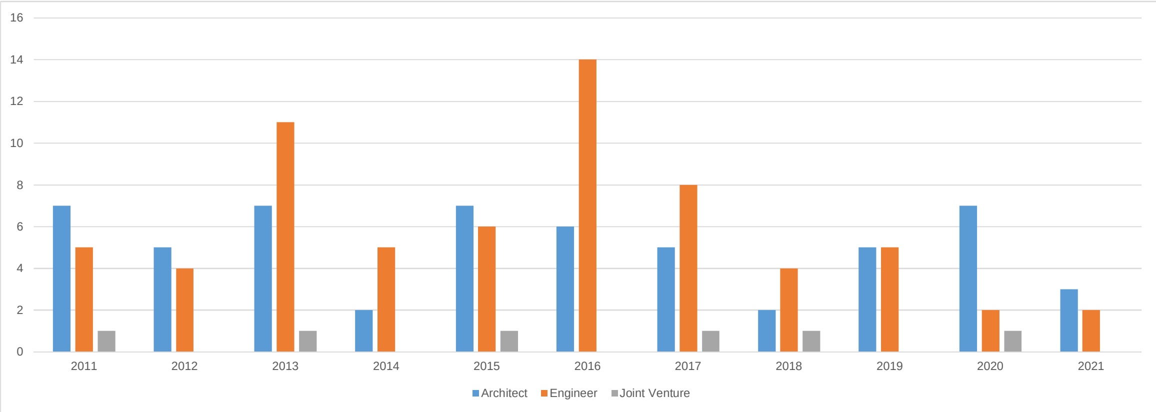
1. All Projects:
1.3. Contract Holder

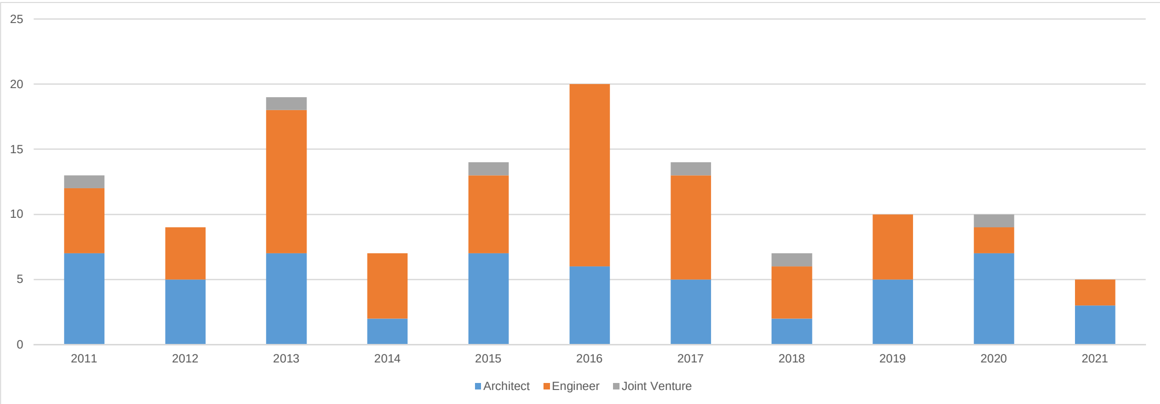
Serial No.	Project No.	Project Code	Project Name	Architect	Engineer	Joint Venture
1.	11-001	MBTR	New Transformer Station 110/22 kV, Mladá Boleslav	1	0	0
2.	11-004	STAC	Apartment Building "Stará cesta", Prague 4	0	1	0
3.	11-013	VIBU	Residential Villas "Bubeneč", Prague 6	0	1	0
4.	11-015	RDHO	Family House, Prague 4	1	0	0
5.	11-018	KKCG	Redesign of Office Building "KKCG", Prague 10	0	1	0
6.	11-022	PAPA	Office Park "Prague Airport", Prague 6	1	0	0
7.	11-029	ZADV	Residential Area "Zámecký dvůr", Brandýs nad Labem	0	0	1
8.	11-037	KPTE	Reconstruction of Premonstratensian Monastery, Teplá	0	1	0
9.	11-044	MEDI	Hotel "Praga", Prague 7	1	0	0
10.	11-048	TRVL	Turkish Embassy, Prague 6	1	0	0
11.	11-054	KAFI	Office Buildings "AFI City", Prague 9	1	0	0
12.	11-056	VILP	Residential Villa, Prague 6	1	0	0
13.	11-065	RPKK	Modernization of the Lock Chamber, Chrášťany	0	1	0
14.	12-007	DAPA	Residential Building Reconstruction, Dačice	0	1	0
15.	12-008	PDRU	Mixed Use Building, Prague 1	1	0	0
16.	12-019	HOHI	Hilton Hotel, Ulaanbaatar	0	1	0
17.	12-022	ECRW	Embassy of the Czech Republic, Washington D.C.	1	0	0
18.	12-042	PANU	Science and Technology Park "Nupharo", Libouchec	0	1	0
19.	12-043	WALT	Residential project "Waltrovka", Prague 5	1	0	0
20.	12-046	MEML	Hotel "Metropole", Mariánské Lázně	1	0	0
21.	12-051	NAPR	Mixed Use Building "Na Příkopě 9 a 11", Prague 1	0	1	0
22.	12-052	VOKO	"Evropská Business Centre AFI", Prague 6	1	0	0
23.	13-004	MSAT	Laboratories "Lonza Biotec", Kouřim	0	1	0
24.	13-014	PABR	Residential Center "Partizanska - Bradlianska", Bratislava	0	1	0
25.	13-015	REZL	Residential Project "TRIO", Prague 5	0	1	0
26.	13-016	RDTE	Family House, Prague 6	0	1	0
27.	13-022	TRSU	Family Houses "Top Residence", Prague 6	0	1	0
28.	13-023	KONE	Mixed Use Building, Prague 3	1	0	0
29.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	1	0	0
30.	13-034	FLVW	Fit-Out "Florentinum - Veolia", Prague 1	0	1	0
31.	13-035	OP46	Office Building Reconstruction, Prague 1	1	0	0
32.	13-037	OSK2	Residential Complex "CTR", Prague 8	0	1	0
33.	13-041	FLPE	Fit-Out "Florentinum - Penta", Prague 1	0	1	0
34.	13-042	FLSE	Fit-Out "Florentinum - Servier", Prague 1	0	1	0
35.	13-045	NKVA	Hotel Reconstruction "National House", Karlovy Vary	1	0	0
36.	13-048	VSE3	Attic Refurbishment, Prague 1	0	1	0
37.	13-052	CSM2	Mixed Use Building, Prague 9	1	0	0
38.	13-054	KIND	Mixed Use Building "Karlin Park", Prague 8	0	1	0
39.	13-055	GAZO	Reconstruction "Gaston Restaurant", Prague 7	1	0	0
40.	13-056	RADA	Office Complex, Prague 5	0	0	1
41.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	1	0	0
42.	14-003	CISC	Fit-Out "Cisco Systems", Prague 1	0	1	0
43.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0	1	0
44.	14-009	FLDA	Fit-Out "Florentinum - Dalkia", Prague 1	0	1	0
45.	14-010	ERAP	Office and Development Centre "ERA", Pardubice	1	0	0
46.	14-014	UZIC	Housing Project, Úžice	0	1	0
47.	14-016	VRA4	Residential Villas, Černošice	1	0	0
48.	14-028	RGZ4	Office Building "River Gardens West", Prague 8	0	1	0
49.	15-003	VIHR	Residential Villa, Prague 5	1	0	0
50.	15-004	GATE	High School "Open Gate II", Prague 6	1	0	0
51.	15-005	MASK	Castle Refurbishment, Malá Skála	0	1	0
52.	15-009	HDBR	Hotel Reconstruction "Chateau", Dolní Břežany	0	1	0
53.	15-012	LIHO	Mixed Use Project "Zlatý Lihovar", Prague 5	1	0	0
54.	15-023	BDPE	Apartment Building, Prague 6	0	1	0
55.	15-024	NSCH	Elementary School, Chýně	1	0	0
56.	15-026	MILO	Health Center, Milovice	0	1	0
57.	15-028	RAP5	Zoning Plan "Radlická Street", Prague 5	0	0	1
58.	15-036	VRC8	Residential Building, Prague 5	1	0	0
59.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0	1	0
60.	15-045	BESM	Hotel "Belveder", Špindlerův Mlýn	0	1	0
61.	15-046	STHV	Residential Villa, Prague 6	1	0	0
62.	15-047	USBA	Zoning Plan "Barrandov", Prague 5	1	0	0
63.	16-006	KDUB	Dominican Monastery Reconstruction, Uherský Brod	1	0	0
64.	16-010	SEBE	Retirement House, Šeberov	0	1	0
65.	16-013	TELC	Retirement House, Telč	0	1	0
66.	16-020	MICO	Residential Building Reconstruction "Vanguard", Prague 12	0	1	0
67.	16-021	BLOB	Residential Building "Block B", Prague 8	0	1	0
68.	16-022	JIKL	Refurbishment "Jiřský Monastery", Prague 1	0	1	0
69.	16-024	UJVI	Apartment Building Reconstruction, Prague 1	1	0	0
70.	16-027	DDOP	Refurbishment "Dejvické Theater", Prague 6	1	0	0
71.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0	1	0
72.	16-030	OPUK	Philosofical Faculty Refurbishment and Completion, Prague 1	1	0	0
73.	16-033	HO26	Residential Complex, Prague 5	0	1	0
74.	16-034	SPML	Apartment Refurbishment, Špindlerův Mlýn	0	1	0
75.	16-040	FOMY	Shopping Unit Refurbishment, "Myslbek", Prague 1	1	0	0
76.	16-044	LAND	Office Building "Landmark", Brno	0	1	0
77.	16-045	RDZB	Family House, Zbuzany	0	1	0
78.	16-049	MAGS	Restaurant Refurbishment "Marina Grosseto", Prague 1	0	1	0
79.	16-054	PPFG	Pavilion "Fragner Gallery", Prague 1	0	1	0
80.	16-055	SKAD	Administrative Complex, Postřižín	0	1	0
81.	16-060	POME	Residential Villas "Top Residence", Prague 5	1	0	0
82.	16-061	KASE	Office Space Refurbishment, Prague 1	0	1	0
83.	17-002	KOST	Elementary School Extension and Reconstruction, Kostelec/Labem	0	1	0

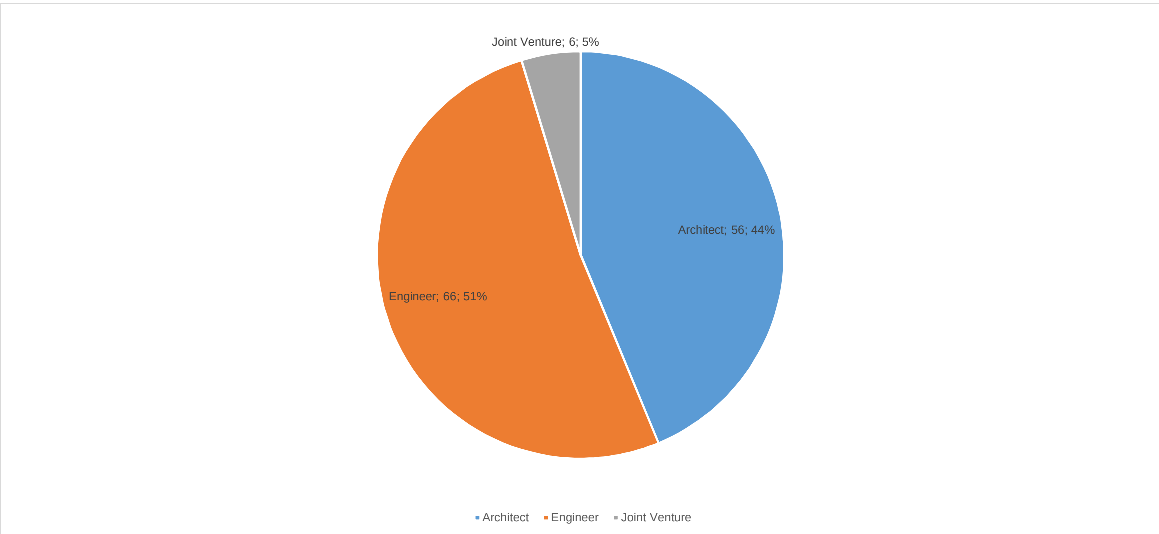
84.	17-003	DOBR	Apartment Buildings, Prague 16	1	0	0
85.	17-007	HOHO	Residential Building, Prague 5	0	1	0
86.	17-012	RRMV	Residential Project "Relax", Prague 5	0	0	1
87.	17-015	SARG	Apartment Building, Sargans	1	0	0
88.	17-019	MEPA	Mixed Use Complex " Mendel Plaza", Brno	0	1	0
89.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0	1	0
90.	17-021	KOBR	Residential Building, Prague 5	0	1	0
91.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	1	0	0
92.	17-024	FLOR	As Built Project Documentation "Florentinum", Prague 1	0	1	0
93.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	1	0	0
94.	17-038	VITA	Retirement House "Sacre Coeur III", Prague 5	0	1	0
95.	17-046	JURY	Extension and Reconstruction "Botanique Hotel", Prague 8	1	0	0
96.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	0	1	0
97.	18-001	BDKA	Apartment Building, Prague 3	0	1	0
98.	18-002	NORA	New Townhall, Mníšek pod Brdy	1	0	0
99.	18-004	ANPA	Mixed Use Complex "Palmovka", Prague 8	0	1	0
100.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	0	1	0
101.	18-014	SDAE	Landscaping, Transport and Infrastructure "Smichov City South", Prague 5	0	0	1
102.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0	1	0
103.	18-017	ERA2	Office Building "ERA", Pardubice	1	0	0
104.	19-004	MIPE	Residential and Mixed Use Complex "Michelské pekárny", Prague 4	0	1	0
105.	19-009	MANI	Gastronomy Project "Manifesto Market", Prague 5	1	0	0
106.	19-010	HODK	Residentail Complex, Prague 4	0	1	0
107.	19-015	CINA	Reconstruction and Extension "Embassy of the PRC", Prague 6	0	1	0
108.	19-020	IBCP	Office Complex Refurbishment "IBC", Prague 8	0	1	0
109.	19-021	FENX	Residentail Complex "Papírny", Prague 6	1	0	0
110.	19-022	BAAR	Residential and Mixed Use Complex "Park Baarova II", Prague 4	1	0	0
111.	19-024	JIHL	Multifunctional Arena, Jihlava	1	0	0
112.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	0	1	0
113.	19-028	BLUE	Office Project "Blue Building", Prague 11	1	0	0
114.	20-002	PRIK	Mixed Use Building Reconstruction, Prague 1	1	0	0
115.	20-005	LAN2	Office Building "Landmark 2", Brno	1	0	0
116.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	1	0	0
117.	20-007	JIZI	Sport Center, Jihlava	1	0	0
118.	20-009	MAAN	Gastronomy Project "Manifesto Market - Anděl", Prague 5	0	1	0
119.	20-012	CIHL	Residential Villa, Prague 5	1	0	0
120.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	1	0	0
121.	20-014	BDKB	Residential Building "Košířská brána", Prague 5	1	0	0
122.	20-018	VIML	Residential Villa, Kondrac	0	0	1
123.	20-019	PODE	Family House Reconstruction, Poděbrady	0	1	0
124.	21-002	HORN	Mixed Use Centre, Prague 10	1	0	0
125.	21-003	KOTV	Department Store Reconstruction "Kotva", Prague 1	0	1	0
126.	21-007	PZDO	Fire Station, Dobřichovice	1	0	0
127.	21-011	KESN	Residential Villas, Prague 5	1	0	0
128.	21-012	SVPJ	Family House Reconstruction, Světlá pod Ještědem	0	1	0
128			**Total number of projects**	**56**	**66**	**6**
100%			**% split of projects**	**44%**	**52%**	**5%**

1. All Projects:
1.3. Contract Holder

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Architect	7	5	7	2	7	6	5	2	5	7	3	56
Engineer	5	4	11	5	6	14	8	4	5	2	2	66
Joint Venture	1	0	1	0	1	0	1	1	0	1	0	6
Total	**13**	**9**	**19**	**7**	**14**	**20**	**14**	**7**	**10**	**10**	**5**	**128**





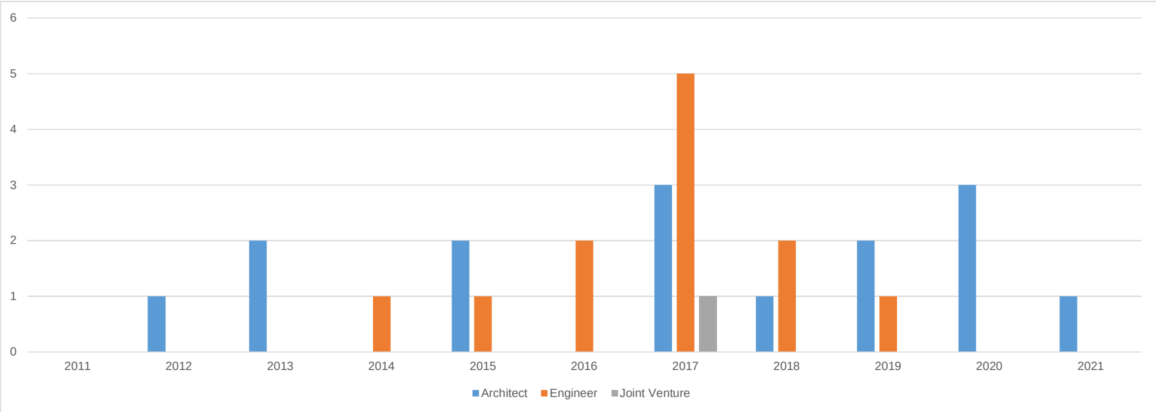


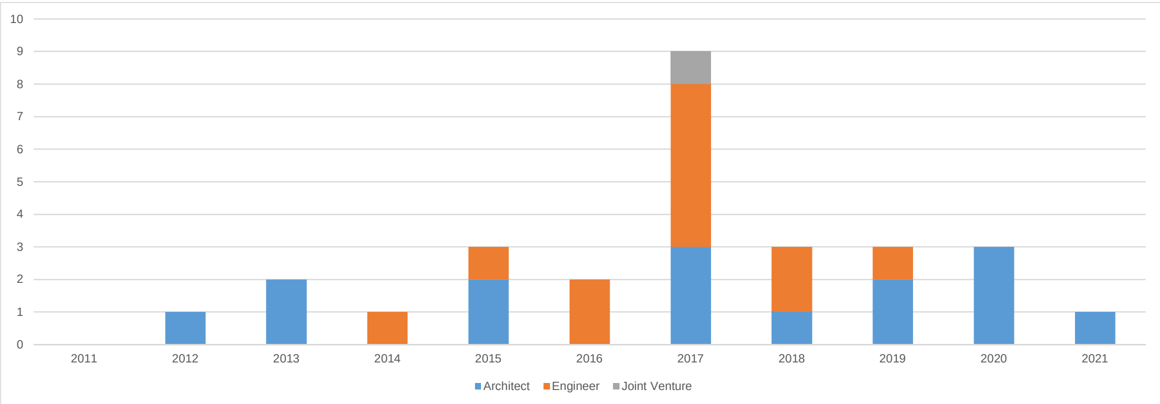
2. BIM Projects:
2.1. Contract Holder

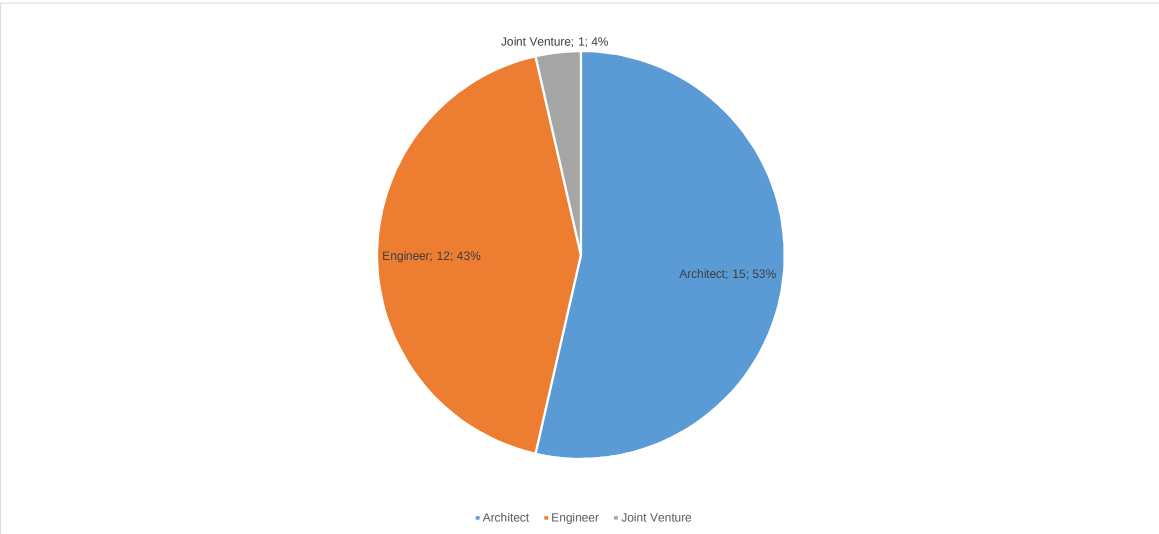
Serial No.	Project No.	Project Code	Project Name	Architect	Engineer	Joint Venture
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	1	0	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	1	0	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	1	0	0
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0	1	0
5.	15-004	GATE	High School "Open Gate II", Prague 6	1	0	0
6.	15-024	NSCH	Elementary School, Chýně	1	0	0
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0	1	0
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0	1	0
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0	1	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	1	0	0
11.	17-007	HOHO	Residential Building, Prague 5	0	1	0
12.	17-012	RRMV	Residential Project "Relax", Prague 5	0	0	1
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	0	1	0
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0	1	0
15.	17-021	KOBR	Residential Building, Prague 5	0	1	0
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	1	0	0
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	1	0	0
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	0	1	0
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	0	1	0
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0	1	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	1	0	0
22.	19-024	JIHL	Multifunctional Arena, Jihlava	1	0	0
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	0	1	0
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	1	0	0
25.	20-005	LAN2	Office Building "Landmark 2", Brno	1	0	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	1	0	0
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	1	0	0
28.	21-002	HORN	Mixed Use Centre, Prague 10	1	0	0
28			**Total number of projects**	**15**	**12**	**1**
100%			**% split of projects**	**54%**	**43%**	**4%**

2. BIM:
2.1. Contract Holder

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Architect	0	1	2	0	2	0	3	1	2	3	1	15
Engineer	0	0	0	1	1	2	5	2	1	0	0	12
Joint Venture	0	0	0	0	0	0	1	0	0	0	0	1
Total	**0**	**1**	**2**	**1**	**3**	**2**	**9**	**3**	**3**	**3**	**1**	**28**







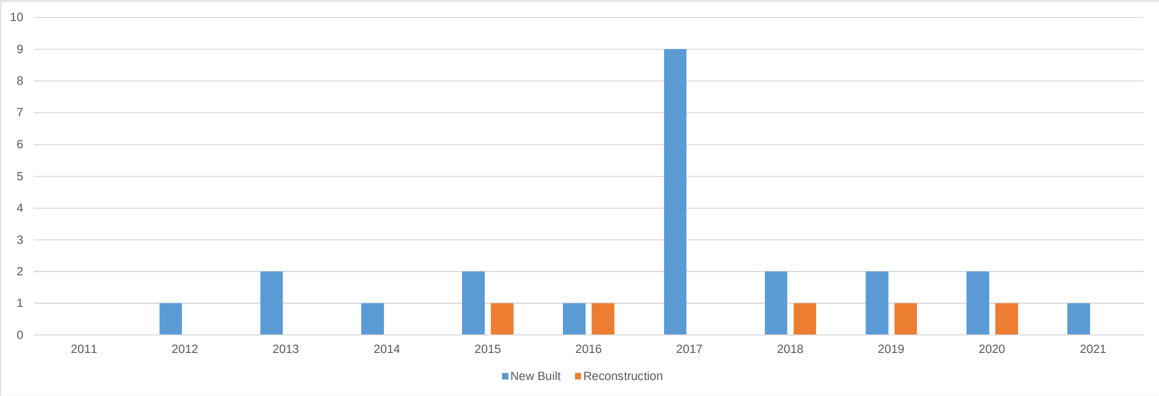
2. BIM Projects:
2.2. Type of Construction: New Built vs. Reconstruction

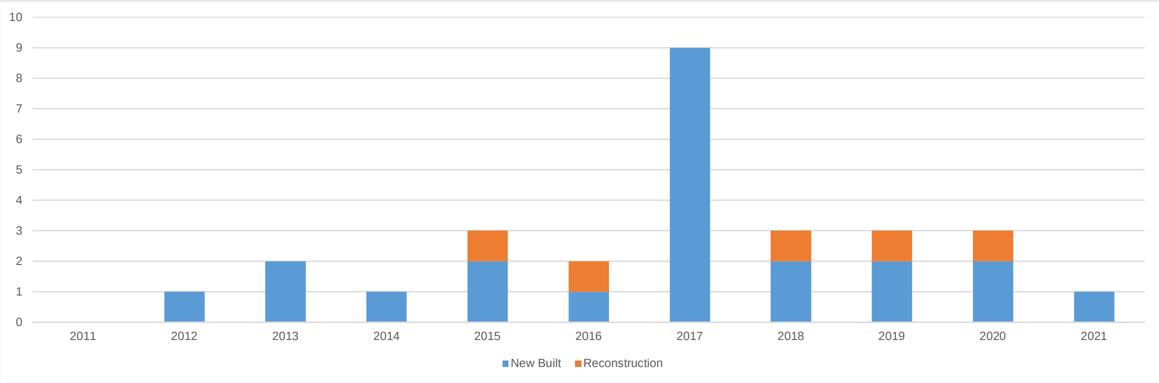
Serial No.	Project No.	Project Code	Project Name	New Built	Reconstruction
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	1	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	1	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	1	0
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	1	0
5.	15-004	GATE	High School "Open Gate II", Prague 6	1	0
6.	15-024	NSCH	Elementary School, Chýně	1	0
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0	1
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0	1
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	1	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	1	0
11.	17-007	HOHO	Residential Building, Prague 5	1	0
12.	17-012	RRMV	Residential Project "Relax", Prague 5	1	0
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	1	0
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	1	0
15.	17-021	KOBR	Residential Building, Prague 5	1	0
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	1	0
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	1	0
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	1	0
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1	0
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	1	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	0	1
22.	19-024	JIHL	Multifunctional Arena, Jihlava	1	0
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	0	1
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	1	0
25.	20-005	LAN2	Office Building "Landmark 2", Brno	1	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0	1
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	1	0
28.	21-002	HORN	Mixed Use Centre, Prague 10	1	0
28			**Total number of projects**	**23**	**5**
100%			**% split of projects**	**82%**	**18%**

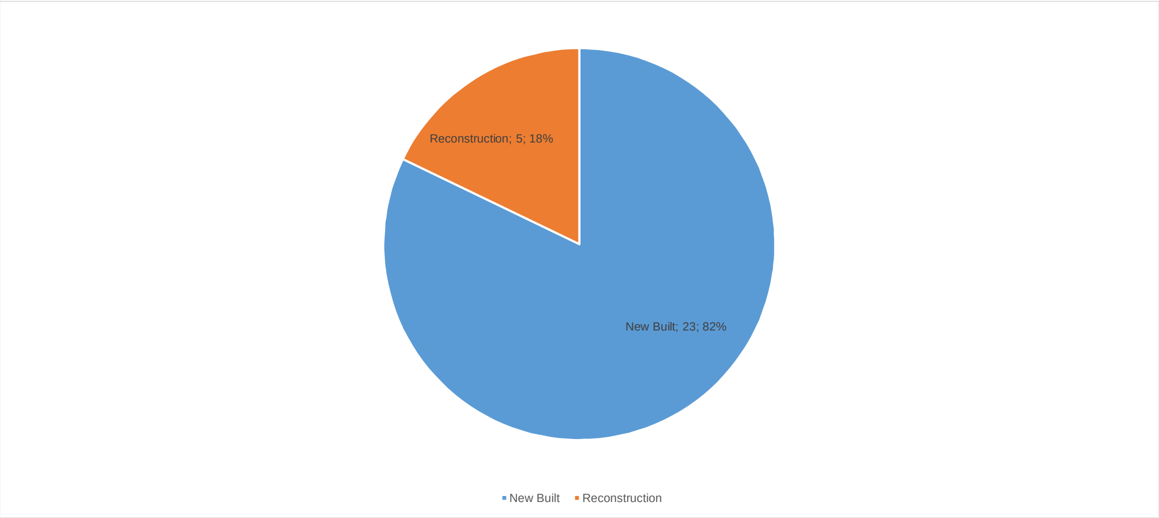
2. BIM Projects:

2.2. Type of Construction: New Built vs. Reconstruction

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
New Built	0	1	2	1	2	1	9	2	2	2	1	23
Reconstruction	0	0	0	0	1	1	0	1	1	1	0	5
Total	**0**	**1**	**2**	**1**	**3**	**2**	**9**	**3**	**3**	**3**	**1**	**28**





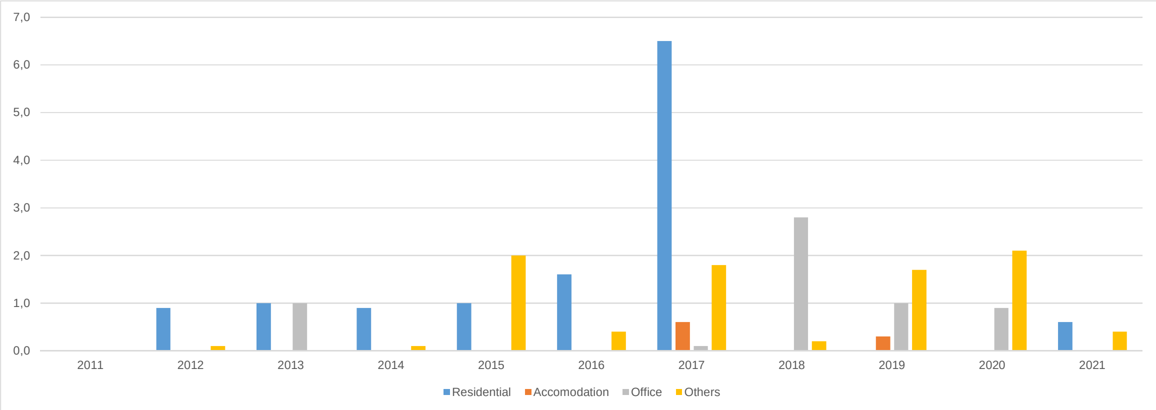


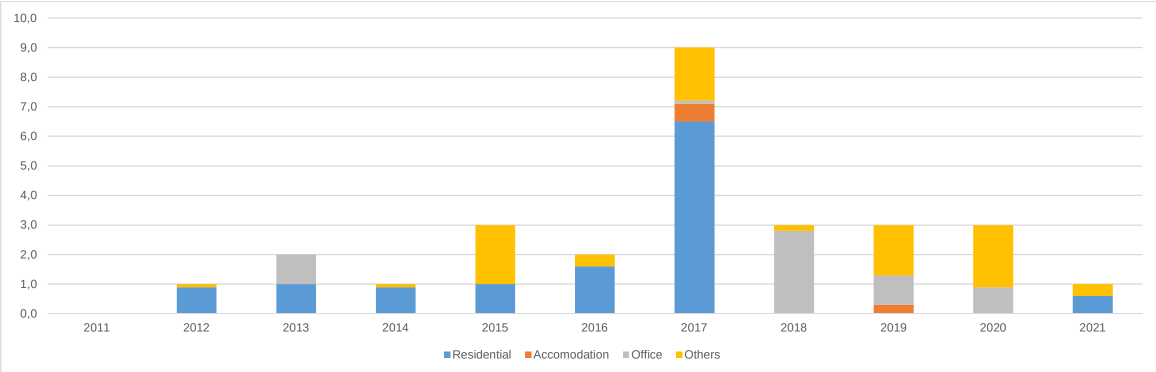
2. BIM Projects:
2.3. Functional Use

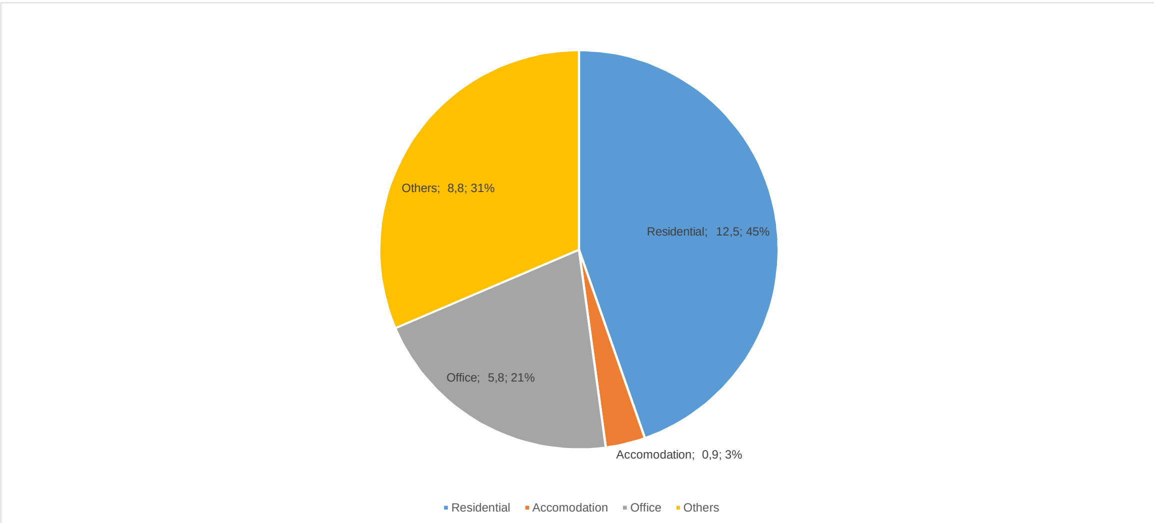
Serial No.	Project No.	Project Code	Project Name	Residential	Accomodation	Office	Others
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	90%	0%	0%	10%
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	100%	0%	0%	0%
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	0%	0%	100%	0%
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	90%	0%	0%	10%
5.	15-004	GATE	High School "Open Gate II", Prague 6	0%	0%	0%	100%
6.	15-024	NSCH	Elementary School, Chýně	0%	0%	0%	100%
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	100%	0%	0%	0%
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	60%	0%	0%	40%
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	100%	0%	0%	0%
10.	17-003	DOBR	Apartment Buildings, Prague 16	100%	0%	0%	0%
11.	17-007	HOHO	Residential Building, Prague 5	100%	0%	0%	0%
12.	17-012	RRMV	Residential Project "Relax", Prague 5	100%	0%	0%	0%
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	60%	10%	10%	20%
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	100%	0%	0%	0%
15.	17-021	KOBR	Residential Building, Prague 5	100%	0%	0%	0%
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0%	50%	0%	50%
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0%	0%	0%	100%
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	90%	0%	0%	10%
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	0%	0%	100%	0%
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0%	0%	80%	20%
21.	18-017	ERA2	Office Building "ERA", Pardubice	0%	0%	100%	0%
22.	19-024	JIHL	Multifunctional Arena, Jihlava	0%	0%	0%	100%
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	0%	30%	0%	70%
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	0%	0%	100%	0%
25.	20-005	LAN2	Office Building "Landmark 2", Brno	0%	0%	90%	10%
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0%	0%	0%	100%
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	0%	0%	0%	100%
28.	21-002	HORN	Mixed Use Centre, Prague 10	60%	0%	0%	40%
28			**Part of total number of projects**	**12,5**	**0,9**	**5,8**	**8,8**
100%			**% split of total number of projects**	**45%**	**3%**	**21%**	**31%**

2. BIM Projects:
2.3. Functional Use

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Residential	0,0	0,9	1,0	0,9	1,0	1,6	6,5	0,0	0,0	0,0	0,6	12,5
Accomodation	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,0	0,3	0,0	0,0	0,9
Office	0,0	0,0	1,0	0,0	0,0	0,0	0,1	2,8	1,0	0,9	0,0	5,8
Others	0,0	0,1	0,0	0,1	2,0	0,4	1,8	0,2	1,7	2,1	0,4	8,8
Total	**0**	**1**	**2**	**1**	**3**	**2**	**9**	**3**	**3**	**3**	**1**	**28,0**







2. BIM Projects:
2.4. Gross Floor Area (GFA) of Buildings

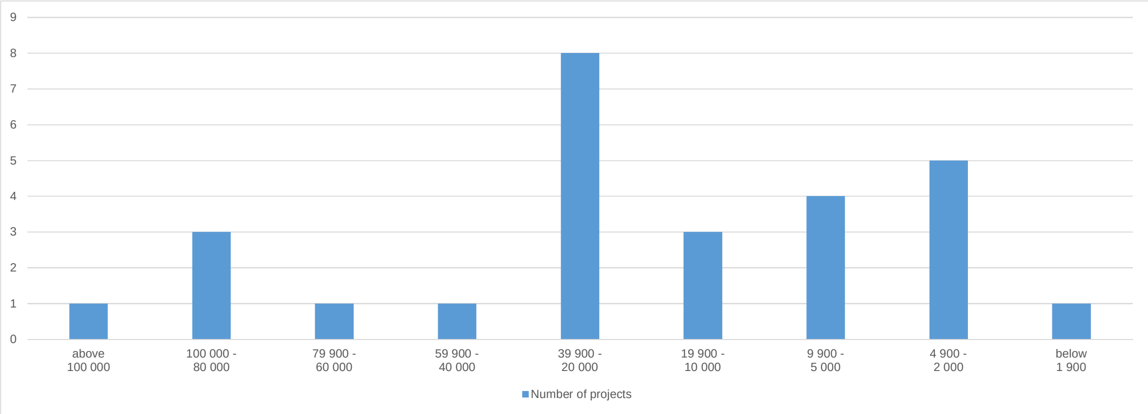
Serial No.	Project No.	Project Code	Project Name		GFA total [sqm]	Subtotal	% split	no.
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	1.	above 100 000	1	4%	1
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	2.	100 000 - 80 000	3	11%	1
24.	19-028	BLUE	Office Project "Blue Building", Prague 11					1
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5					1
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	3.	79 900 - 60 000	1	4%	1
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	4.	59 900 - 40 000	1	4%	1
28.	21-002	HORN	Mixed Use Centre, Prague 10	5.	39 900 - 20 000	8	30%	1
1.	12-043	WALT	Residential project "Waltrovka", Prague 5					1
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12					1
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12					1
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10					1
22.	19-024	JIHL	Multifunctional Arena, Jihlava					1
5.	15-004	GATE	High School "Open Gate II", Prague 6					1
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12					1
25.	20-005	LAN2	Office Building "Landmark 2", Brno	6.	19 900 - 10 000	3	11%	1
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5					1
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6					1
12.	17-012	RRMV	Residential Project "Relax", Prague 5					
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	7.	9 900 - 5 000	4	15%	1
6.	15-024	NSCH	Elementary School, Chýně					1
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5					1
21.	18-017	ERA2	Office Building "ERA", Pardubice					1
15.	17-021	KOBR	Residential Building, Prague 5	8.	4 900 - 2 000	5	19%	1
11.	17-007	HOHO	Residential Building, Prague 5					1
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7					1
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6					1
10.	17-003	DOBR	Apartment Buildings, Prague 16					1
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	9.	below 1 900	1	4%	1
28			**Total number of projects**			**27**	**100%**	**27**
0%			**% split of projects**					

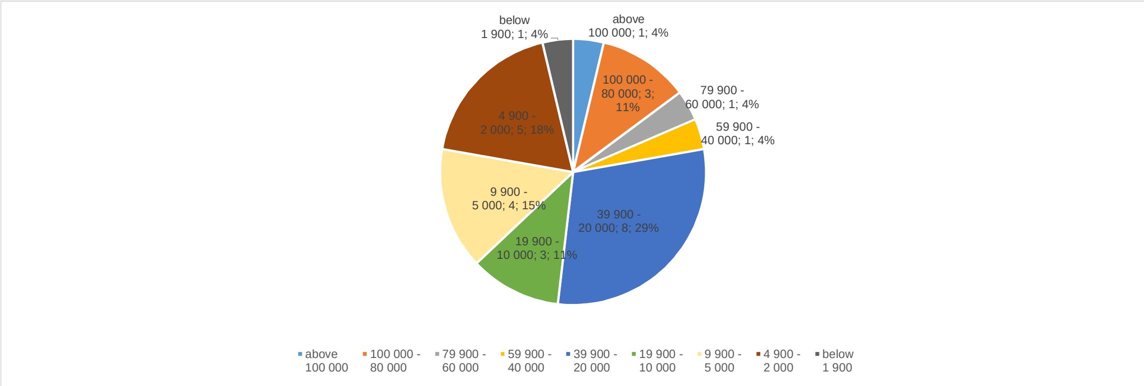
2. BIM Projects:
2.4. Gross Floor Area (GFA) of Buildings

Project Code	GFA total	Total	Residential	Accomodation	Office	Others	GFA below ground
MEPA	108 300	85 500	56 500	4 700	4 000	20 300	22 800
RPMO	131 400	124 500	100 000	1 100	0	23 400	6 900
BLUE	89 200	63 400	59 100	0	0	4 300	25 800
SHQ2	86 100	49 800	0	0	49 800	0	36 300
OLOW	66 200	42 300	0	0	42 300	0	23 900
TERM	58 800	58 800	50 000	0	0	8 800	0
HORN	39 300	30 700	0	0	30 700	0	8 600
WALT	38 400	29 100	0	0	0	29 100	9 300
BEL2	36 300	26 800	16 300		0	10 500	9 500
MICO	34 700	27 000	26 700	0	0	300	7 700
NAPA	33 700	25 900	25 900	0	0	0	7 800
JIHL	31 400	24 500	0	1 100	0	23 400	6 900
GATE	20 600	20 600	12 500	0	0	8 100	0
MOCU	20 500	13 500	12 000	0	0	1 500	7 000
LAN2	19 500	13 000	0	0	0	13 000	6 500
CISA	18 200	11 900	11 400	0	0	500	6 300
JENE	11 200	8 500	0	0	7 900	600	2 700
RRMV	10 500	7 500	7 500	0	0	0	3 000
NAVE	8 800	8 800	0	0	0	8 800	0
NSCH	8 600	7 100	0	2 100	0	5 000	1 500
RSKB	7 400	7 400	0	0	0	7 400	0
ERA2	6 000	6 000	0	0	0	6 000	0
KOBR	4 900	3 600	0	0	2 800	800	1 300
HOHO	4 400	4 400	0	0	4 400	0	0
LEME	2 600	2 100	2 100	0	0	0	500
MIHR	2 500	2 000	1 600	0	400	0	500
DOBR	2 200	2 200	0	0	0	2 200	0
MOZO	1 100	800	800	0	0	0	300
	902 800	**707 700**	**382 400**	**9 000**	**142 300**	**174 000**	**195 100**
		78%	54%	1%	20%	25%	22%

2. BIM Projects:
2.4. Gross Floor Area (GFA) of Buildings

	above 100 000	100 000 - 80 000	79 900 - 60 000	59 900 - 40 000	39 900 - 20 000	19 900 - 10 000	9 900 - 5 000	4 900 - 2 000	below 1 900	Total
Number of projects	1	3	1	1	8	3	4	5	1	27
%	4%	11%	4%	4%	30%	11%	15%	19%	4%	100%



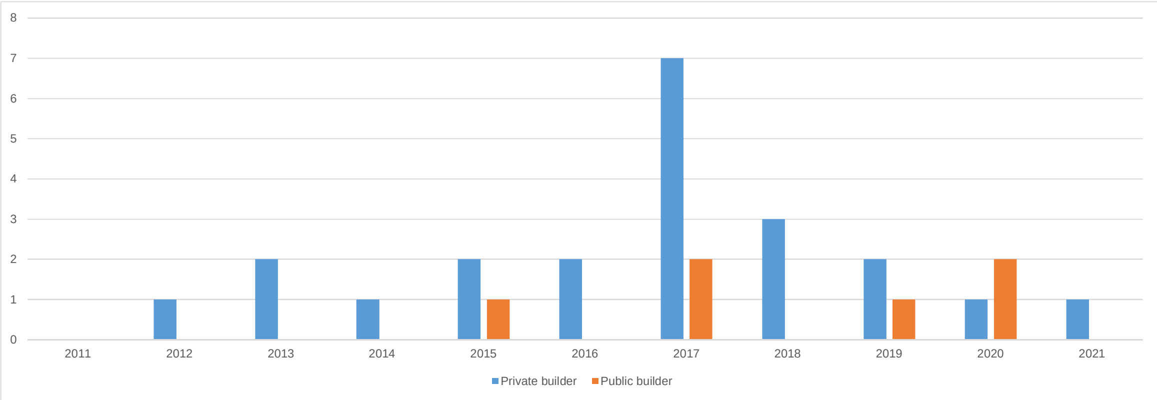


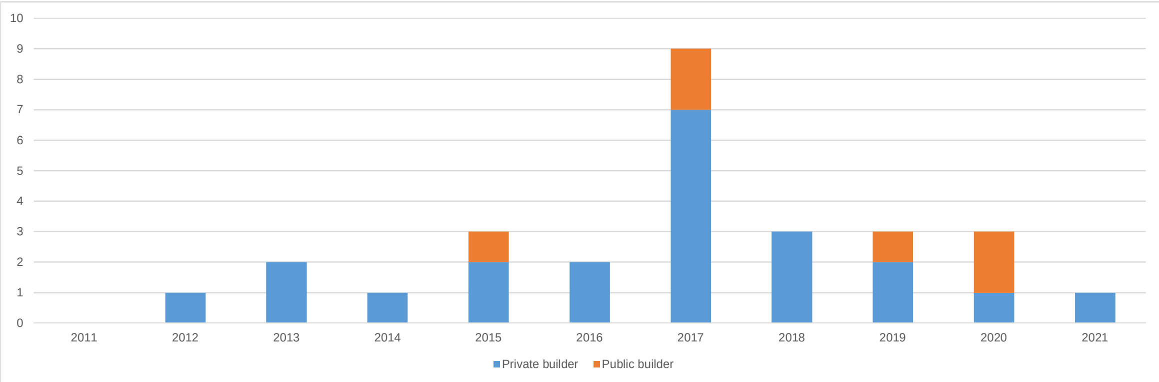
2. BIM Projects:
2.5. Type of a Builder

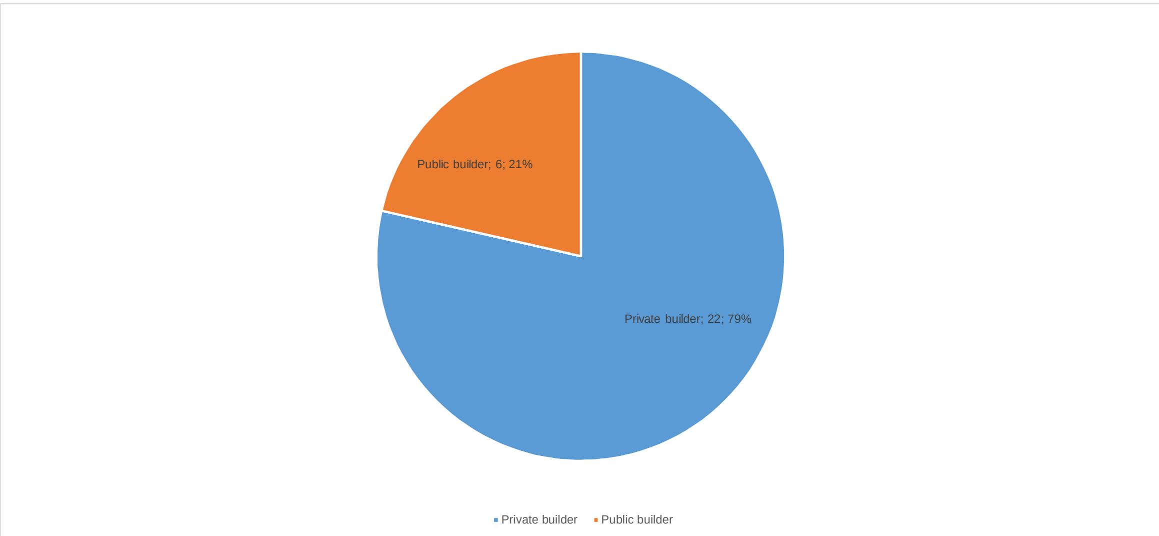
Serial No.	Project No.	Project Code	Project Name	Private	Public
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	1	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	1	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	1	0
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	1	0
5.	15-004	GATE	High School "Open Gate II", Prague 6	1	0
6.	15-024	NSCH	Elementary School, Chýně	0	1
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	1	0
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	1	0
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	1	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	1	0
11.	17-007	HOHO	Residential Building, Prague 5	1	0
12.	17-012	RRMV	Residential Project "Relax", Prague 5	1	0
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	1	0
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	1	0
15.	17-021	KOBR	Residential Building, Prague 5	1	0
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0	1
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0	1
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	1	0
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1	0
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	1	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	1	0
22.	19-024	JIHL	Multifunctional Arena, Jihlava	0	1
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	1	0
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	1	0
25.	20-005	LAN2	Office Building "Landmark 2", Brno	1	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0	1
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	0	1
28.	21-002	HORN	Mixed Use Centre, Prague 10	1	0
28			**Total number of projects**	**22**	**6**
100%			**% split of projects**	**79%**	**21%**

2. BIM Projects:
2.5. Type of a Builder

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Private builder	0	1	2	1	2	2	7	3	2	1	1	22
Public builder	0	0	0	0	1	0	2	0	1	2	0	6
Total	**0**	**1**	**2**	**1**	**3**	**2**	**9**	**3**	**3**	**3**	**1**	**28**





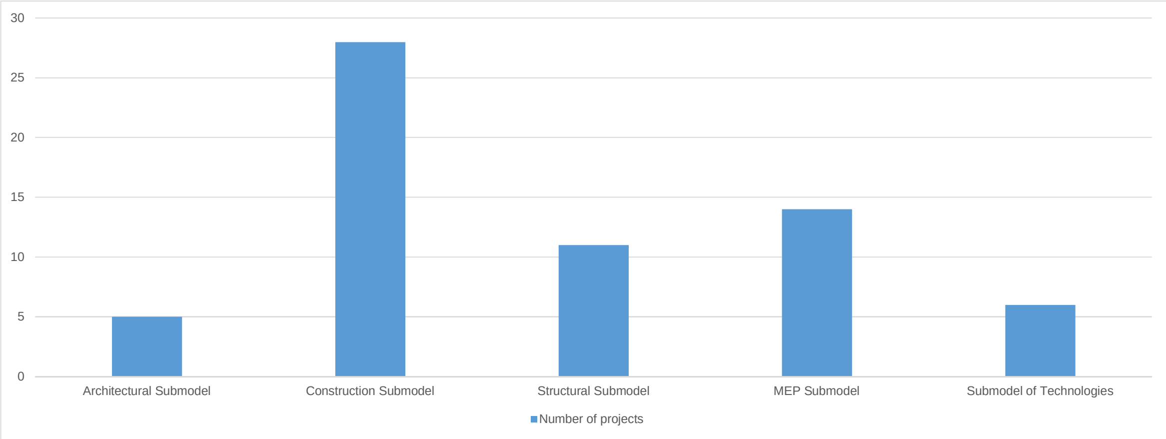


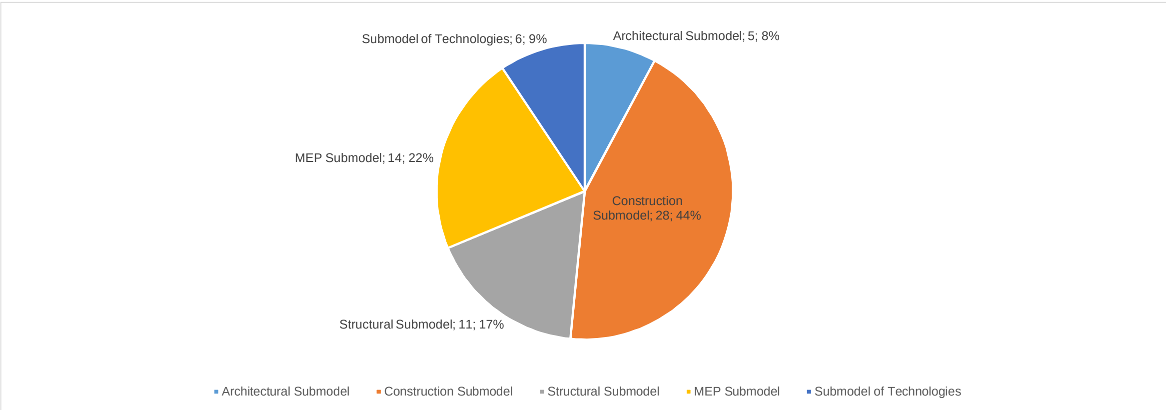
2. BIM Projects:
2.6. Use of the Submodels

Serial No.	Project No.	Project Code	Project Name	Architectural Submodel	Construction Submodel	Structural Submodel	MEP Submodel	Submodel of Technologies
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	0	1	0	0	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	0	1	0	0	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	0	1	1	1	1
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0	1	0	0	0
5.	15-004	GATE	High School "Open Gate II", Prague 6	0	1	0	0	0
6.	15-024	NSCH	Elementary School, Chýně	0	1	1	1	0
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0	1	0	0	0
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0	1	0	0	0
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0	1	0	1	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	0	1	0	0	0
11.	17-007	HOHO	Residential Building, Prague 5	0	1	1	1	0
12.	17-012	RRMV	Residential Project "Relax", Prague 5	1	1	0	0	0
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	0	1	0	0	0
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0	1	0	0	0
15.	17-021	KOBR	Residential Building, Prague 5	0	1	1	1	0
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0	1	0	0	0
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	1	1	0	1	0
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	0	1	1	1	1
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1	1	1	1	1
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0	1	0	0	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	0	1	1	1	1
22.	19-024	JIHL	Multifunctional Arena, Jihlava	1	1	1	1	1
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	0	1	0	0	0
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	0	1	1	1	1
25.	20-005	LAN2	Office Building "Landmark 2", Brno	0	1	0	1	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	1	1	1	0	0
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	0	1	0	1	0
28.	21-002	HORN	Mixed Use Centre, Prague 10	0	1	1	1	0
64			**Total number of submodels**	**5**	**28**	**11**	**14**	**6**
100%			**% split of submodels**	**8%**	**44%**	**17%**	**22%**	**9%**

2. BIM Projects:
2.6. Use of the Submodels

	Architectural Submodel	Construction Submodel	Structural Submodel	MEP Submodel	Submodel of Technologies
Number of projects	5	28	11	14	6
%	8%	44%	17%	22%	9%



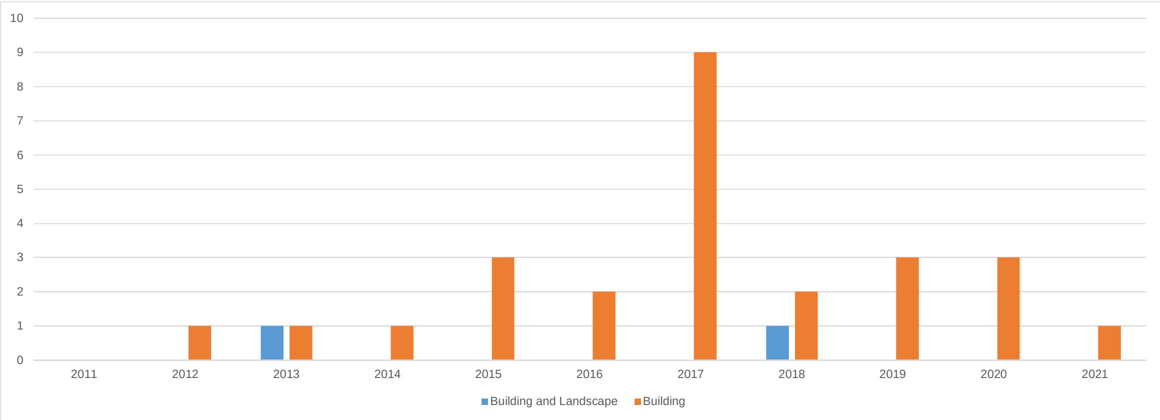


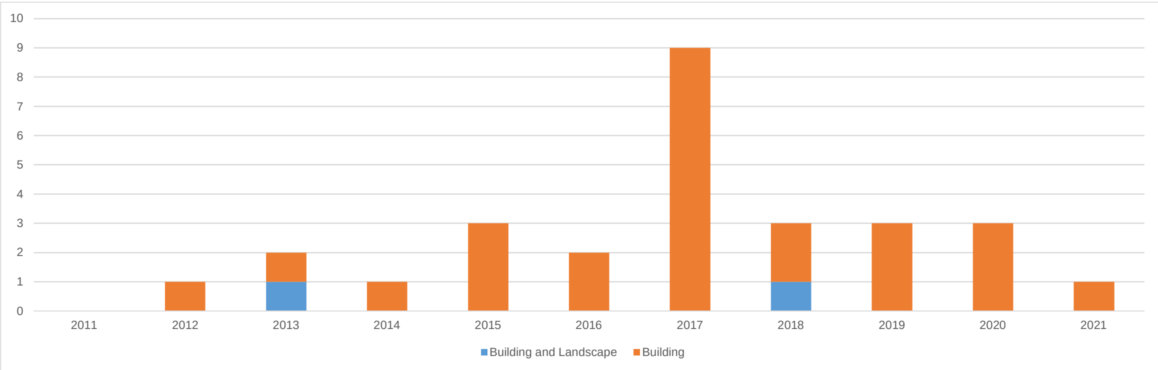
2. BIM Projects:
2.7. Modelling of Construction Objects

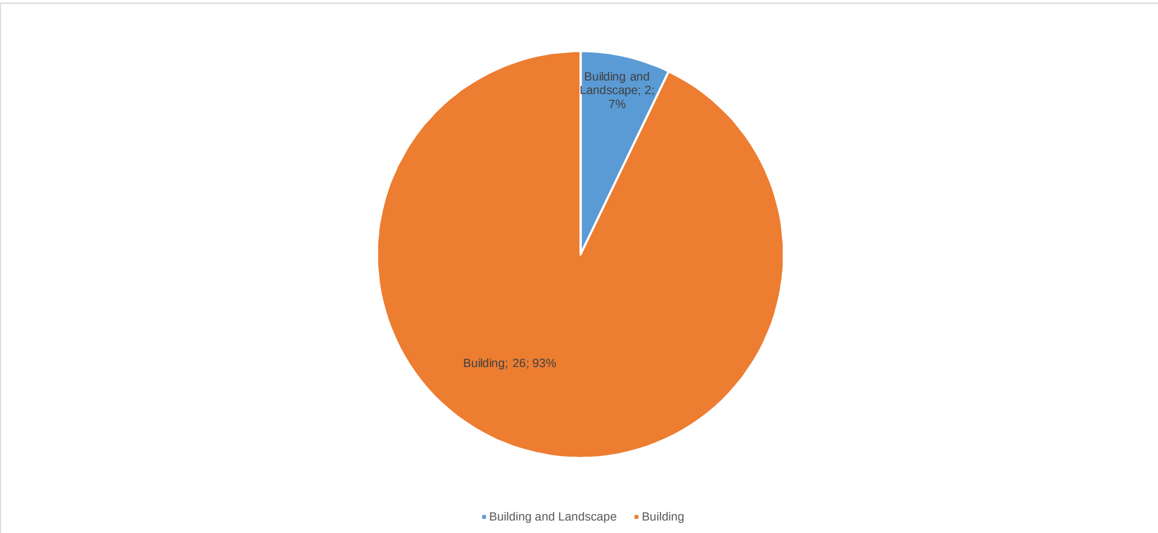
Serial No.	Project No.	Project Code	Project Name	Building and Landscape	Building
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	0	1
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	0	1
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	1	0
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0	1
5.	15-004	GATE	High School "Open Gate II", Prague 6	0	1
6.	15-024	NSCH	Elementary School, Chýně	0	1
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0	1
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0	1
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0	1
10.	17-003	DOBR	Apartment Buildings, Prague 16	0	1
11.	17-007	HOHO	Residential Building, Prague 5	0	1
12.	17-012	RRMV	Residential Project "Relax", Prague 5	0	1
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	0	1
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0	1
15.	17-021	KOBR	Residential Building, Prague 5	0	1
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0	1
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0	1
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	0	1
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1	0
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0	1
21.	18-017	ERA2	Office Building "ERA", Pardubice	0	1
22.	19-024	JIHL	Multifunctional Arena, Jihlava	0	1
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	0	1
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	0	1
25.	20-005	LAN2	Office Building "Landmark 2", Brno	0	1
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0	1
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	0	1
28.	21-002	HORN	Mixed Use Centre, Prague 10	0	1
28			**Total number of projects**	**2**	**26**
100%			**% split of projects**	**7%**	**93%**

2. BIM Projects:
2.7. Modelling of Construction Objects

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Building and Landscape	0	0	1	0	0	0	0	1	0	0	0	2
Building	0	1	1	1	3	2	9	2	3	3	1	26
Total	**0**	**1**	**2**	**1**	**3**	**2**	**9**	**3**	**3**	**3**	**1**	**28**





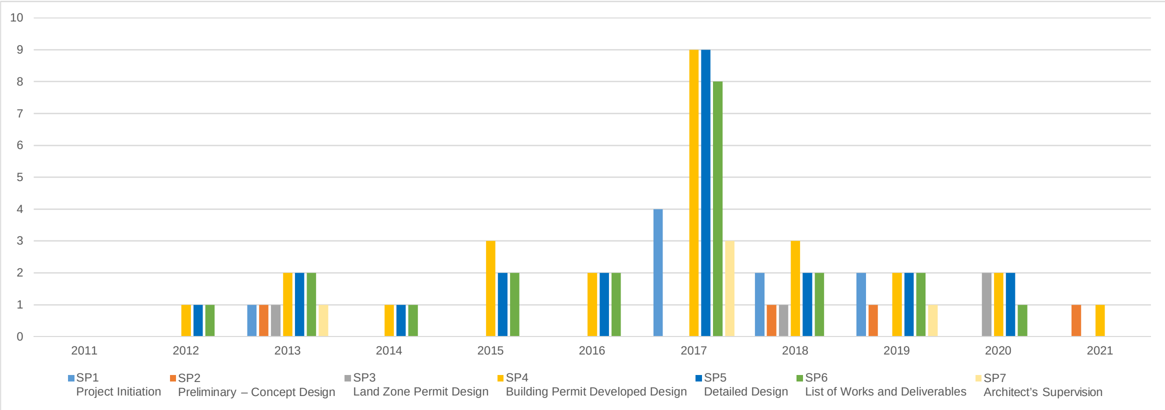


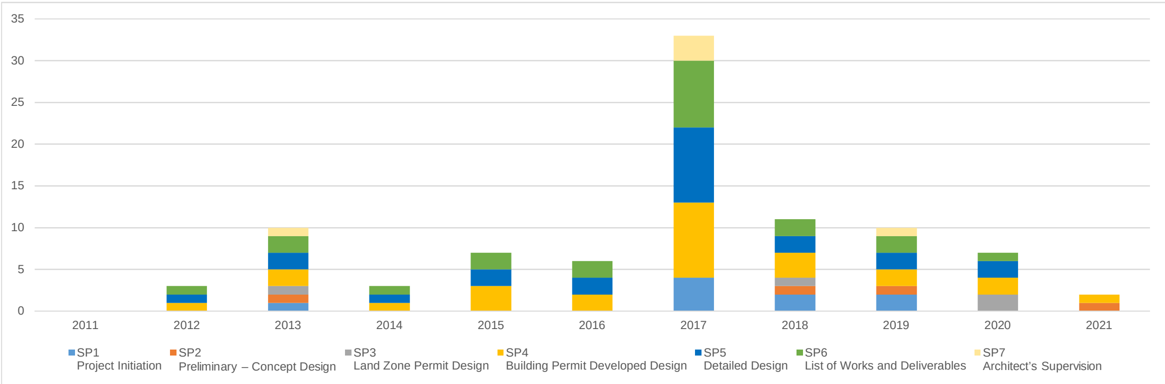
2. BIM Projects:
2.8. Service Phases Processed by the BIM method

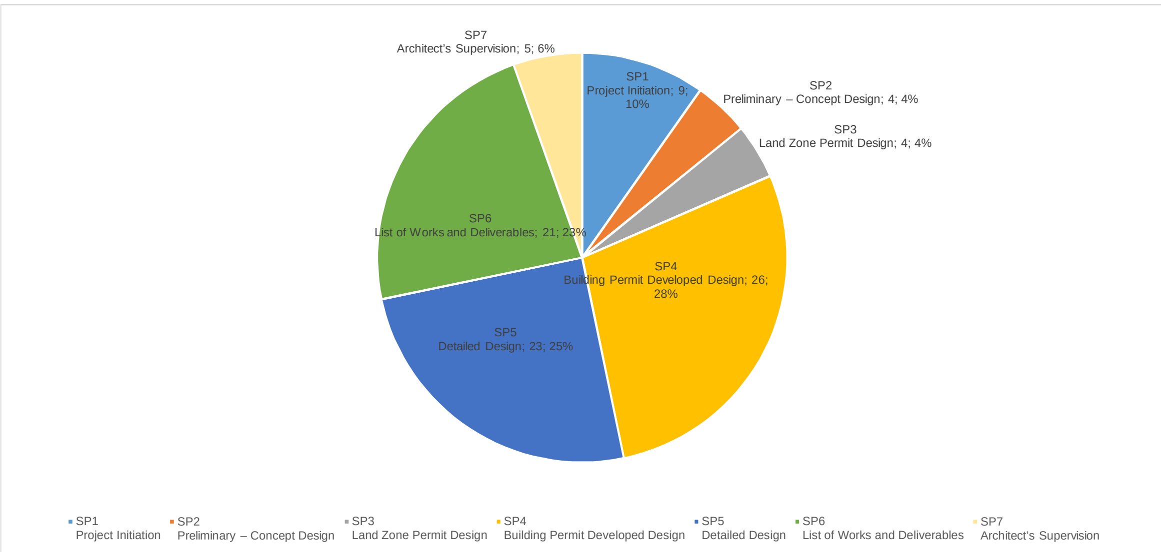
Serial No.	Project No.	Project Code	Project Name	SP1 Project Initiation	SP2 Preliminary – Concept Design	SP3 Land Zone Permit Design	SP4 Building Permit Developed Design	SP5 Detailed Design	SP6 List of Works and Deliverables	SP7 Architect's Supervision
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	0	0	0	1	1	1	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	0	0	0	1	1	1	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	1	1	1	1	1	1	1
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0	0	0	1	1	1	0
5.	15-004	GATE	High School "Open Gate II", Prague 6	0	0	0	1	0	0	0
6.	15-024	NSCH	Elementary School, Chýně	0	0	0	1	1	1	0
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0	0	0	1	1	1	0
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0	0	0	1	1	1	0
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0	0	0	1	1	1	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	0	0	0	1	1	1	0
11.	17-007	HOHO	Residential Building, Prague 5	1	0	0	1	1	1	1
12.	17-012	RRMV	Residential Project "Relax", Prague 5	0	0	0	1	1	0	0
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	1	0	0	1	1	1	0
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0	0	0	1	1	1	0
15.	17-021	KOBR	Residential Building, Prague 5	1	0	0	1	1	1	1
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0	0	0	1	1	1	0
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0	0	0	1	1	1	0
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	1	0	0	1		1	1
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1	1	1	1	1	1	0
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0	0	0	1	0	0	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	1	0	0	1	1	1	0
22.	19-024	JIHL	Multifunctional Arena, Jihlava	1	0	0	1	1	1	0
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	1	1	0	0	0	0	0
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	0	0	0	1	1	1	1
25.	20-005	LAN2	Office Building "Landmark 2", Brno	0	0	0	1	1	1	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0	0	1	0	0	0	0
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	0	0	1	1	1	0	0
28.	21-002	HORN	Mixed Use Centre, Prague 10	0	1	0	1	0	0	0
91			**Total number of phases**	**9**	**4**	**4**	**26**	**22**	**21**	**5**
100%			**% split of phases**	**10%**	**4%**	**4%**	**29%**	**24%**	**23%**	**5%**

2. BIM Projects:
2.8. Service Phases Processed by the BIM method

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
SP1 Project Initiation	0	0	1	0	0	0	4	2	2	0	0	9
SP2 Preliminary – Concept Design	0	0	1	0	0	0	0	1	1	0	1	4
SP3 Land Zone Permit Design	0	0	1	0	0	0	0	1	0	2	0	4
SP4 Building Permit Developed Design	0	1	2	1	3	2	9	3	2	2	1	26
SP5 Detailed Design	0	1	2	1	2	2	9	2	2	2	0	23
SP6 List of Works and Deliverables	0	1	2	1	2	2	8	2	2	1	0	21
SP7 Architect's Supervision	0	0	1	0	0	0	3	0	1	0	0	5
Total	**0**	**3**	**10**	**3**	**7**	**6**	**33**	**11**	**10**	**7**	**2**	**92**

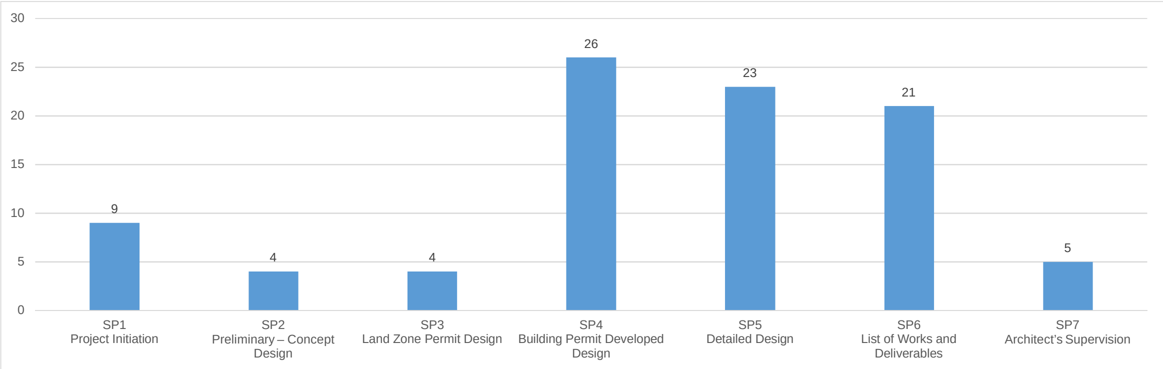






2. BIM Projects:
2.8. Service Phases Processed by the BIM method

	BIM execution	%	Total Number of Projects
SP1 Project Initiation	9	32%	28
SP2 Preliminary – Concept Design	4	14%	28
SP3 Land Zone Permit Design	4	14%	28
SP4 Building Permit Developed Design	26	93%	28
SP5 Detailed Design	23	82%	28
SP6 List of Works and Deliverables	21	75%	28
SP7 Architect's Supervision	5	18%	28
Total	**92**		**BIM execution**



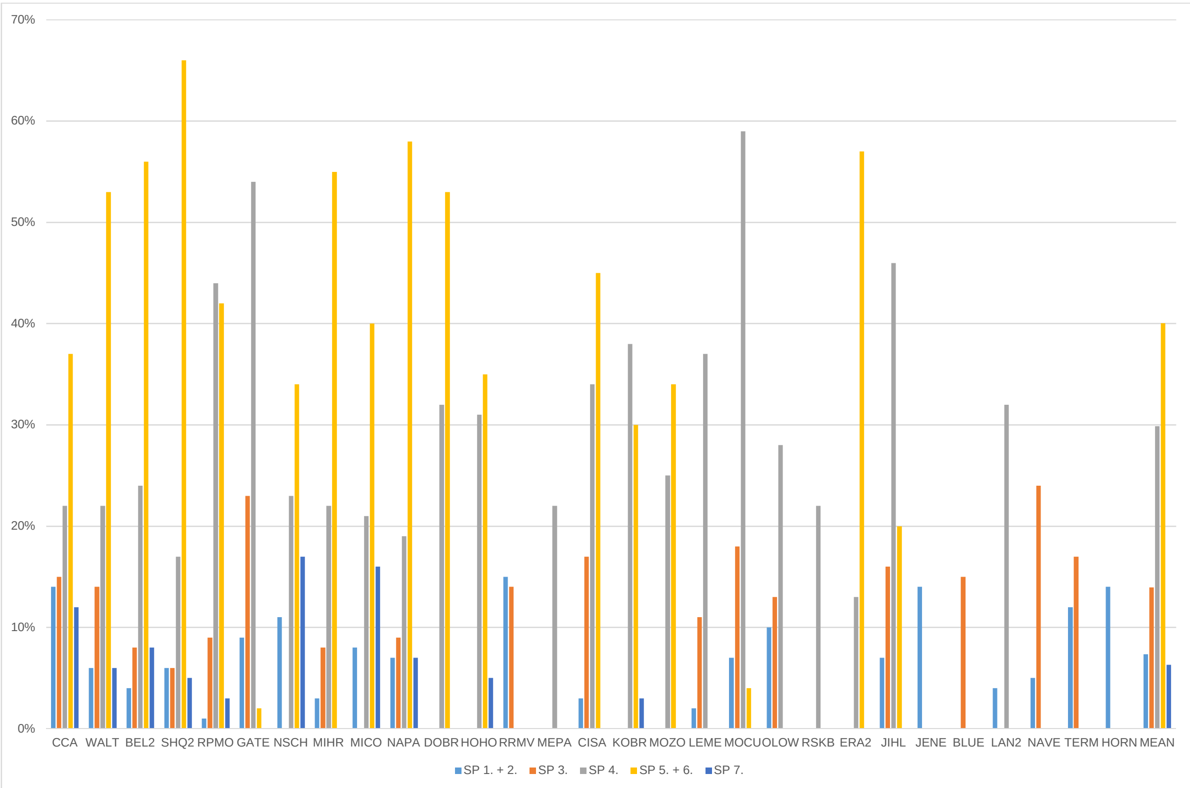
2. BIM Projects:
2.9. Relative Time Consumption of Individual Service Phases

Serial No.	Project No.	Project Code	Project Name	SP 1. + 2.	SP 3.	SP 4.	SP 5. + 6.	SP 7.	Total	*Addition*
				14%	*15%*	*22%*	*32%*	*17%*	*100%*	*hrs*
0.			**CCA**	***14%***	***15%***	***22%***	***37%***	***12%***	*100%*	
1.	**12-043**	**WALT**	**Residential project "Waltrovka", Prague 5**							
				1 431	3 385	5 417	13 177	1 368	24 778	*24 778*
			% acc. to CCA	*14%*	*15%*	*22%*	*37%*	*12%*	*100%*	
			% corrected to reality	***6%***	***14%***	***22%***	***53%***	***6%***	*100%*	
2.	**13-024**	**BEL2**	**Apartment Buildings "Belárie", Prague 12**							
				777	1 545	4 492	10 754	1 466	19 034	*19 034*
			% acc. to CCA	*14%*	*15%*	*22%*	*37%*	*12%*	*100%*	
			% corrected to reality	***4%***	***8%***	***24%***	***56%***	***8%***	*100%*	
3.	**13-062**	**SHQ2**	**South Headquarters of ČSOB - SHQ, Radlická, Prague 5**							
				5 576	5 184	15 524	59 423	4 142	89 849	*89 849*
			% acc. to CCA	*14%*	*15%*	*22%*	*37%*	*12%*	*100%*	
			% corrected to reality	***6%***	***6%***	***17%***	***66%***		*95%*	
4.	**14-006**	**RPMO**	**Residence Project "Zahálka", Prague 12**							
				298	2 007	9 576	9 232	649	21 762	*21 762*
			% acc. to CCA	*14%*	*15%*	*22%*	*37%*	*12%*	*100%*	
			% corrected to reality	***1%***	***9%***	***44%***	***42%***	***3%***	*100%*	
5.	**15-004**	**GATE**	**High School "Open Gate II", Prague 6**							
				670	1 729	4 100	126		6 625	*7 528*
			% acc. to CCA	*14%*	*15%*	*22%*	*37%*	*0%*	*88%*	
			% corrected to reality	***9%***	***23%***	***54%***	***2%***		*88%*	
6.	**15-024**	**NSCH**	**Elementary School, Chýně**							
				805	0	1 628	2 405	1 166	6 004	*7 064*
			% acc. to CCA	*14%*	*0%*	*22%*	*37%*	*12%*	*85%*	
			% corrected to reality	***11%***		***23%***	***34%***	***17%***	*85%*	
7.	**15-043**	**MIHR**	**Residential Villa Refurbishment, Prague 6**							
				109	288	816	2 014	0	3 227	*3 667*
			% acc. to CCA	*14%*	*15%*	*22%*	*37%*	*0%*	*88%*	
			% corrected to reality	***3%***	***8%***	***22%***	***55%***		*88%*	
8.	**16-020**	**MICO**	**Residentil Building Reconstruction "Vanguard", Prague 12**							
				1 411	0	3 635	7 053	2 911	15 010	*17 659*
			% acc. to CCA	*14%*	*0%*	*22%*	*37%*	*12%*	*85%*	
			% corrected to reality	***8%***		***21%***	***40%***	***16%***	*85%*	
9.	**16-029**	**NAPA**	**Residential Complex "Green Port + Silver Port", Prague 10**							
				1 093	1 376	2 981	9 215	1 161	15 826	*15 826*
			% acc. to CCA	*14%*	*15%*	*22%*	*37%*	*12%*	*100%*	
			% corrected to reality	***7%***	***9%***	***19%***	***58%***	***7%***	*100%*	
10.	**17-003**	**DOBR**	**Apartment Buildings, Prague 16**							
				6	0	772	1 282	11	2 071	*2 436*
			% acc. to CCA	*14%*	*0%*	*22%*	*37%*	*12%*	*85%*	
			% corrected to reality	***0%***		***32%***	***53%***	***0%***	*85%*	
11.	**17-007**	**HOHO**	**Residential Building, Prague 5**							
						1 349	1 507	197	3 053	*4 300*
			% acc. to CCA	*0%*	*0%*	*22%*	*37%*	*12%*	*71%*	
			% corrected to reality			***31%***	***35%***	***5%***	*71%*	
12.	**17-012**	**RRMV**	**Residential Project "Relax", Prague 5**							
				1 195	1 185				2 380	*8 207*
			% acc. to CCA	*14%*	*15%*	*0%*	*0%*	*0%*	*29%*	
			% corrected to reality	***15%***	***14%***				*29%*	
13.	**17-019**	**MEPA**	**Mixed Use Complex " Mendel Plaza", Brno**							
				0	0	14 994	0	0	14 994	*68 155*
			% acc. to CCA	*0%*	*0%*	*22%*	*0%*	*0%*	*22%*	
			% corrected to reality			***22%***			*22%*	
14.	**17-020**	**CISA**	**Residential Complex "Císařská Vinice", Prague 5**							
				338	1 841	3 713	4 929	36	10 857	*10 857*
			% acc. to CCA	*14%*	*15%*	*22%*	*37%*	*12%*	*100%*	
			% corrected to reality	***3%***	***17%***	***34%***	***45%***	***0%***	*100%*	
15.	**17-021**	**KOBR**	**Residential Building, Prague 5**							
				0	0	1 162	906	96	2 164	*3 048*
			% acc. to CCA	*0%*	*0%*	*22%*	*37%*	*12%*	*71%*	
			% corrected to reality			***38%***	***30%***	***3%***	*71%*	
16.	**17-022**	**MOZO**	**Accommodation House "ZOO Prague", Prague 7**							
				0	0	837	1 111	0	1 948	*3 302*
			% acc. to CCA	*0%*	*0%*	*22%*	*37%*	*0%*	*59%*	
			% corrected to reality			***25%***	***34%***		*59%*	

17.	**17-037**	**LEME**	**Pavilon "ZOO: Arctic - Polar Bears", Prague 7**							
				174	843	2 811	0	0	3 828	*7 506*
			% acc. to CCA	*14%*	*15%*	*22%*		*0%*	*51%*	
			% corrected to reality	***2%***	***11%***	***37%***			*51%*	
18.	**17-049**	**MOCU**	**Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12**							
				850	2 150	7 224	533	0	10 757	*12 224*
			% acc. to CCA	*14%*	*15%*	*22%*	*37%*	*0%*	*88%*	
			% corrected to reality	***7%***	***18%***	***59%***	***4%***		*88%*	
19.	**18-013**	**OLOW**	**Office Buildings "Smichov City South", Prague 5**							
				1 093	1 376	2 981	0	0	5 450	*10 686*
			% acc. to CCA	*14%*	*15%*	*22%*	*0%*	*0%*	*51%*	
			% corrected to reality	***10%***	***13%***	***28%***			*51%*	
20.	**18-015**	**RSKB**	**Office Building "Košířská brána", Prague 5**							
				0	0	1 339	0	0	1 339	*6 086*
			% acc. to CCA	*0%*	*0%*	*22%*	*0%*	*0%*	*22%*	
			% corrected to reality			***22%***			*22%*	
21.	**18-017**	**ERA2**	**Office Building "ERA", Pardubice**							
				0	0	1 438	6 119	28	7 585	*10 683*
			% acc. to CCA	*0%*	*0%*	*22%*	*37%*	*12%*	*71%*	
			% corrected to reality			***13%***	***57%***	***0%***	*71%*	
22.	**19-024**	**JIHL**	**Multifunctional Arena, Jihlava**							
				633	1 525	4 475	1 921	0	8 554	*9 720*
			% acc. to CCA	*14%*	*15%*	*22%*	*37%*	*0%*	*88%*	
			% corrected to reality	***7%***	***16%***	***46%***	***20%***		*88%*	
23.	**19-025**	**JENE**	**Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6**							
				1 054	0	0	0	0	1 054	*7 529*
			% acc. to CCA	*14%*	*0%*	*0%*	*0%*	*0%*	*14%*	
			% corrected to reality	***14%***					*14%*	
24.	**19-028**	**BLUE**	**Office Project "Blue Building", Prague 11**							
				0	1 376	0	0	0	1 376	*9 173*
			% acc. to CCA	*0%*	*15%*	*0%*	*0%*	*0%*	*15%*	
			% corrected to reality		***15%***				*15%*	
25.	**20-005**	**LAN2**	**Office Building "Landmark 2", Brno**							
				507	0	3 739	0	0	4 246	*11 794*
			% acc. to CCA	*14%*	*0%*	*22%*	*0%*	*0%*	*36%*	
			% corrected to reality	***4%***		***32%***			*36%*	
26.	**20-006**	**NAVE**	**Railway Station "Veleslavín", Prague 6**							
				333	1 579	0	0	0	1 912	*6 593*
			% acc. to CCA	*14%*	*15%*	*0%*	*0%*	*0%*	*29%*	
			% corrected to reality	***5%***	***24%***				*29%*	
27.	**20-013**	**TERM**	**Traffic Terminal "Smichov", Prague 5**							
				117	170	0	0	0	287	*990*
			% acc. to CCA	*14%*	*15%*	*0%*	*0%*	*0%*	*29%*	
			% corrected to reality	***12%***	***17%***				*29%*	
28.	**21-002**	**HORN**	**Mixed Use Centre, Prague 10**							
				1 093	0	0	0	0	1 093	*7 807*
			% acc. to CCA	*14%*	*0%*	*0%*	*0%*	*0%*	*14%*	
			% corrected to reality	***14%***					*14%*	

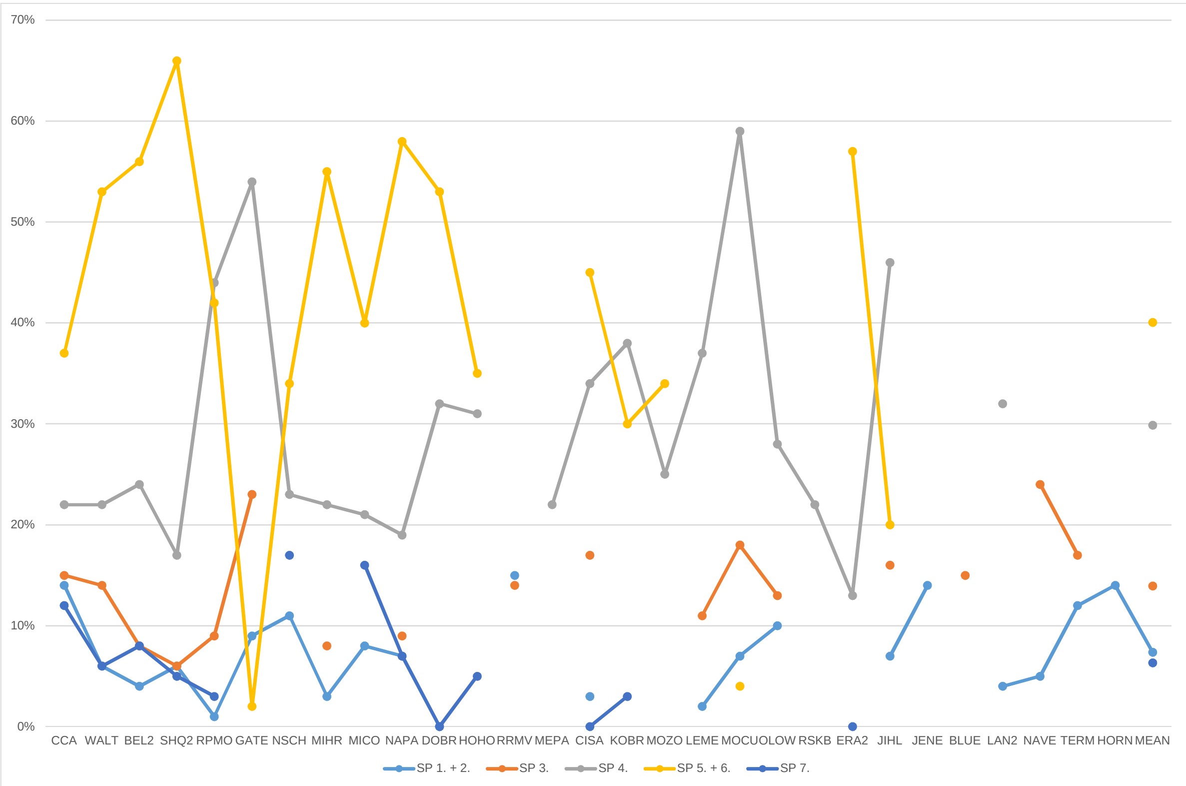
2. BIM Projects:
2.9. Relative Time Consumption of Individual Service Phases

Serial No.	Project No.	Project Code	SP 1. + 2.	SP 3.	SP 4.	SP 5. + 6.	SP 7.
		CCA	**14%**	**15%**	**22%**	**37%**	**12%**
1.	12-043	WALT	6%	14%	22%	53%	6%
2.	13-024	BEL2	4%	8%	24%	56%	8%
3.	13-062	SHQ2	6%	6%	17%	66%	5%
4.	14-006	RPMO	1%	9%	44%	42%	3%
5.	15-004	GATE	9%	23%	54%	2%	
6.	15-024	NSCH	11%		23%	34%	17%
7.	15-043	MIHR	3%	8%	22%	55%	
8.	16-020	MICO	8%		21%	40%	16%
9.	16-029	NAPA	7%	9%	19%	58%	7%
10.	17-003	DOBR	0%		32%	53%	0%
11.	17-007	HOHO			31%	35%	5%
12.	17-012	RRMV	15%	14%			
13.	17-019	MEPA			22%		
14.	17-020	CISA	3%	17%	34%	45%	0%
15.	17-021	KOBR			38%	30%	3%
16.	17-022	MOZO			25%	34%	
17.	17-037	LEME	2%	11%	37%		
18.	17-049	MOCU	7%	18%	59%	4%	
19.	18-013	OLOW	10%	13%	28%		
20.	18-015	RSKB			22%		
21.	18-017	ERA2			13%	57%	0%
22.	19-024	JIHL	7%	16%	46%	20%	
23.	19-025	JENE	14%				
24.	19-028	BLUE		15%			
25.	20-005	LAN2	4%		32%		
26.	20-006	NAVE	5%	24%			
27.	20-013	TERM	12%	17%			
28.	21-002	HORN	14%				
		MEAN	**7%**	**14%**	**30%**	**40%**	**6%**



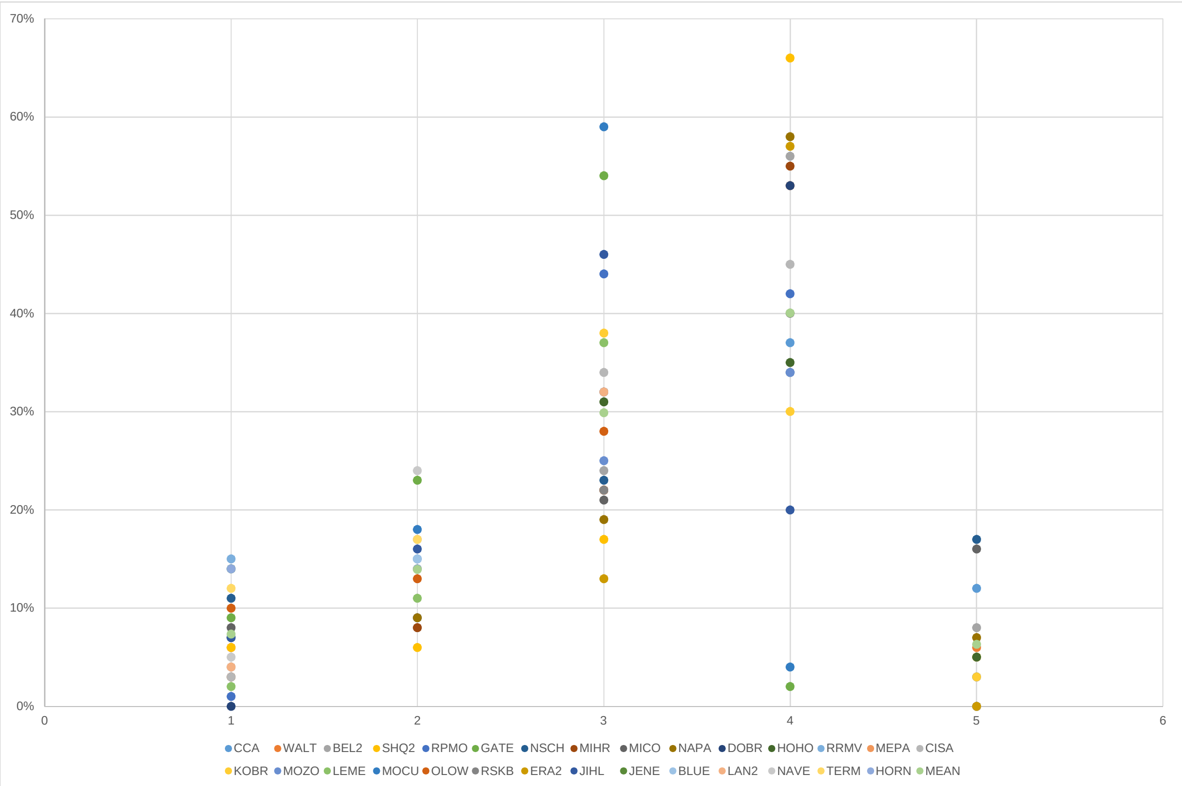
2. BIM Projects:
2.9. Relative Time Consumption of Individual Service Phases

Serial No.	Project No.	Project Code	SP 1. + 2.	SP 3.	SP 4.	SP 5. + 6.	SP 7.
		CCA	**14%**	**15%**	**22%**	**37%**	**12%**
1.	12-043	WALT	6%	14%	22%	53%	6%
2.	13-024	BEL2	4%	8%	24%	56%	8%
3.	13-062	SHQ2	6%	6%	17%	66%	5%
4.	14-006	RPMO	1%	9%	44%	42%	3%
5.	15-004	GATE	9%	23%	54%	2%	
6.	15-024	NSCH	11%		23%	34%	17%
7.	15-043	MIHR	3%	8%	22%	55%	
8.	16-020	MICO	8%		21%	40%	16%
9.	16-029	NAPA	7%	9%	19%	58%	7%
10.	17-003	DOBR	0%		32%	53%	0%
11.	17-007	HOHO			31%	35%	5%
12.	17-012	RRMV	15%	14%			
13.	17-019	MEPA			22%		
14.	17-020	CISA	3%	17%	34%	45%	0%
15.	17-021	KOBR			38%	30%	3%
16.	17-022	MOZO			25%	34%	
17.	17-037	LEME	2%	11%	37%		
18.	17-049	MOCU	7%	18%	59%	4%	
19.	18-013	OLOW	10%	13%	28%		
20.	18-015	RSKB			22%		
21.	18-017	ERA2			13%	57%	0%
22.	19-024	JIHL	7%	16%	46%	20%	
23.	19-025	JENE	14%				
24.	19-028	BLUE		15%			
25.	20-005	LAN2	4%		32%		
26.	20-006	NAVE	5%	24%			
27.	20-013	TERM	12%	17%			
28.	21-002	HORN	14%				
		MEAN	**7%**	**14%**	**30%**	**40%**	**6%**



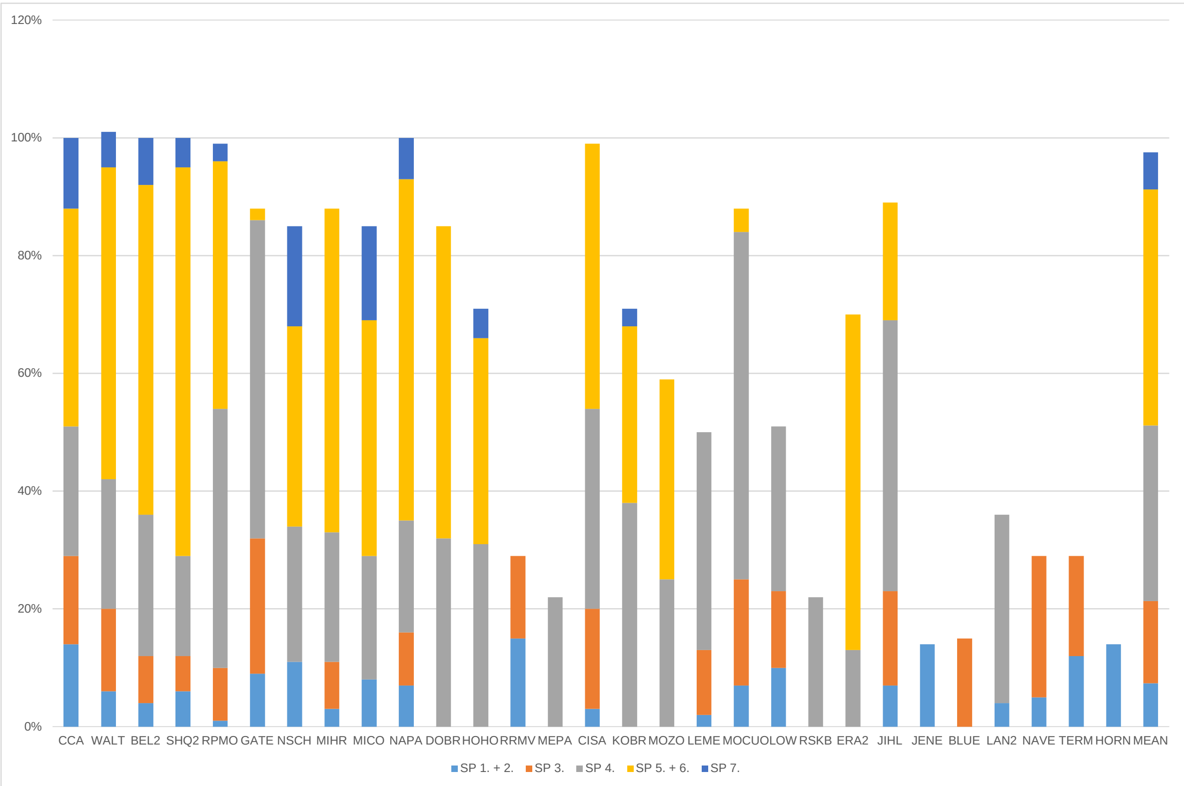
2. BIM Projects:
2.9. Relative Time Consumption of Individual Service Phases

Serial No.	Project No.	Project Code	SP 1. + 2.	SP 3.	SP 4.	SP 5. + 6.	SP 7.
		CCA	**14%**	**15%**	**22%**	**37%**	**12%**
1.	12-043	WALT	6%	14%	22%	53%	6%
2.	13-024	BEL2	4%	8%	24%	56%	8%
3.	13-062	SHQ2	6%	6%	17%	66%	5%
4.	14-006	RPMO	1%	9%	44%	42%	3%
5.	15-004	GATE	9%	23%	54%	2%	
6.	15-024	NSCH	11%		23%	34%	17%
7.	15-043	MIHR	3%	8%	22%	55%	
8.	16-020	MICO	8%		21%	40%	16%
9.	16-029	NAPA	7%	9%	19%	58%	7%
10.	17-003	DOBR	0%		32%	53%	0%
11.	17-007	HOHO			31%	35%	5%
12.	17-012	RRMV	15%	14%			
13.	17-019	MEPA			22%		
14.	17-020	CISA	3%	17%	34%	45%	0%
15.	17-021	KOBR			38%	30%	3%
16.	17-022	MOZO			25%	34%	
17.	17-037	LEME	2%	11%	37%		
18.	17-049	MOCU	7%	18%	59%	4%	
19.	18-013	OLOW	10%	13%	28%		
20.	18-015	RSKB			22%		
21.	18-017	ERA2			13%	57%	0%
22.	19-024	JIHL	7%	16%	46%	20%	
23.	19-025	JENE	14%				
24.	19-028	BLUE		15%			
25.	20-005	LAN2	4%		32%		
26.	20-006	NAVE	5%	24%			
27.	20-013	TERM	12%	17%			
28.	21-002	HORN	14%				
		MEAN	**7%**	**14%**	**30%**	**40%**	**6%**



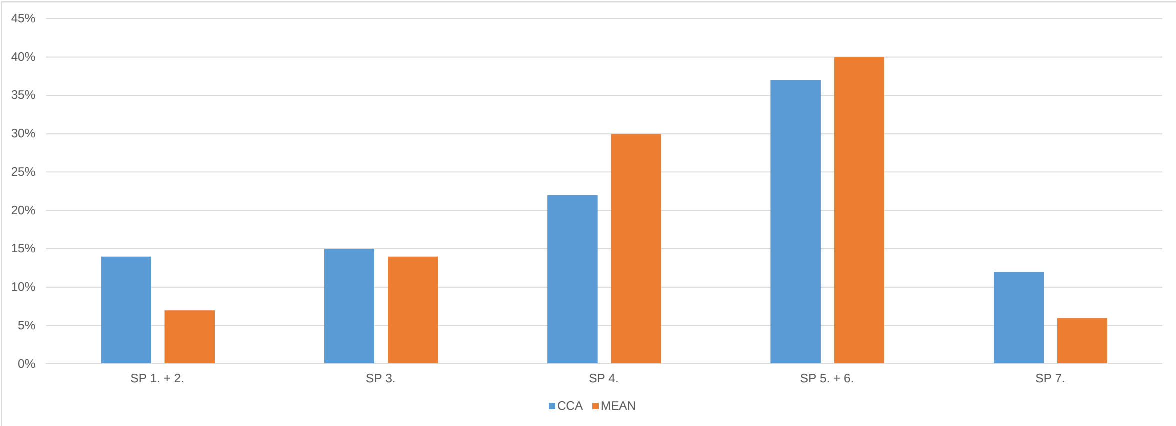
2. BIM Projects:
2.9. Relative Time Consumption of Individual Service Phases

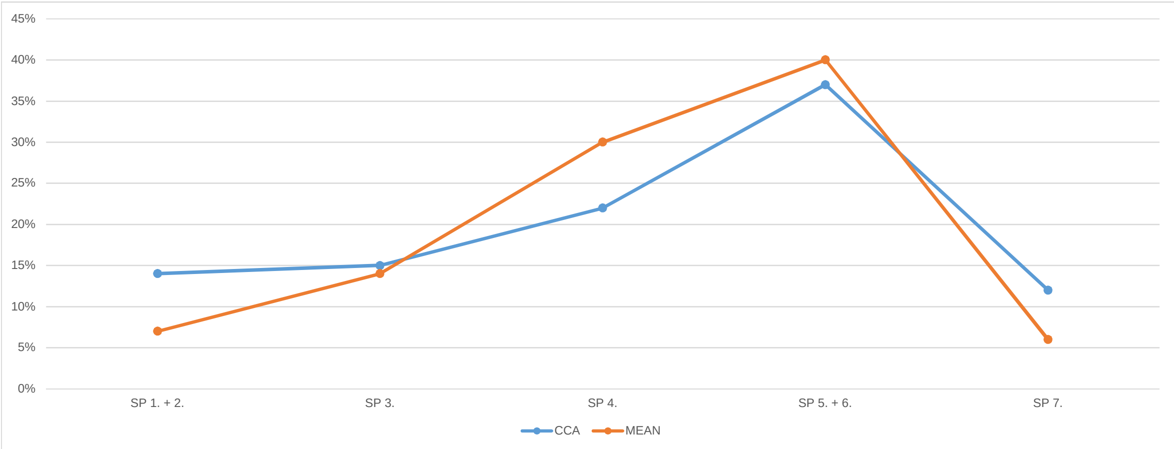
Serial No.	Project No.	Project Code	SP 1. + 2.	SP 3.	SP 4.	SP 5. + 6.	SP 7.
		CCA	**14%**	**15%**	**22%**	**37%**	**12%**
1.	12-043	WALT	6%	14%	22%	53%	6%
2.	13-024	BEL2	4%	8%	24%	56%	8%
3.	13-062	SHQ2	6%	6%	17%	66%	5%
4.	14-006	RPMO	1%	9%	44%	42%	3%
5.	15-004	GATE	9%	23%	54%	2%	
6.	15-024	NSCH	11%		23%	34%	17%
7.	15-043	MIHR	3%	8%	22%	55%	
8.	16-020	MICO	8%		21%	40%	16%
9.	16-029	NAPA	7%	9%	19%	58%	7%
10.	17-003	DOBR	0%		32%	53%	0%
11.	17-007	HOHO			31%	35%	5%
12.	17-012	RRMV	15%	14%			
13.	17-019	MEPA			22%		
14.	17-020	CISA	3%	17%	34%	45%	0%
15.	17-021	KOBR			38%	30%	3%
16.	17-022	MOZO			25%	34%	
17.	17-037	LEME	2%	11%	37%		
18.	17-049	MOCU	7%	18%	59%	4%	
19.	18-013	OLOW	10%	13%	28%		
20.	18-015	RSKB			22%		
21.	18-017	ERA2			13%	57%	0%
22.	19-024	JIHL	7%	16%	46%	20%	
23.	19-025	JENE	14%				
24.	19-028	BLUE		15%			
25.	20-005	LAN2	4%		32%		
26.	20-006	NAVE	5%	24%			
27.	20-013	TERM	12%	17%			
28.	21-002	HORN	14%				
		MEAN	**7%**	**14%**	**30%**	**40%**	**6%**



2. BIM Projects:
2.9. Relative Time Consumption of Individual Service Phases

	SP 1. + 2.	SP 3.	SP 4.	SP 5. + 6.	SP 7.
CCA	14%	15%	22%	37%	12%
MEAN	7%	14%	30%	40%	6%
DIFFERENCE	200%	107%	73%	93%	200%



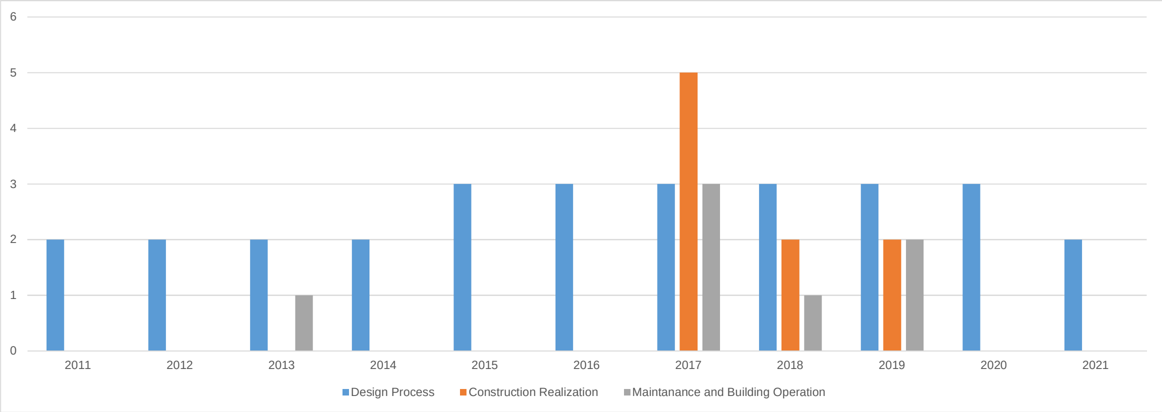


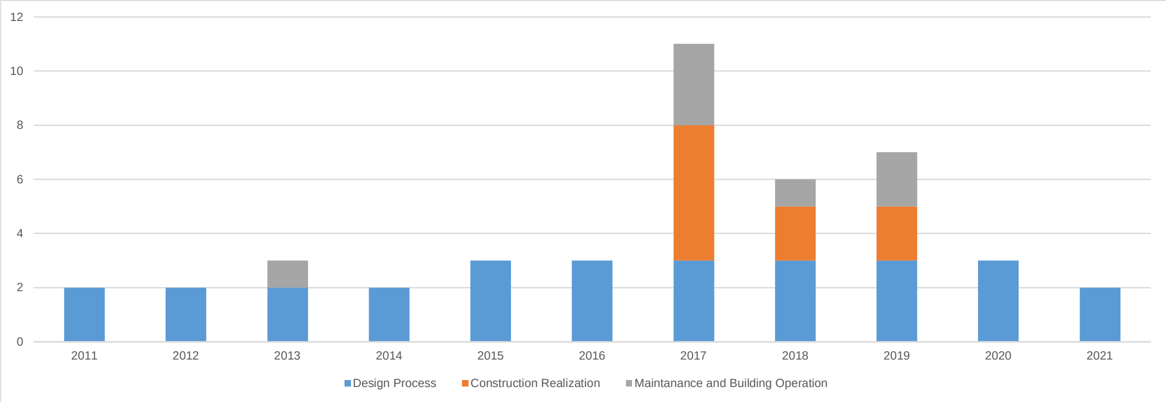
2. BIM Projects:
2.10. Reasons for Using BIM Method

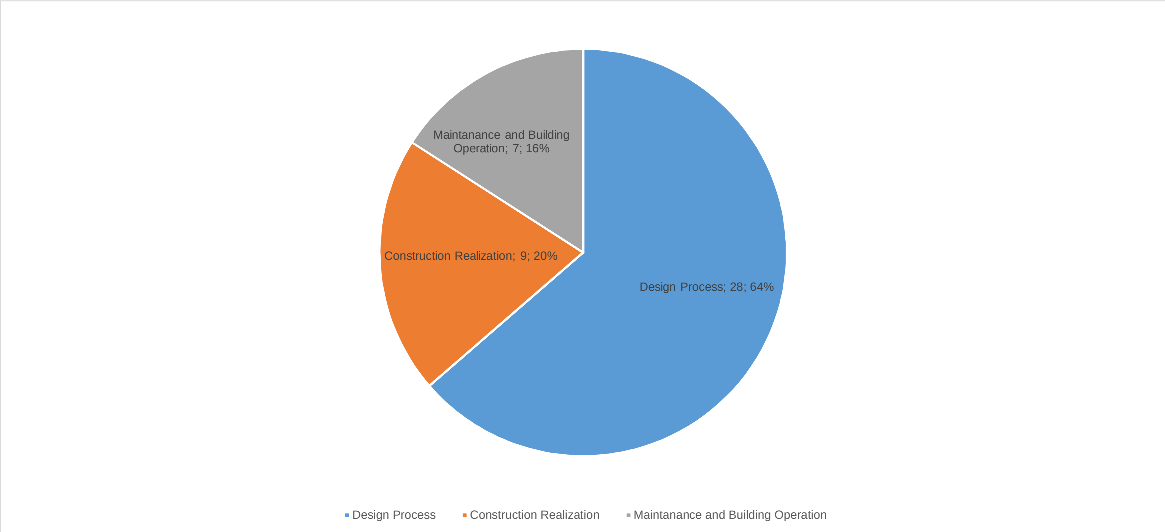
Serial No.	Project No.	Project Code	Project Name	Design Process	Construction Realization	Maintanance and Building
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	1	0	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	1	0	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	1	0	1
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	1	0	0
5.	15-004	GATE	High School "Open Gate II", Prague 6	1	0	0
6.	15-024	NSCH	Elementary School, Chýně	1	0	0
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	1	0	0
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	1	0	0
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	1	0	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	1	0	0
11.	17-007	HOHO	Residential Building, Prague 5	1	1	1
12.	17-012	RRMV	Residential Project "Relax", Prague 5	1	1	0
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	1	1	0
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	1	0	0
15.	17-021	KOBR	Residential Building, Prague 5	1	1	1
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	1	0	0
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	1	0	0
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	1	1	1
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1	1	1
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	1	0	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	1	1	0
22.	19-024	JIHL	Multifunctional Arena, Jihlava	1	1	1
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	1	0	0
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	1	1	1
25.	20-005	LAN2	Office Building "Landmark 2", Brno	1	0	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	1	0	0
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	1	0	0
28.	21-002	HORN	Mixed Use Centre, Prague 10	1	0	0
44			**Total number of reasons**	**28**	**9**	**7**
100%			**% split of reasons**	**64%**	**20%**	**16%**

2. BIM Projects:
2.10. Reasons for Using BIM Method

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Design Process	2	2	2	2	3	3	3	3	3	3	2	28
Construction Realization	0	0	0	0	0	0	5	2	2	0	0	9
Maintanance and Building Operation	0	0	1	0	0	0	3	1	2	0	0	7
Total	**2**	**2**	**3**	**2**	**3**	**3**	**11**	**6**	**7**	**3**	**2**	**44**





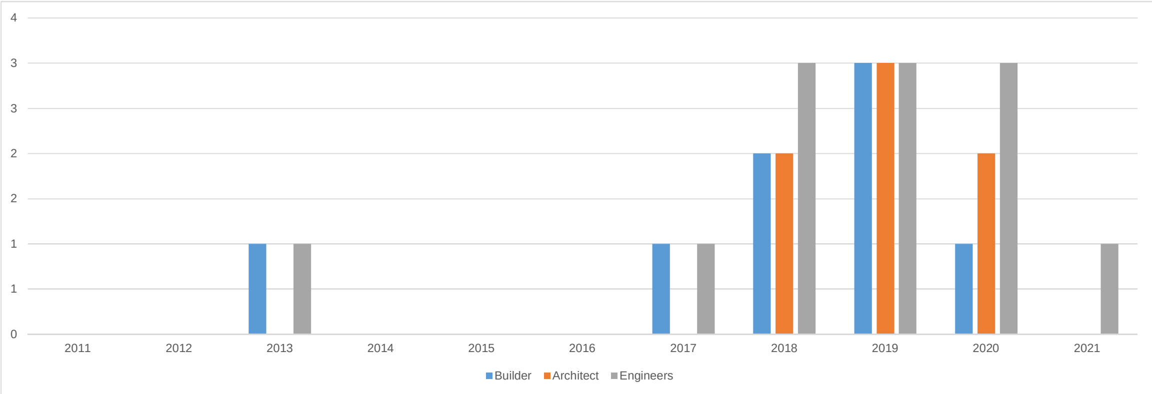


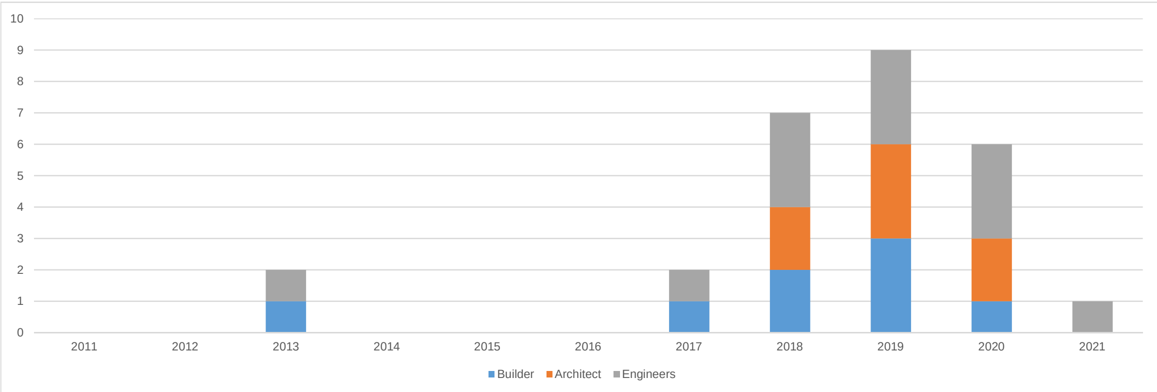
2. BIM Projects:
2.11. Use of the CDE by Construction Process Participants

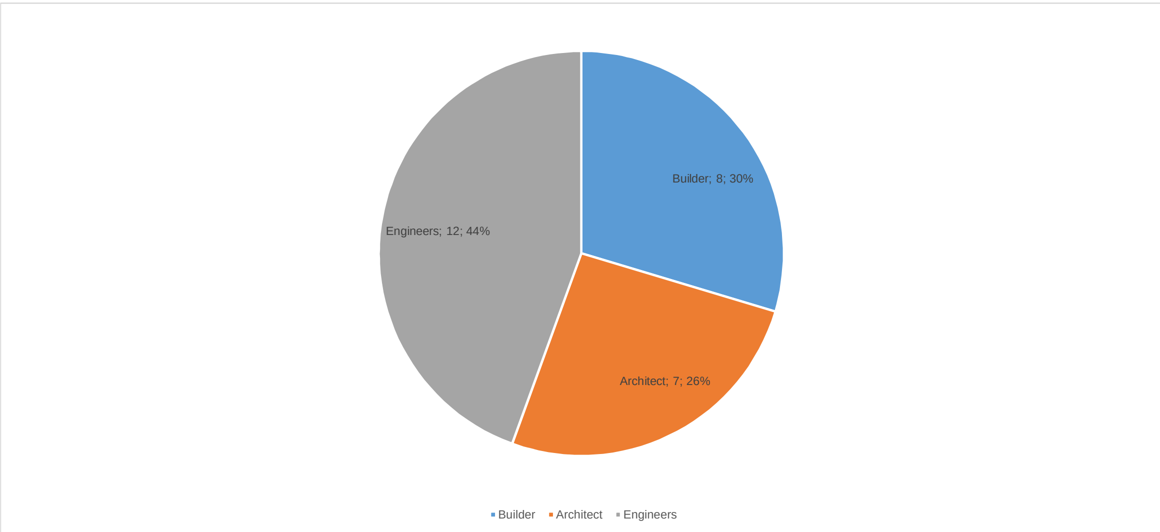
Serial No.	Project No.	Project Code	Project Name	Builder	Architect	Engineers
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	0	0	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	0	0	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	1	0	1
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0	0	0
5.	15-004	GATE	High School "Open Gate II", Prague 6	0	0	0
6.	15-024	NSCH	Elementary School, Chýně	0	0	0
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0	0	0
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0	0	0
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0	0	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	0	0	0
11.	17-007	HOHO	Residential Building, Prague 5	0	0	0
12.	17-012	RRMV	Residential Project "Relax", Prague 5	0	0	0
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	0	0	0
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0	0	0
15.	17-021	KOBR	Residential Building, Prague 5	0	0	0
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0	0	0
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0	0	0
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	1	0	1
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1	1	1
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0	0	1
21.	18-017	ERA2	Office Building "ERA", Pardubice	1	1	1
22.	19-024	JIHL	Multifunctional Arena, Jihlava	1	1	1
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	1	1	1
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	1	1	1
25.	20-005	LAN2	Office Building "Landmark 2", Brno	0	0	1
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0	1	1
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	1	1	1
28.	21-002	HORN	Mixed Use Centre, Prague 10	0	0	1
27			**Total number of uses**	**8**	**7**	**12**
100%			**% split of uses**	**30%**	**26%**	**44%**

2. BIM Projects:
2.11. Use of the CDE by Construction Process Participants

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Builder	0	0	1	0	0	0	1	2	3	1	0	8
Architect	0	0	0	0	0	0	0	2	3	2	0	7
Engineers	0	0	1	0	0	0	1	3	3	3	1	12
Total	**0**	**0**	**2**	**0**	**0**	**0**	**2**	**7**	**9**	**6**	**1**	**27**





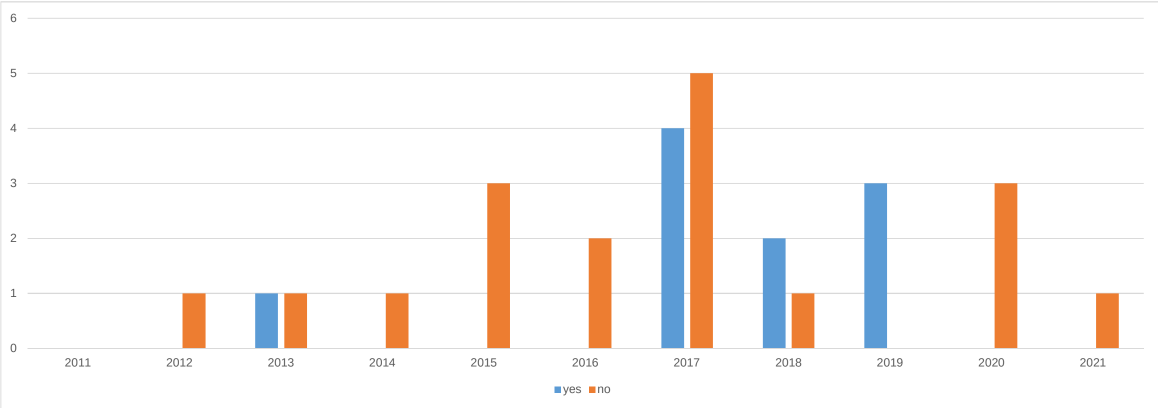


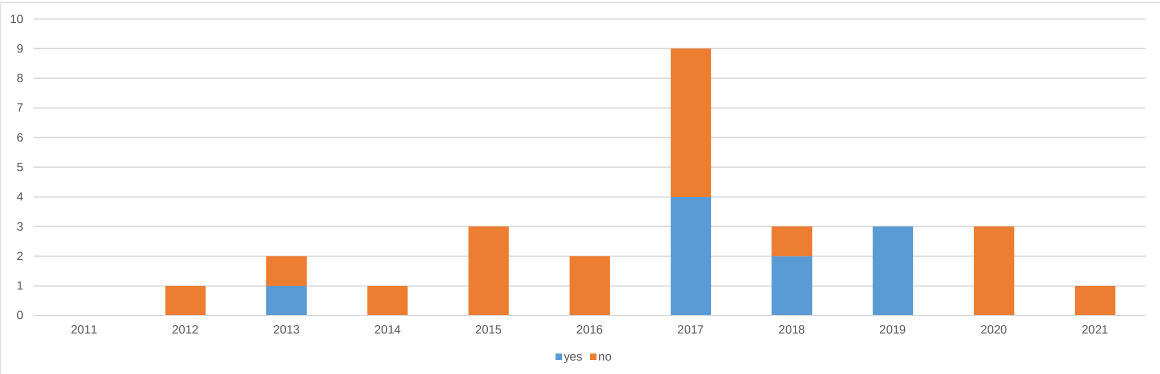
2. BIM Projects:
2.12. Requirement for BIM in Contract

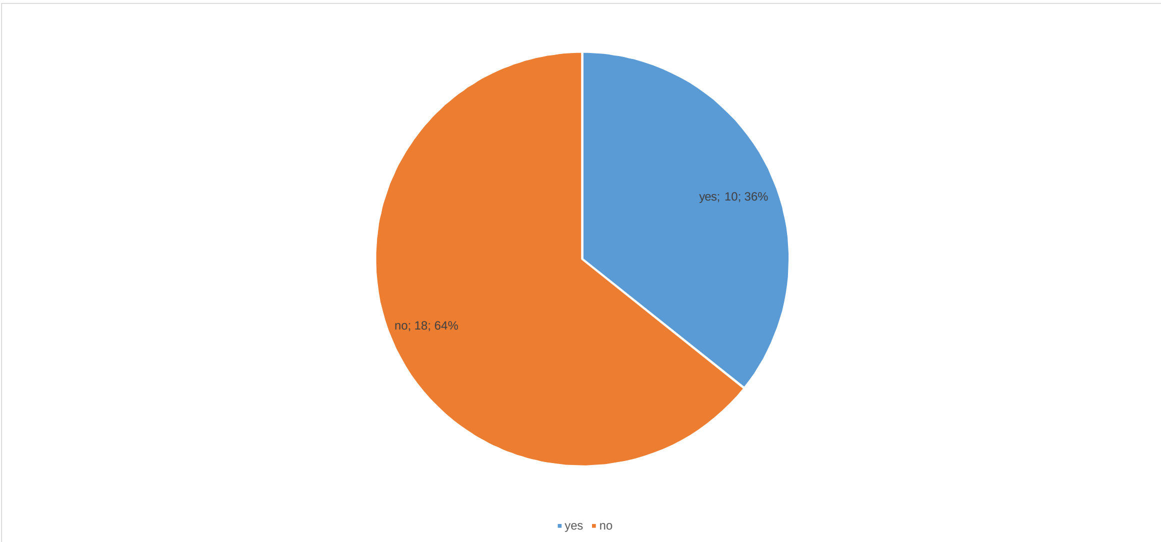
Serial No.	Project No.	Project Code	Project Name	yes / no
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	1
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0
5.	15-004	GATE	High School "Open Gate II", Prague 6	0
6.	15-024	NSCH	Elementary School, Chýně	0
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	0
11.	17-007	HOHO	Residential Building, Prague 5	1
12.	17-012	RRMV	Residential Project "Relax", Prague 5	0
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	1
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0
15.	17-021	KOBR	Residential Building, Prague 5	1
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	1
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	1
22.	19-024	JIHL	Multifunctional Arena, Jihlava	1
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	1
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	1
25.	20-005	LAN2	Office Building "Landmark 2", Brno	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	0
28.	21-002	HORN	Mixed Use Centre, Prague 10	0
28			**Total number of projects**	**10**
36%			**% split of projects**	**36%**

2. BIM Projects:
2.12. Requirement for BIM in Contract

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
yes	0	0	1	0	0	0	4	2	3	0	0	10
no	0	1	1	1	3	2	5	1	0	3	1	18
Total	**0**	**1**	**2**	**1**	**3**	**2**	**9**	**3**	**3**	**3**	**1**	**28**





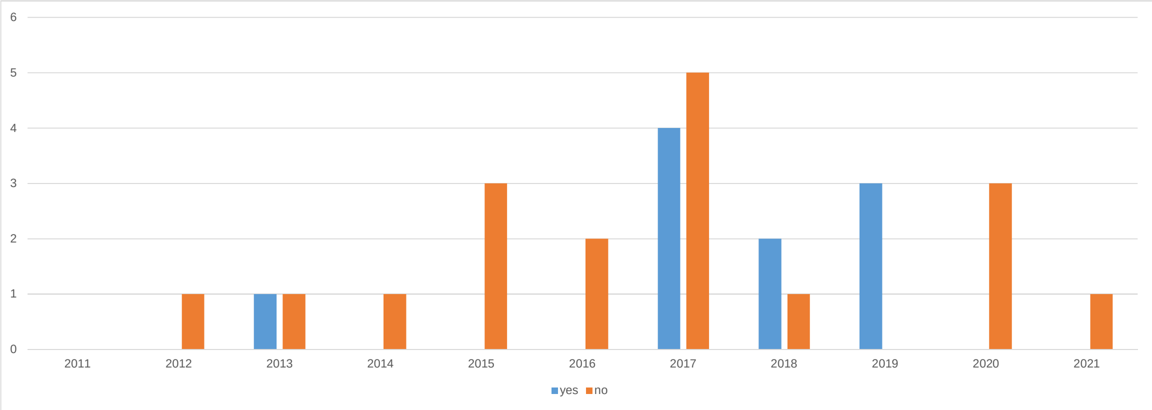


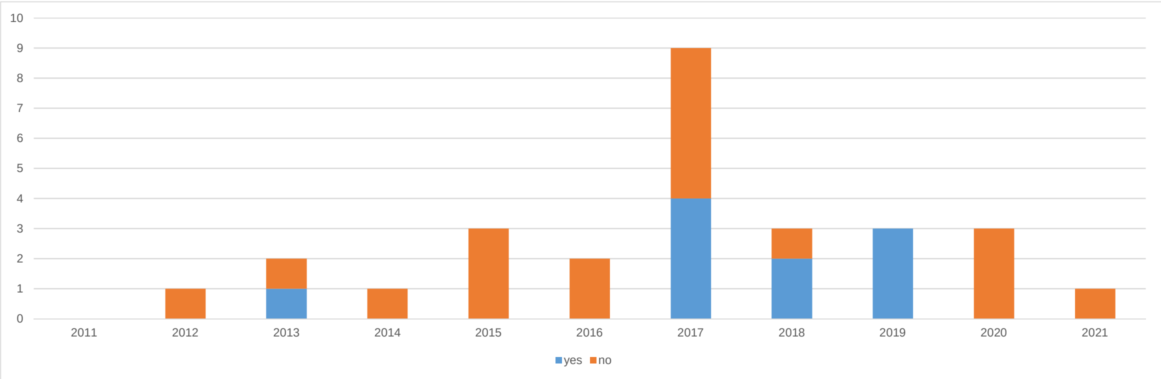
2. BIM Projects:
2.13. Builder's Ability to Define BIM Requirements

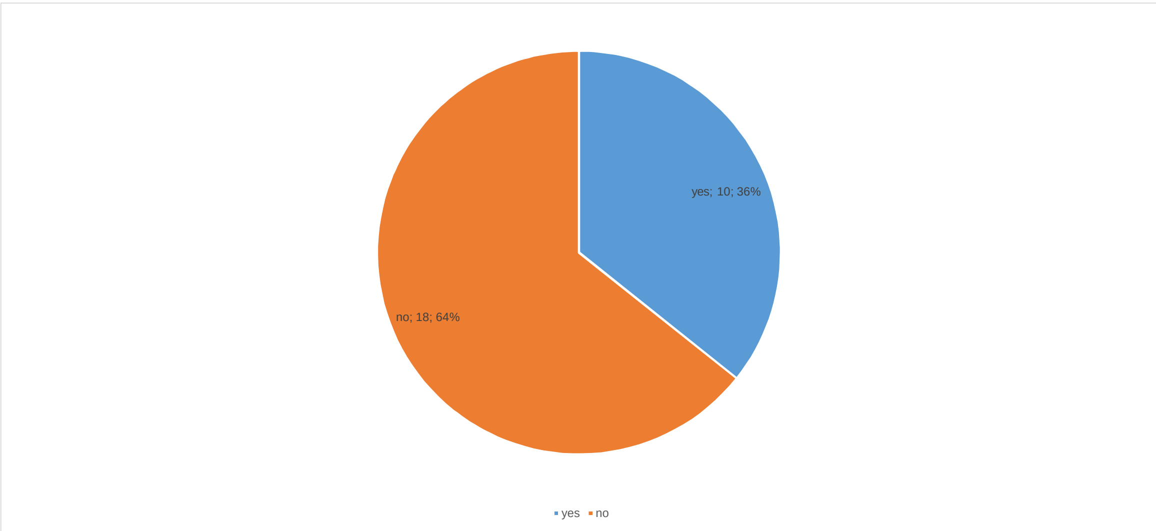
Serial No.	Project No.	Project Code	Project Name	yes / no
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	1
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0
5.	15-004	GATE	High School "Open Gate II", Prague 6	0
6.	15-024	NSCH	Elementary School, Chýně	0
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	0
11.	17-007	HOHO	Residential Building, Prague 5	1
12.	17-012	RRMV	Residential Project "Relax", Prague 5	0
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	1
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0
15.	17-021	KOBR	Residential Building, Prague 5	1
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	1
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	1
22.	19-024	JIHL	Multifunctional Arena, Jihlava	1
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	1
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	1
25.	20-005	LAN2	Office Building "Landmark 2", Brno	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	0
28.	21-002	HORN	Mixed Use Centre, Prague 10	0
28			**Total number of projects**	**10**
36%			**% split of projects**	**36%**

2. BIM Projects:
2.13. Client's Ability to Define BIM Requirements

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
yes	0	0	1	0	0	0	4	2	3	0	0	10
no	0	1	1	1	3	2	5	1	0	3	1	18
Total	**0**	**1**	**2**	**1**	**3**	**2**	**9**	**3**	**3**	**3**	**1**	**28**





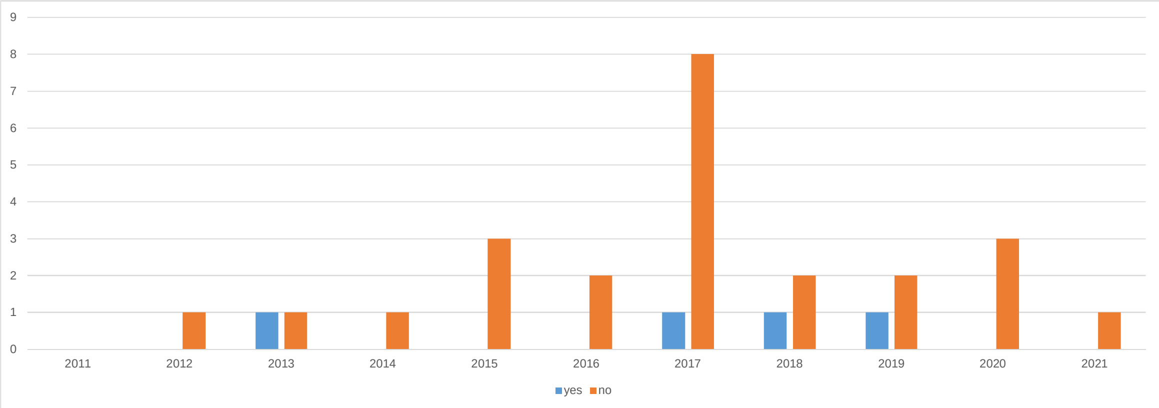


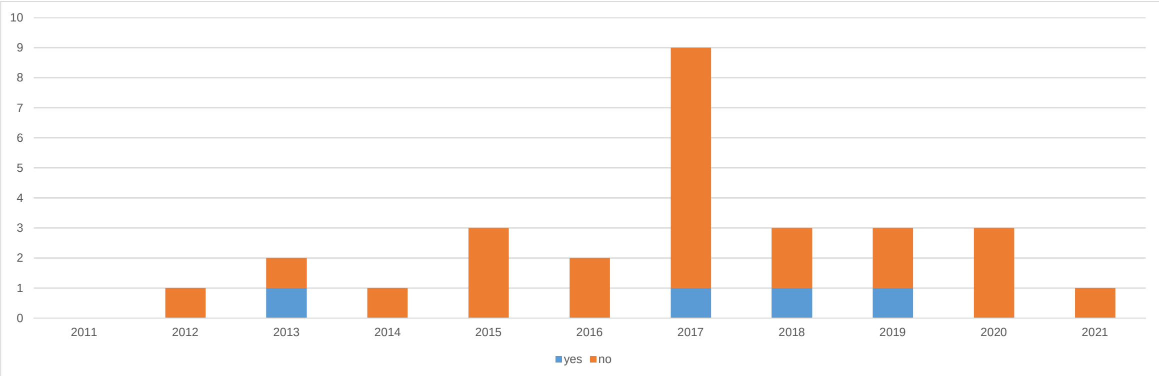
2. BIM Projects:
2.14. Construction Data Standard Defined in the Contract

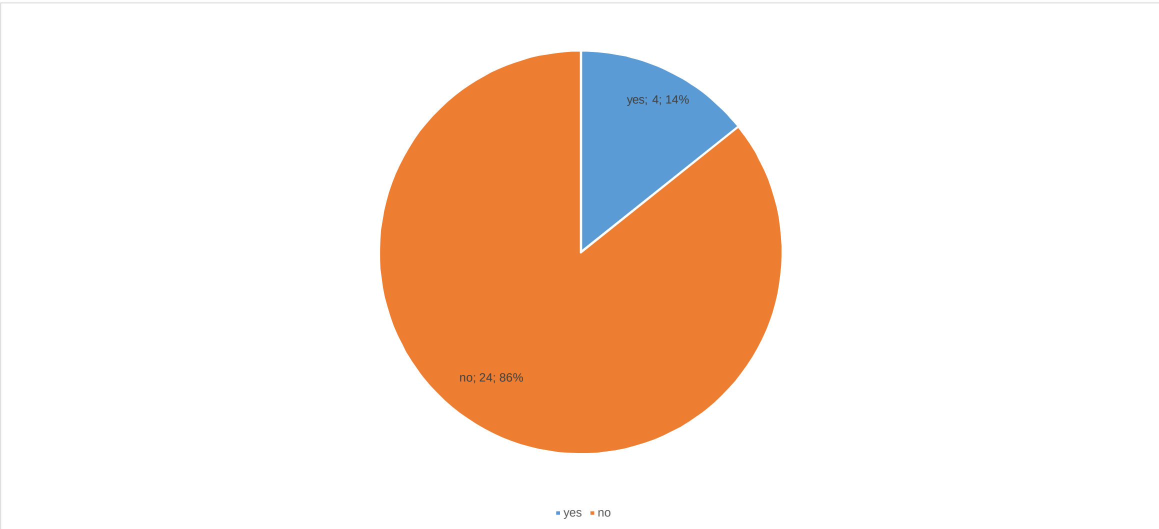
Serial No.	Project No.	Project Code	Project Name	yes / no
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	1
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0
5.	15-004	GATE	High School "Open Gate II", Prague 6	0
6.	15-024	NSCH	Elementary School, Chýně	0
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	0
11.	17-007	HOHO	Residential Building, Prague 5	0
12.	17-012	RRMV	Residential Project "Relax", Prague 5	0
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	0
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0
15.	17-021	KOBR	Residential Building, Prague 5	0
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	1
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	0
22.	19-024	JIHL	Multifunctional Arena, Jihlava	1
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	0
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	0
25.	20-005	LAN2	Office Building "Landmark 2", Brno	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	0
28.	21-002	HORN	Mixed Use Centre, Prague 10	0
28			**Total number of projects**	**4**
14%			**% split of projects**	**14%**

2. BIM Projects:
2.14. Construction Data Standard Defined in the Contract

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
yes	0	0	1	0	0	0	1	1	1	0	0	4
no	0	1	1	1	3	2	8	2	2	3	1	24
Total	**0**	**1**	**2**	**1**	**3**	**2**	**9**	**3**	**3**	**3**	**1**	**28**







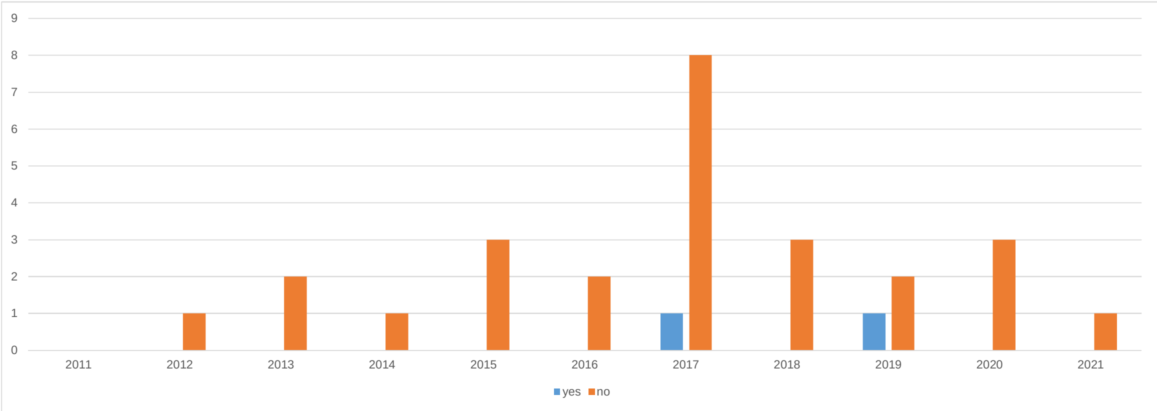
2. BIM Projects:
2.15. The Ability of the Builder to Establish and Operate CDE

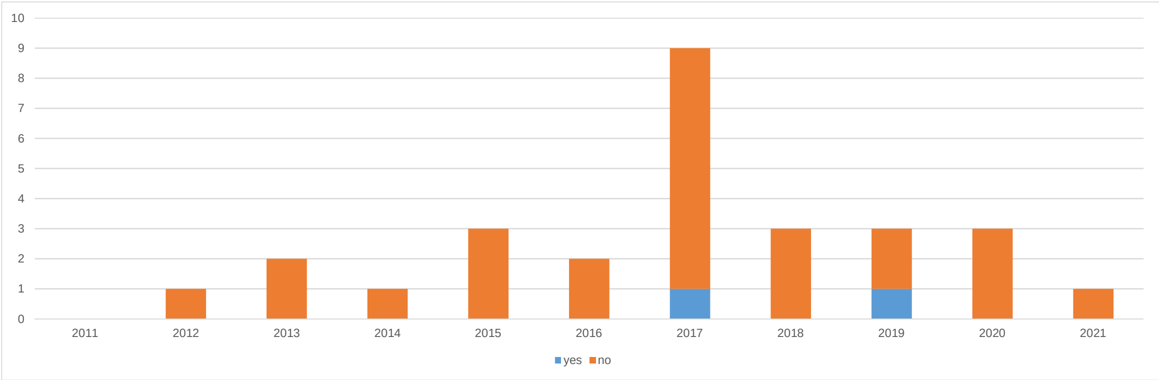
Serial No.	Project No.	Project Code	Project Name	yes / no
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	0
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0
5.	15-004	GATE	High School "Open Gate II", Prague 6	0
6.	15-024	NSCH	Elementary School, Chýně	0
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	0
11.	17-007	HOHO	Residential Building, Prague 5	0
12.	17-012	RRMV	Residential Project "Relax", Prague 5	0
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	0
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0
15.	17-021	KOBR	Residential Building, Prague 5	0
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	1
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	0
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	0
22.	19-024	JIHL	Multifunctional Arena, Jihlava	1
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	0
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	0
25.	20-005	LAN2	Office Building "Landmark 2", Brno	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	0
28.	21-002	HORN	Mixed Use Centre, Prague 10	0
28			**Total number of projects**	**2**
7%			**% split of projects**	**7%**

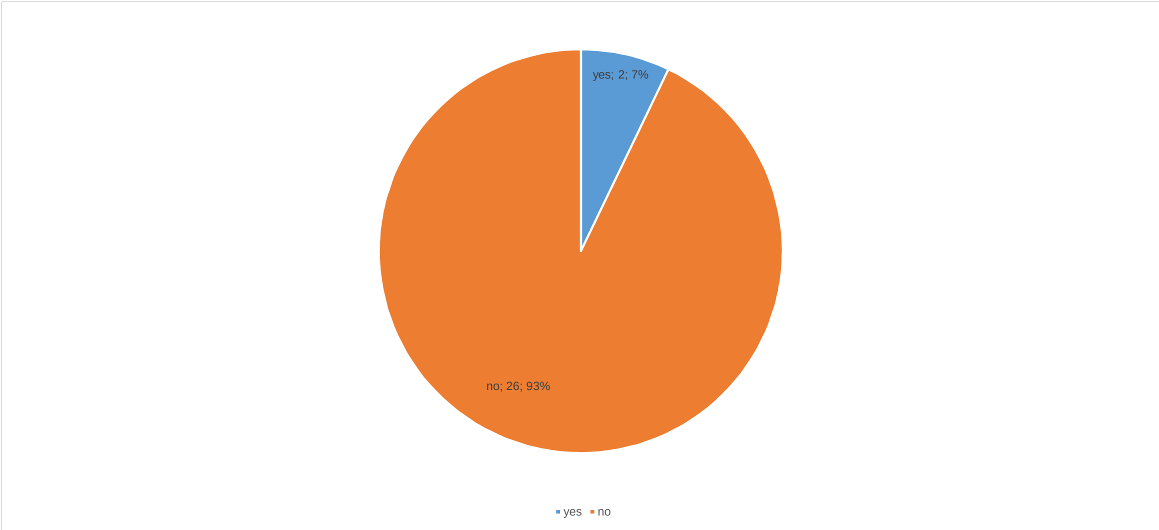
2. BIM Projects:

2.15. The Ability of the Builder to Establish and Operate CDE

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
yes	0	0	0	0	0	0	1	0	1	0	0	2
no	0	1	2	1	3	2	8	3	2	3	1	26
Total	**0**	**1**	**2**	**1**	**3**	**2**	**9**	**3**	**3**	**3**	**1**	**28**





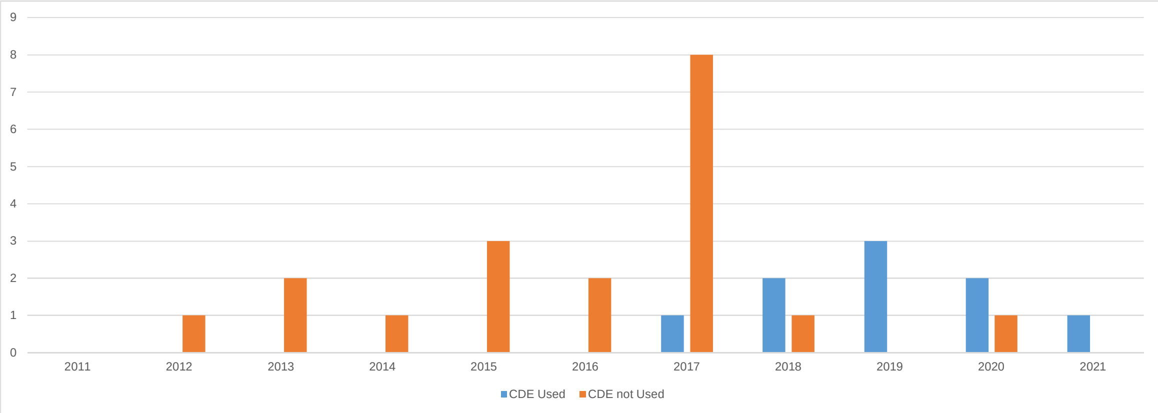


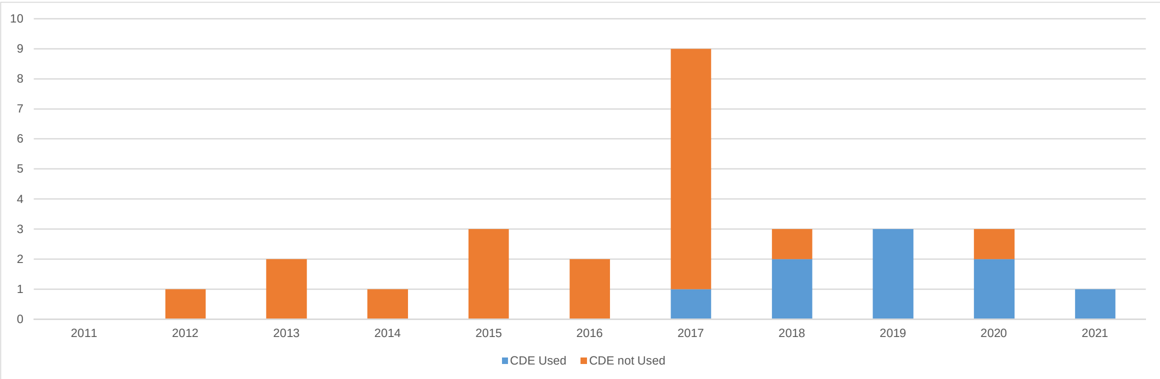
2. BIM Projects:
2.16. CDE Use

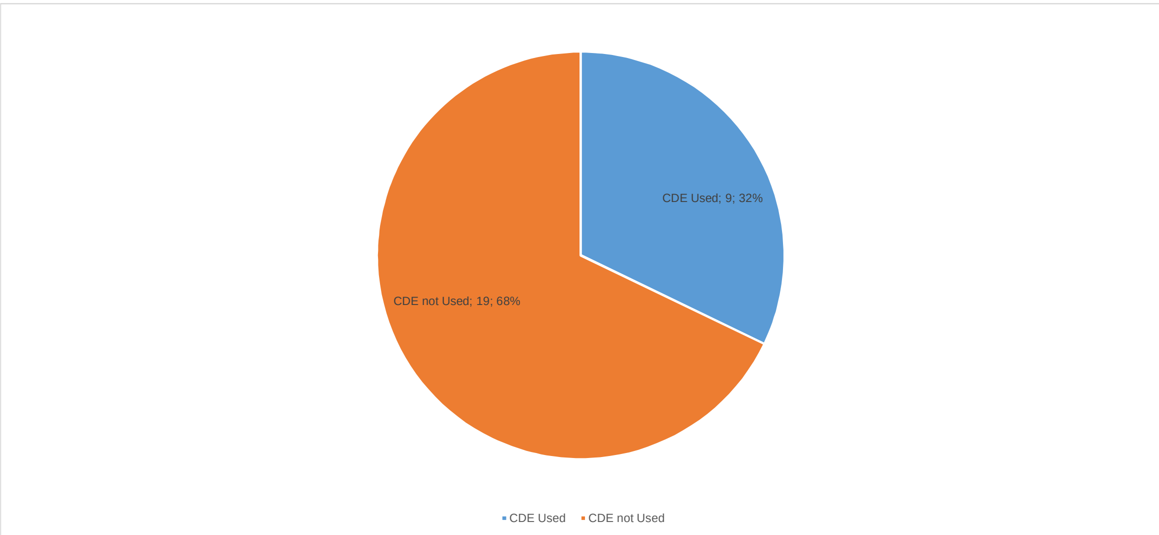
Serial No.	Project No.	Project Code	Project Name	CDE Used	CDE not Used
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	0	1
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	0	1
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	0	1
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	0	1
5.	15-004	GATE	High School "Open Gate II", Prague 6	0	1
6.	15-024	NSCH	Elementary School, Chýně	0	1
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	0	1
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0	1
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0	1
10.	17-003	DOBR	Apartment Buildings, Prague 16	0	1
11.	17-007	HOHO	Residential Building, Prague 5	0	1
12.	17-012	RRMV	Residential Project "Relax", Prague 5	0	1
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	0	1
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0	1
15.	17-021	KOBR	Residential Building, Prague 5	0	1
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0	1
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0	1
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	1	0
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1	0
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	1	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	0	1
22.	19-024	JIHL	Multifunctional Arena, Jihlava	1	0
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	1	0
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	1	0
25.	20-005	LAN2	Office Building "Landmark 2", Brno	1	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0	1
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	1	0
28.	21-002	HORN	Mixed Use Centre, Prague 10	1	0
28			**Total number of projects**	**9**	**19**
100%			**% split of projects**	**32%**	**68%**

2. BIM Projects:
2.16. CDE Use

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
CDE Used	0	0	0	0	0	0	1	2	3	2	1	9
CDE not Used	0	1	2	1	3	2	8	1	0	1	0	19
Total	**0**	**1**	**2**	**1**	**3**	**2**	**9**	**3**	**3**	**3**	**1**	**28**





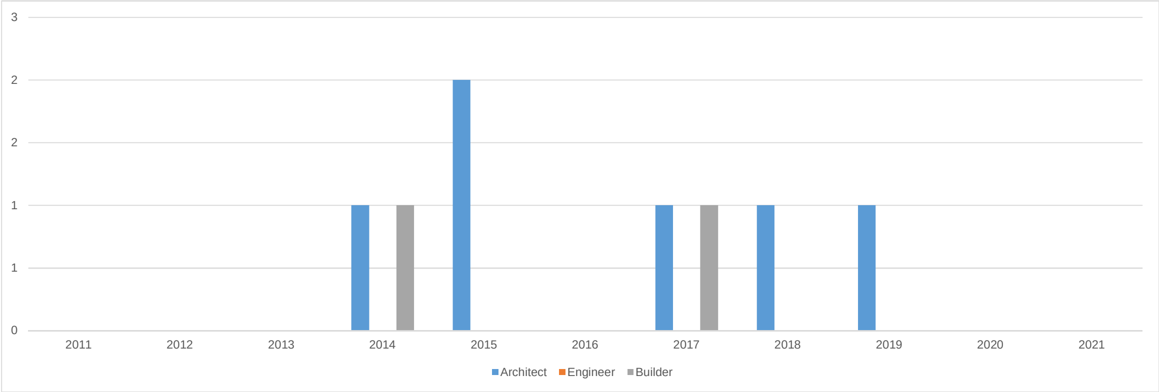


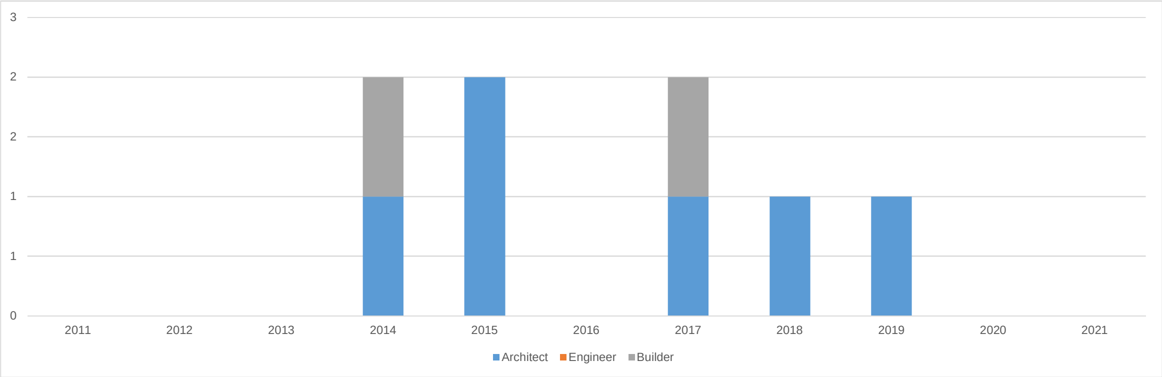
2. BIM Projects:
2.17. Completed International Cooperation

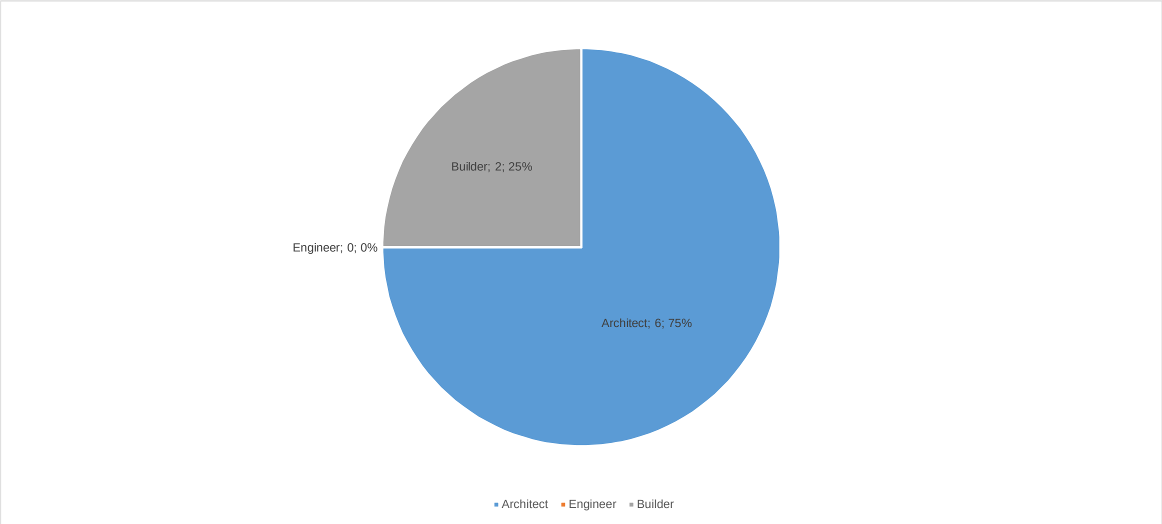
Serial No.	Project No.	Project Code	Project Name	Architect	Engineer	Builder
1.	12-043	WALT	Residential project "Waltrovka", Prague 5	0	0	0
2.	13-024	BEL2	Apartment Buildings "Belárie", Prague 12	0	0	0
3.	13-062	SHQ2	South Headquarters of ČSOB - SHQ, Radlická, Prague 5	0	0	0
4.	14-006	RPMO	Residence Project "Zahálka", Prague 12	1	0	1
5.	15-004	GATE	High School "Open Gate II", Prague 6	0	0	0
6.	15-024	NSCH	Elementary School, Chýně	1	0	0
7.	15-043	MIHR	Residential Villa Refurbishment, Prague 6	1	0	1
8.	16-020	MICO	Residentil Building Reconstruction "Vanguard", Prague 12	0	0	0
9.	16-029	NAPA	Residential Complex "Green Port + Silver Port", Prague 10	0	0	0
10.	17-003	DOBR	Apartment Buildings, Prague 16	0	0	0
11.	17-007	HOHO	Residential Building, Prague 5	0	0	0
12.	17-012	RRMV	Residential Project "Relax", Prague 5	1	0	0
13.	17-019	MEPA	Mixed Use Complex "Mendel Plaza", Brno	0	0	0
14.	17-020	CISA	Residential Complex "Císařská Vinice", Prague 5	0	0	0
15.	17-021	KOBR	Residential Building, Prague 5	0	0	0
16.	17-022	MOZO	Accommodation House "ZOO Prague", Prague 7	0	0	0
17.	17-037	LEME	Pavilon "ZOO: Arctic - Polar Bears", Prague 7	0	0	0
18.	17-049	MOCU	Residential and Mixed Use Complex "Modřanský cukrovar", Prague 12	0	0	0
19.	18-013	OLOW	Office Buildings "Smichov City South", Prague 5	1	0	0
20.	18-015	RSKB	Office Building "Košířská brána", Prague 5	0	0	0
21.	18-017	ERA2	Office Building "ERA", Pardubice	0	0	0
22.	19-024	JIHL	Multifunctional Arena, Jihlava	0	0	0
23.	19-025	JENE	Hotel Complex Reconstruction and Extension "Jenerálka", Prague 6	1	0	0
24.	19-028	BLUE	Office Project "Blue Building", Prague 11	0	0	0
25.	20-005	LAN2	Office Building "Landmark 2", Brno	0	0	0
26.	20-006	NAVE	Railway Station "Veleslavín", Prague 6	0	0	0
27.	20-013	TERM	Traffic Terminal "Smichov", Prague 5	0	0	0
28.	21-002	HORN	Mixed Use Centre, Prague 10	0	0	0
28			**Total number of projects**	**6**	**0**	**2**
29%			**% split of projects**	**21%**	**0%**	**7%**

2. BIM Projects:
2.17. Completed International Cooperation

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Architect	0	0	0	1	2	0	1	1	1	0	0	6
Engineer	0	0	0	0	0	0	0	0	0	0	0	0
Builder	0	0	0	1	0	0	1	0	0	0	0	2
Total	**0**	**0**	**0**	**2**	**2**	**0**	**2**	**1**	**1**	**0**	**0**	**8**







Annex B
Research Data and their Evaluation

2. Questionnaires

Annex B
Research Data and their Evaluation

2. Questionnaires

2.1. Architects

Questionnaire

Question #1

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

a. Yes
b. Rather yes
c. Rather not
d. No

Question #2

I consider BIM a helpful design tool:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #3

I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):

a. Yes
b. Rather yes
c. Rather not
d. No

Question #4

If BIM is used, architects must employ the BIM information model:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #5

If BIM is used, architects must also employ the CDE (common data environment):

a. Yes
b. Rather yes
c. Rather not
d. No

Question #6

The scope of a project does not matter if BIM is used:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #7

If the BIM method is used, the project typology does not matter:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #8

The BIM method suits the following project types:

a. residential
b. office
c. hotels
d. the type does not matter

Question #9

Indicate the project stages in which developing a digital building information model makes sense (tick according to your location):

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

AIA.0	Pre-Design
AIA.1	Schematic Design
AIA.2	Design Development
AIA.3	Construction Documents
AIA.4	Building Permitting
AIA.5	Bidding & Negotiation
AIA.6	Construction Administration

RIBA.0	Strategic Definition
RIBA.1	Preparation and Briefing
RIBA.2	Concept Design
RIBA.3	Spatial Coordination
RIBA.4	Technical Design
RIBA.5	Manufacturing and Construction
RIBA.6	Handover
RIBA.7	Use

Question #10

Indicate the project stages in which using the common data environment (CDE) makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

AIA.0	Pre-Design
AIA.1	Schematic Design
AIA.2	Design Development
AIA.3	Construction Documents
AIA.4	Building Permitting
AIA.5	Bidding & Negotiation
AIA.6	Construction Administration

RIBA.0	Strategic Definition
RIBA.1	Preparation and Briefing
RIBA.2	Concept Design
RIBA.3	Spatial Coordination
RIBA.4	Technical Design
RIBA.5	Manufacturing and Construction
RIBA.6	Handover
RIBA.7	Use

Question #11

Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #12

Indicate who must use the common data environment (CDE) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #13

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

a. project development
b. project development and construction
c. project development and construction, building operation
d. I do not know

Question #14

Using BIM, the information details in individual stages differ from those used in the conventional design process:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #15

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

a. Yes
b. Rather yes
c. Rather not
d. No

Question #16

Describe briefly, if you can, what fundamental data architects should provide in different design stages if using the BIM method:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

AIA.0	Pre-Design
AIA.1	Schematic Design
AIA.2	Design Development
AIA.3	Construction Documents
AIA.4	Building Permitting
AIA.5	Bidding & Negotiation
AIA.6	Construction Administration

RIBA.0	Strategic Definition
RIBA.1	Preparation and Briefing
RIBA.2	Concept Design
RIBA.3	Spatial Coordination
RIBA.4	Technical Design
RIBA.5	Manufacturing and Construction
RIBA.6	Handover
RIBA.7	Use

Question #17

I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).

a. Yes
b. Rather yes
c. Rather not
d. No

Question #18

Describe, if you can, the basic requirements on architects' work briefly if employing the BIM design method:

Question #19

Describe the basic benefits of architects' use of the BIM design method briefly if you can:

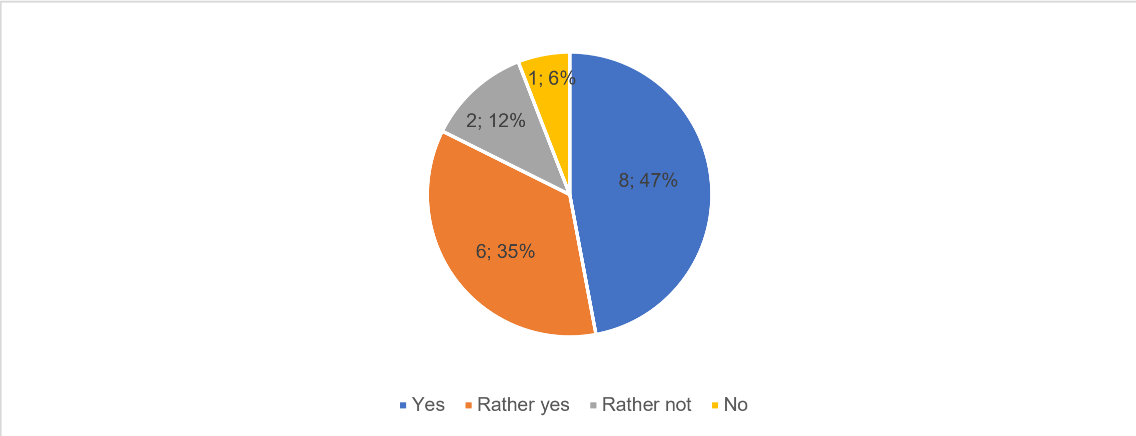
Question #20

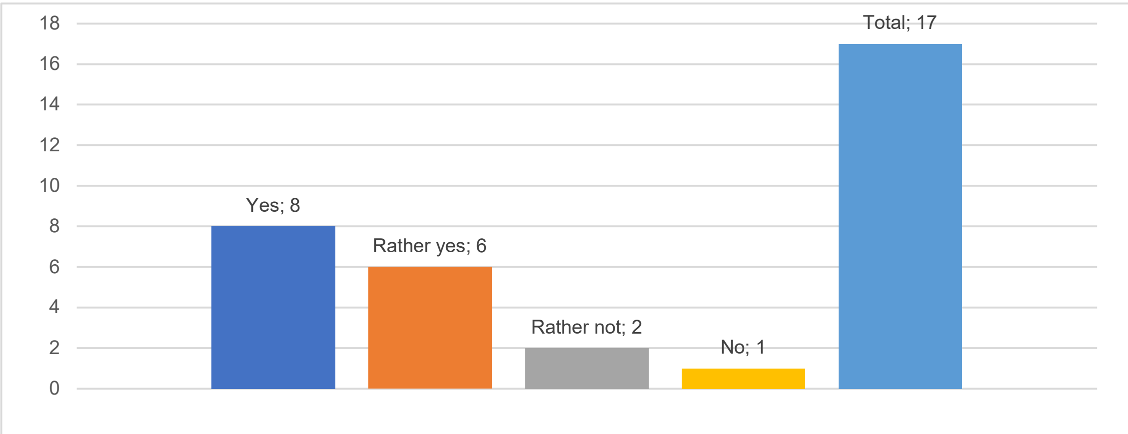
Describe the fundamental problems of architects' use of the BIM design method briefly if you can:

Question #21

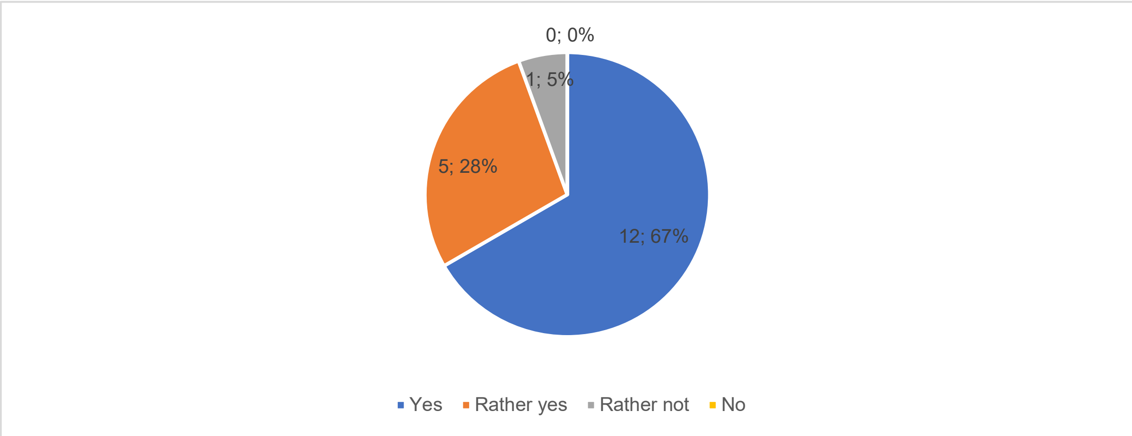
Briefly comment on the use of the BIM method for the project development if you can:

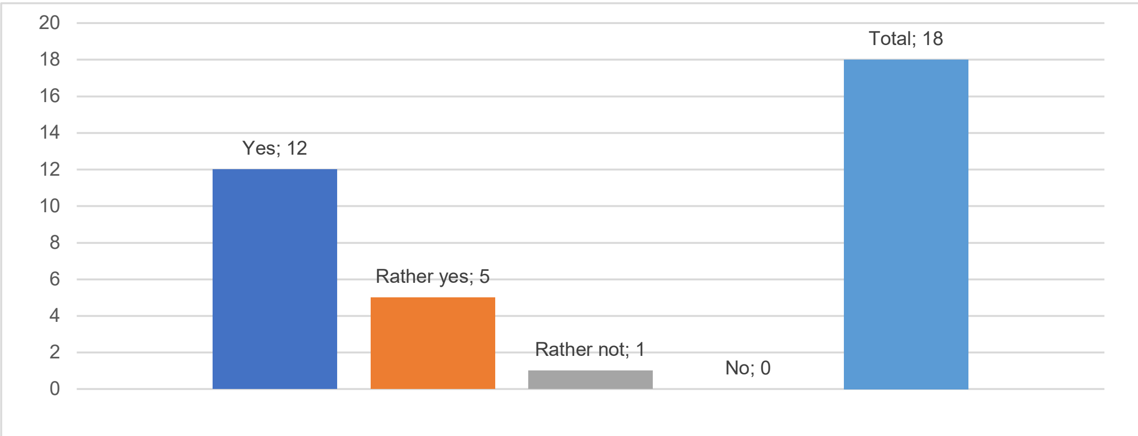
Question #1.	**Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?**
Yes	8
Rather yes	6
Rather not	2
No	1
Total	**17**



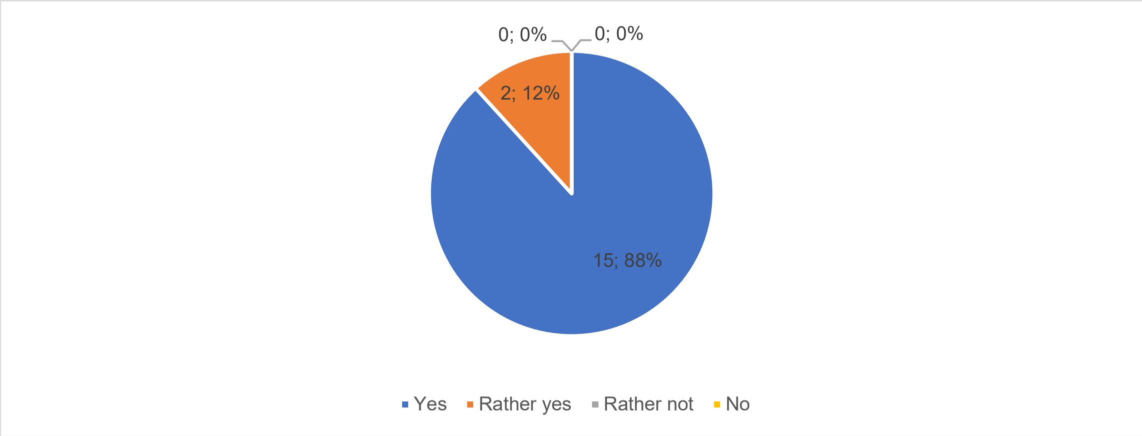


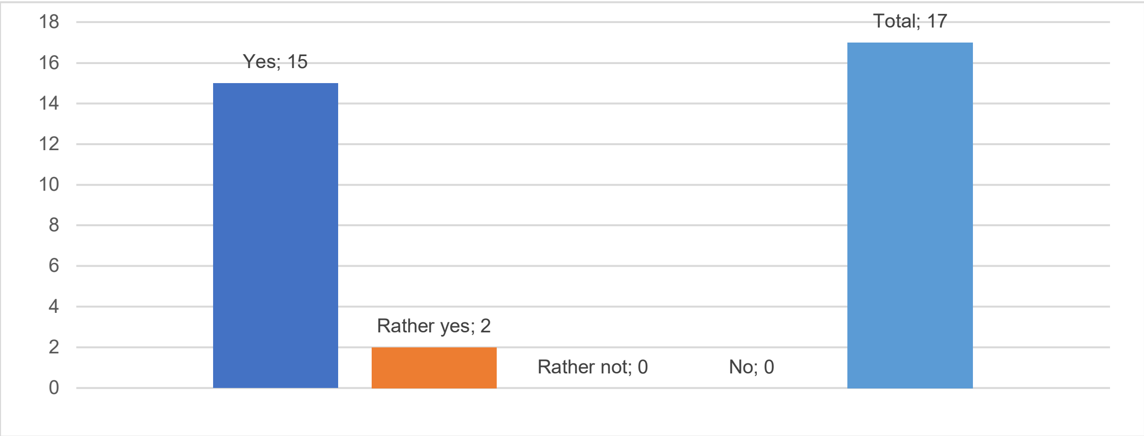
Question #2.	**I consider BIM a helpful design tool:**
Yes	12
Rather yes	5
Rather not	1
No	0
Total	**18**



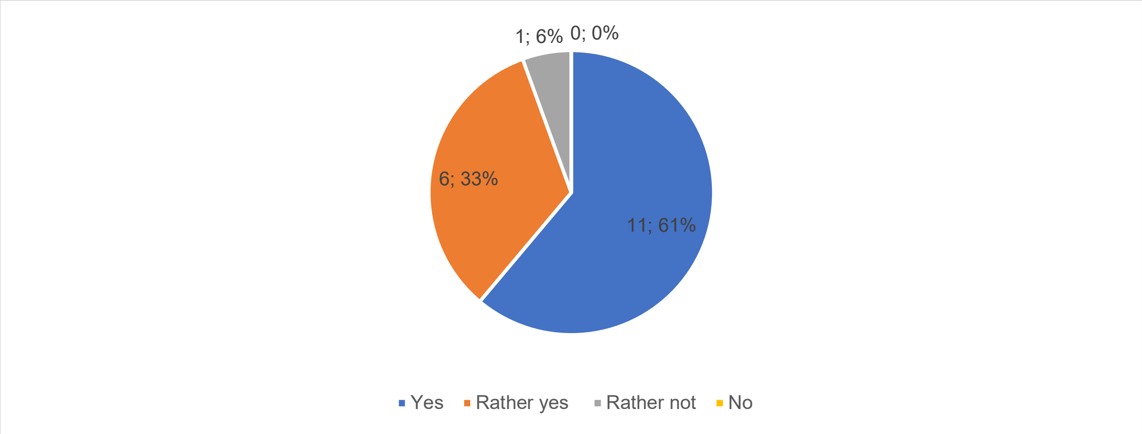


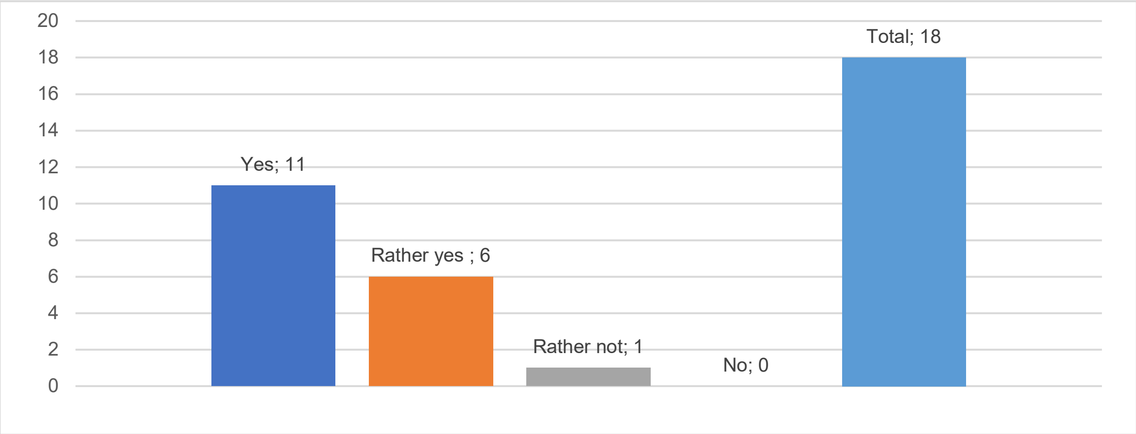
Question #3.	**I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):**
Yes	15
Rather yes	2
Rather not	0
No	0
Total	**17**



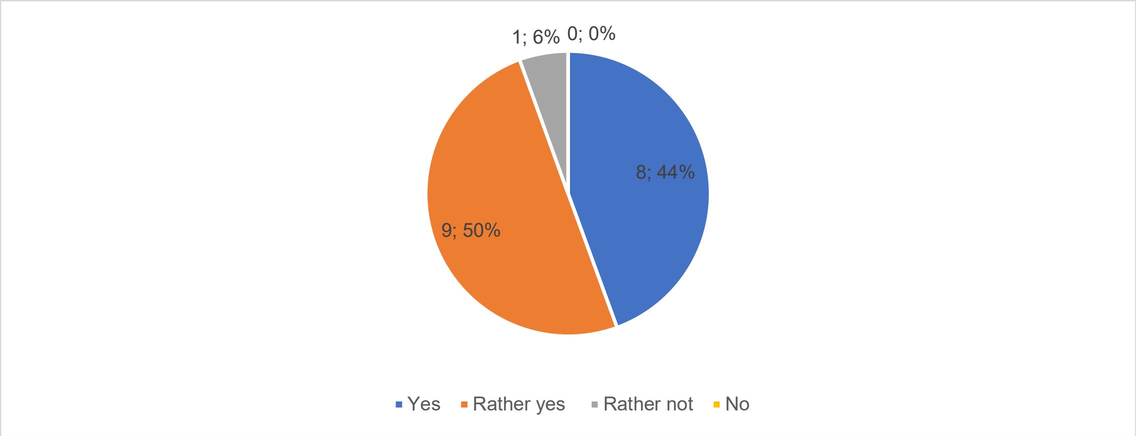


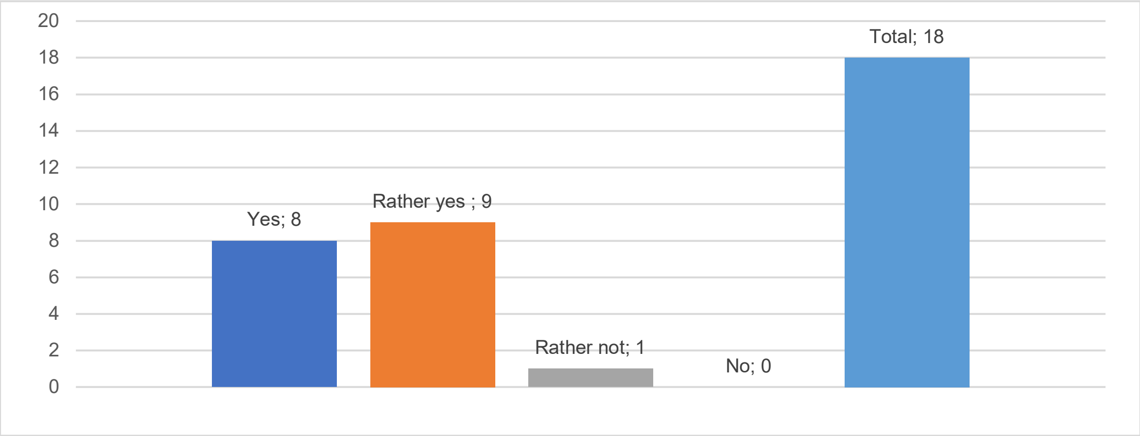
Question #4.	**If BIM is used, architects must also employ the BIM information model:**
Yes	11
Rather yes	6
Rather not	1
No	0
Total	**18**



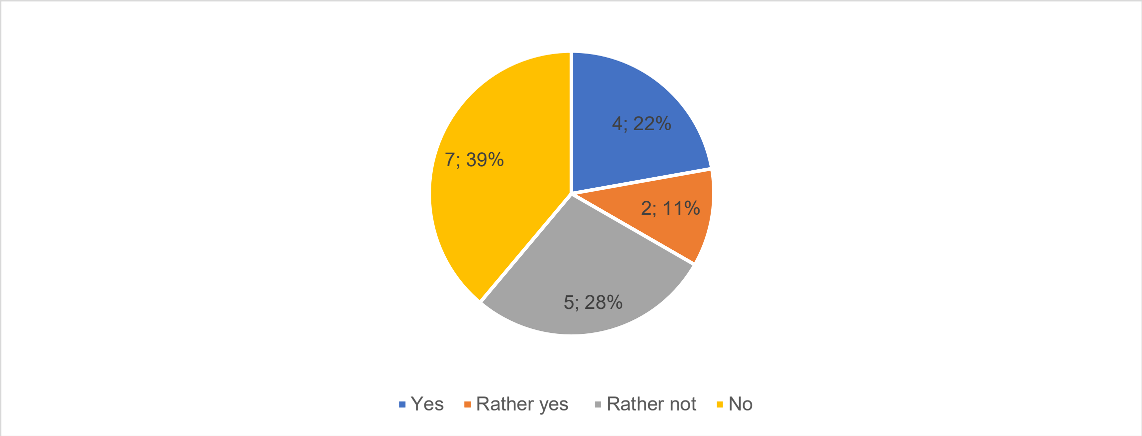


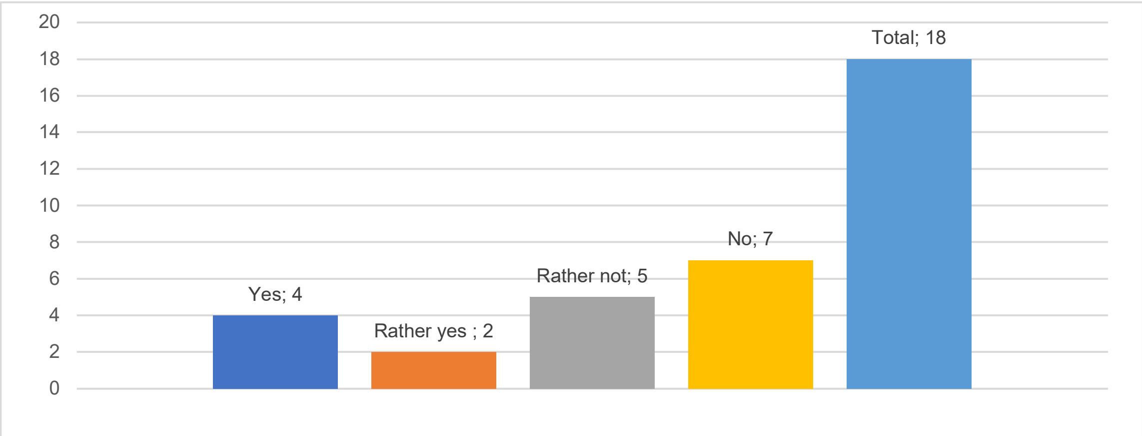
Question #5.	If BIM is used, architects must also employ the CDE (common data environment):
Yes	8
Rather yes	9
Rather not	1
No	0
Total	**18**



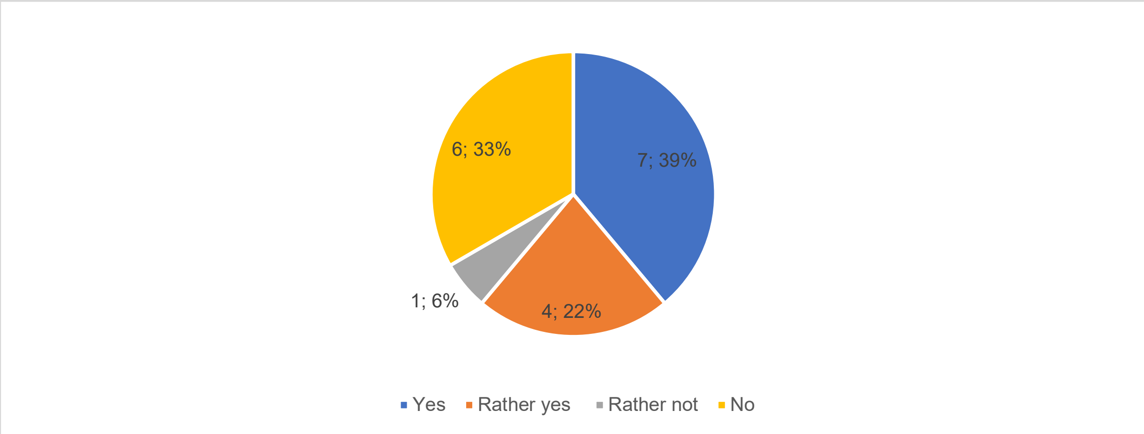


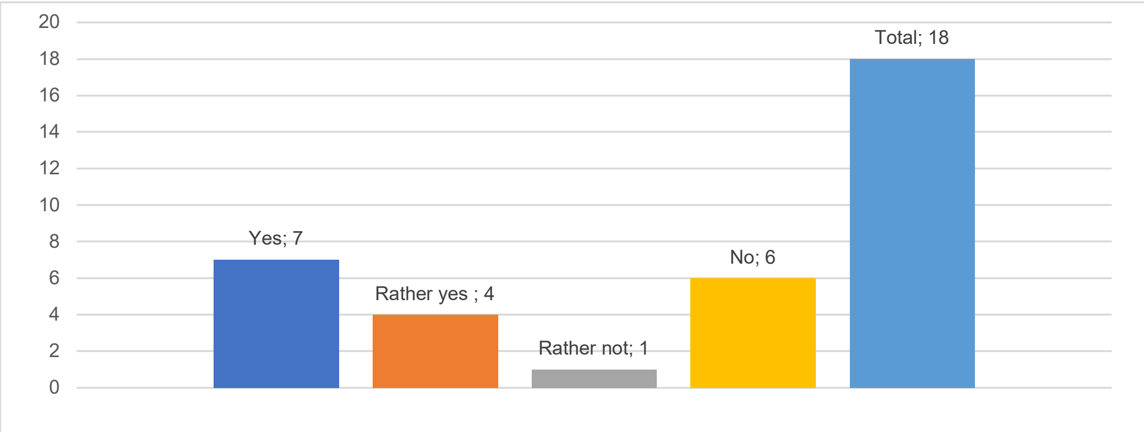
Question #6.	**The scope of a project does not matter if BIM is used:**
Yes	4
Rather yes	2
Rather not	5
No	7
Total	**18**



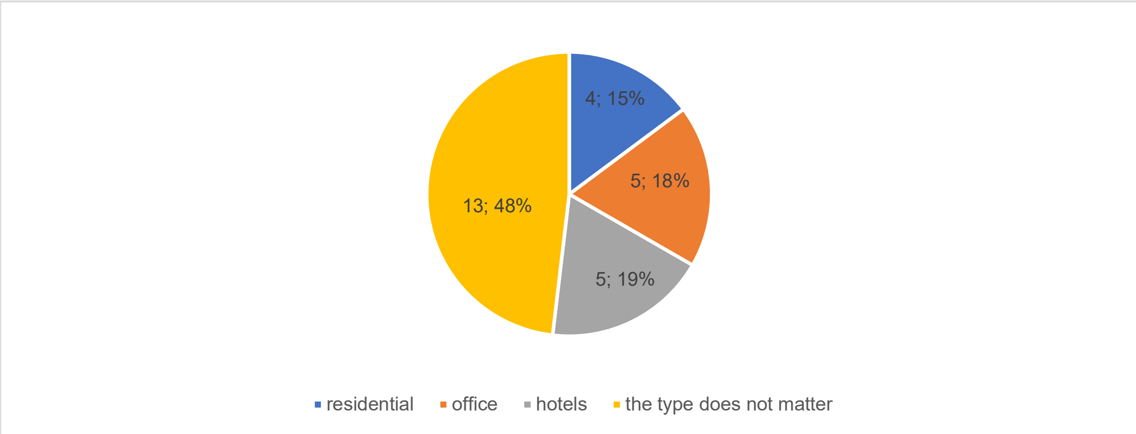


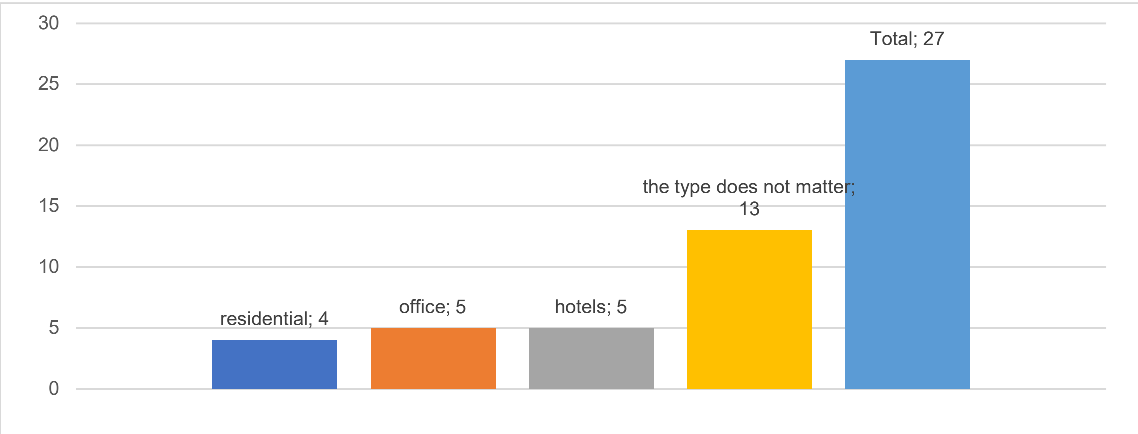
Question #7.	**If the BIM method is used, the project typology does not matter:**
Yes	7
Rather yes	4
Rather not	1
No	6
Total	**18**



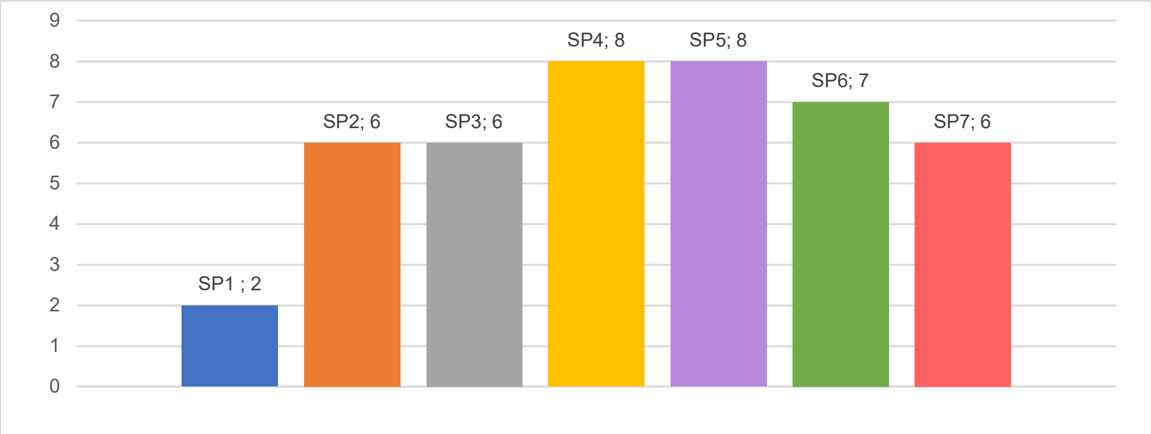


Question #8.	**The BIM method suits the following project types:**
residential	4
office	5
hotels	5
the type does not matter	13
Total	**27**

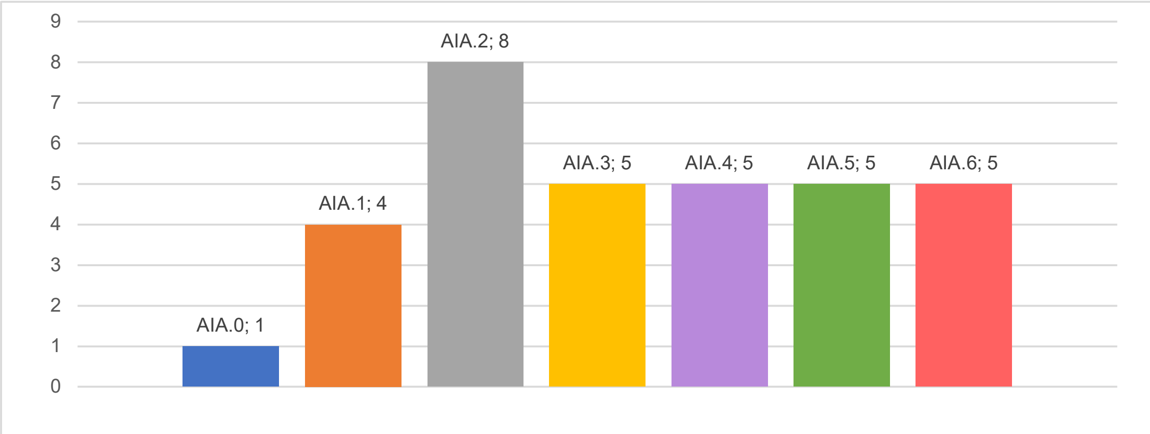




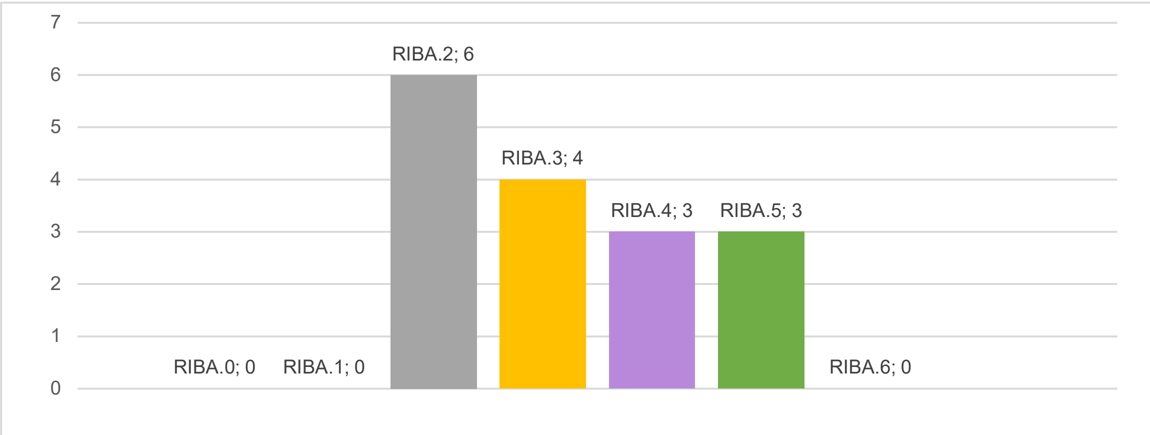
Question #9.	**Indicate the project stages in which developing a digital building information model makes sense:**	
SP1	Project Initiation	2
SP2	Preliminary – Concept Design	6
SP3	Land Zone Permit Design	6
SP4	Building Permit Developed Design	8
SP5	Detailed Design	8
SP6	List of Works and Deliverables	7
SP7	Architect's Supervision	6
Total		**43**



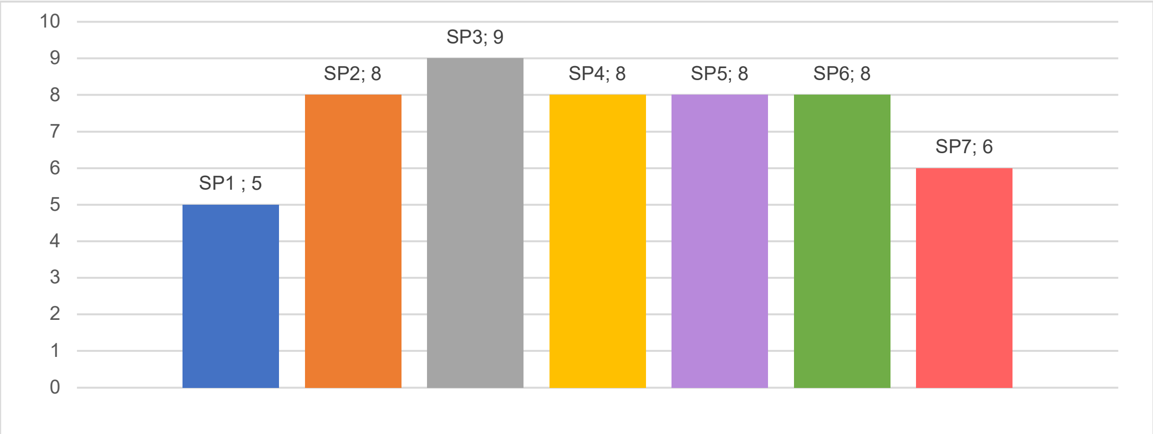
Question #9.	**Indicate the project stages in which developing a digital building information model makes sense:**	
AIA.0	Pre-Design	1
AIA.1	Schematic Design	4
AIA.2	Design Development	8
AIA.3	Construction Documents	5
AIA.4	Building Permitting	5
AIA.5	Bidding & Negotiation	5
AIA.6	Construction Administration	5
Total		**33**



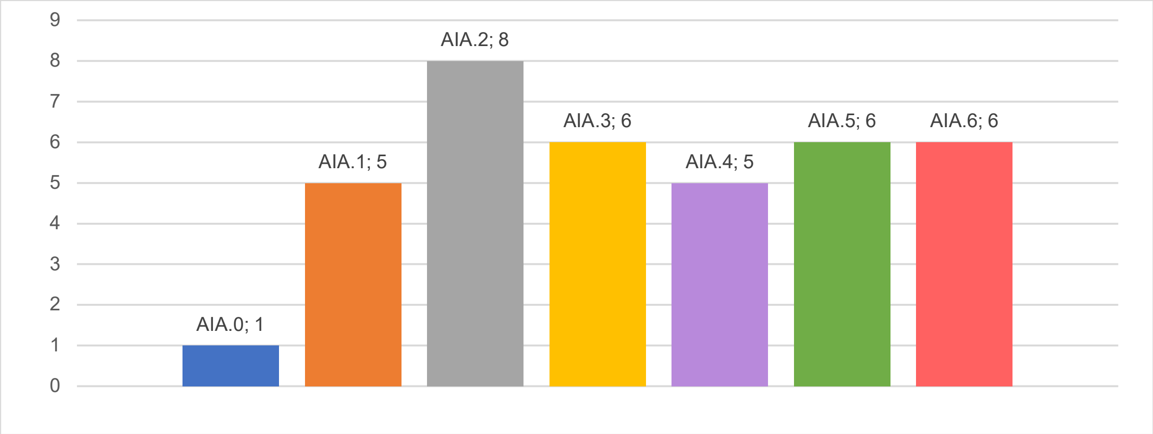
Question #9.	**Indicate the project stages in which developing a digital building information model makes sense:**	
RIBA.0	Strategic Definition	0
RIBA.1	Preparation and Briefing	0
RIBA.2	Concept Design	6
RIBA.3	Spatial Coordination	4
RIBA.4	Technical Design	3
RIBA.5	Manufacturing and Construction	3
RIBA.6	Handover	0
RIBA.7	Use	0
Total		**16**



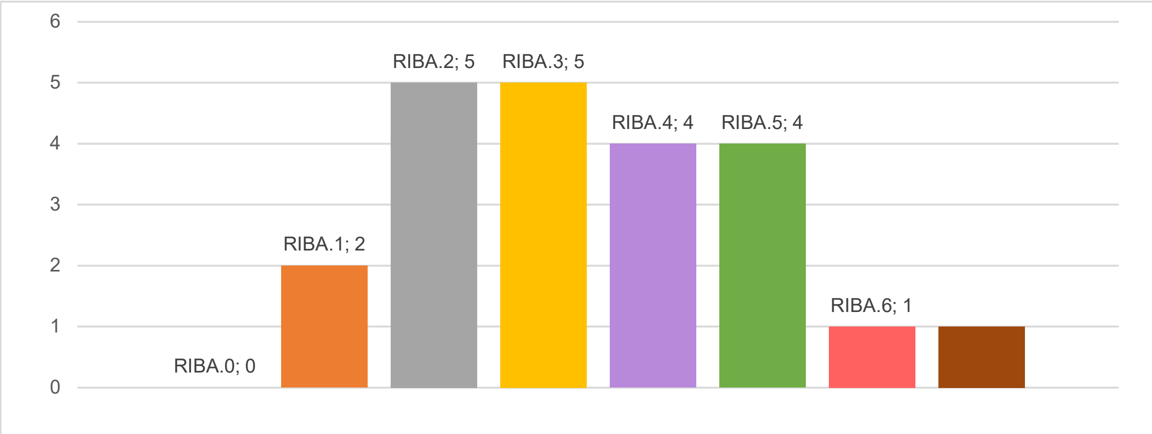
Question #10.	**Indicate the project stages in which using the common data environment (CDE) makes sense:**	
SP1	Project Initiation	5
SP2	Preliminary – Concept Design	8
SP3	Land Zone Permit Design	9
SP4	Building Permit Developed Design	8
SP5	Detailed Design	8
SP6	List of Works and Deliverables	8
SP7	Architect’s Supervision	6
Total		**52**



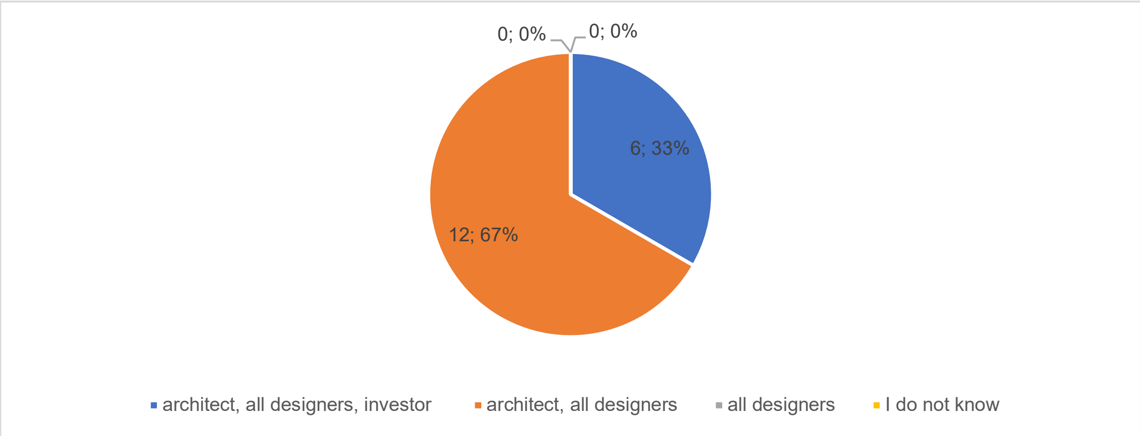
Question #10.	**Indicate the project stages in which using the common data environment (CDE) makes sense:**	
AIA.0	Pre-Design	1
AIA.1	Schematic Design	5
AIA.2	Design Development	8
AIA.3	Construction Documents	6
AIA.4	Building Permitting	5
AIA.5	Bidding & Negotiation	6
AIA.6	Construction Administration	6
Total		**37**

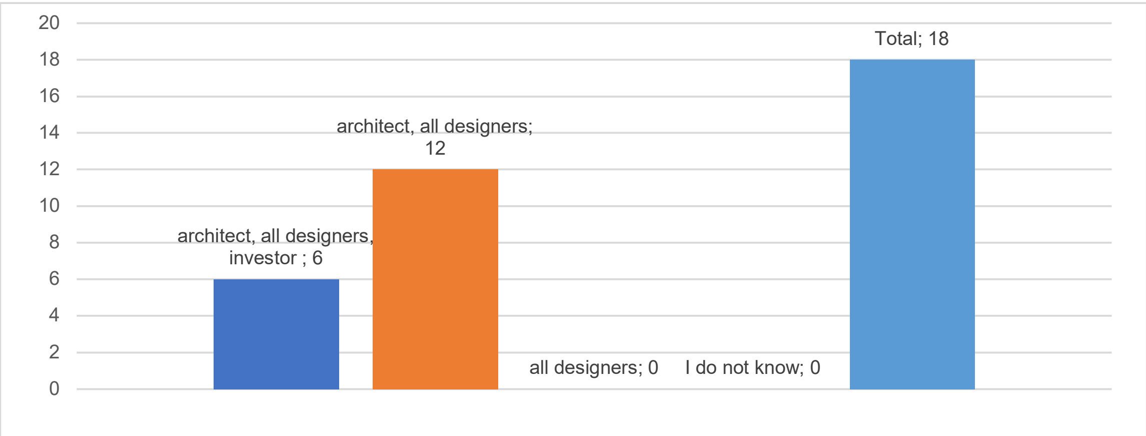


Question #10.	**Indicate the project stages in which using the common data environment (CDE) makes sense:**	
RIBA.0	Strategic Definition	0
RIBA.1	Preparation and Briefing	2
RIBA.2	Concept Design	5
RIBA.3	Spatial Coordination	5
RIBA.4	Technical Design	4
RIBA.5	Manufacturing and Construction	4
RIBA.6	Handover	1
RIBA.7	Use	1
Total		**22**

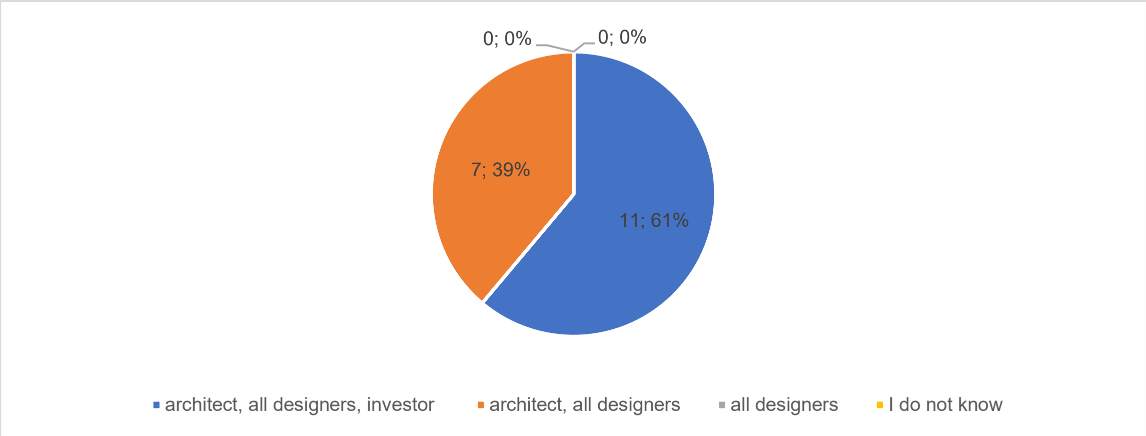


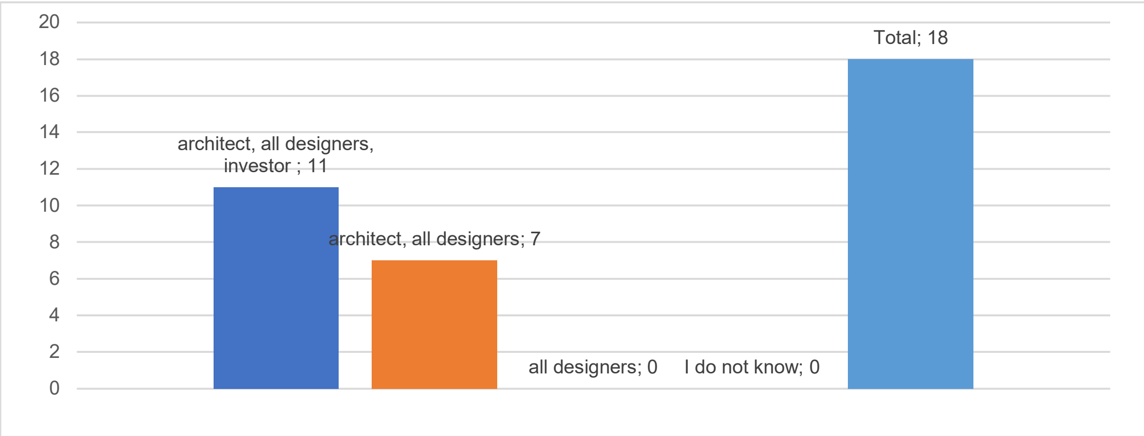
Question #11.	**Indicate who must use the (digital) building information model (IMS) for a meaningful design process:**
architect, all designers, investor	6
architect, all designers	12
all designers	0
I do not know	0
Total	**18**



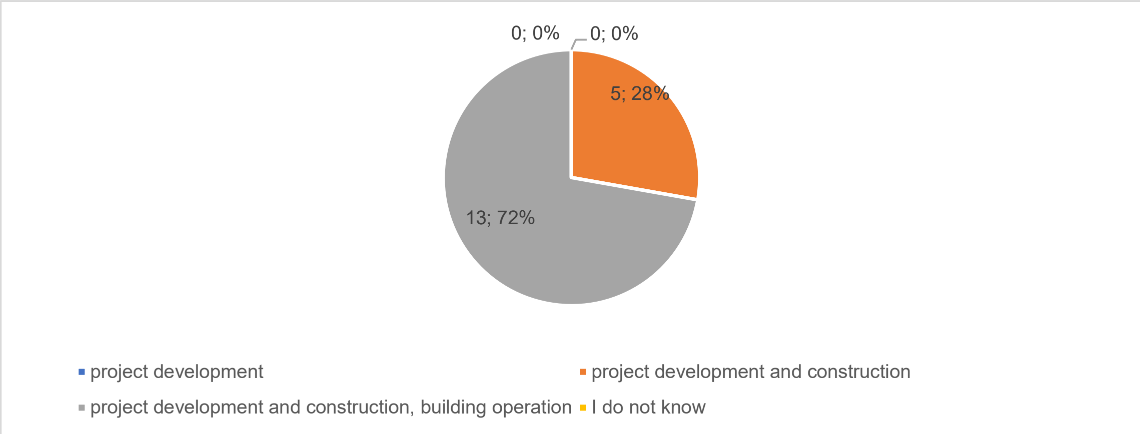


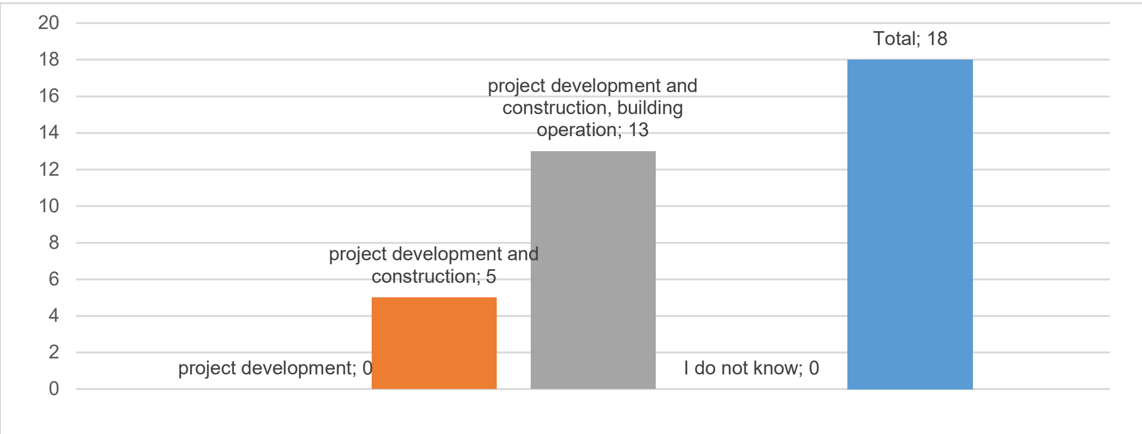
Question #12.	**Indicate who must use the common data environment (CDE) for a meaningful design process:**
architect, all designers, investor	11
architect, all designers	7
all designers	0
I do not know	0
Total	**18**



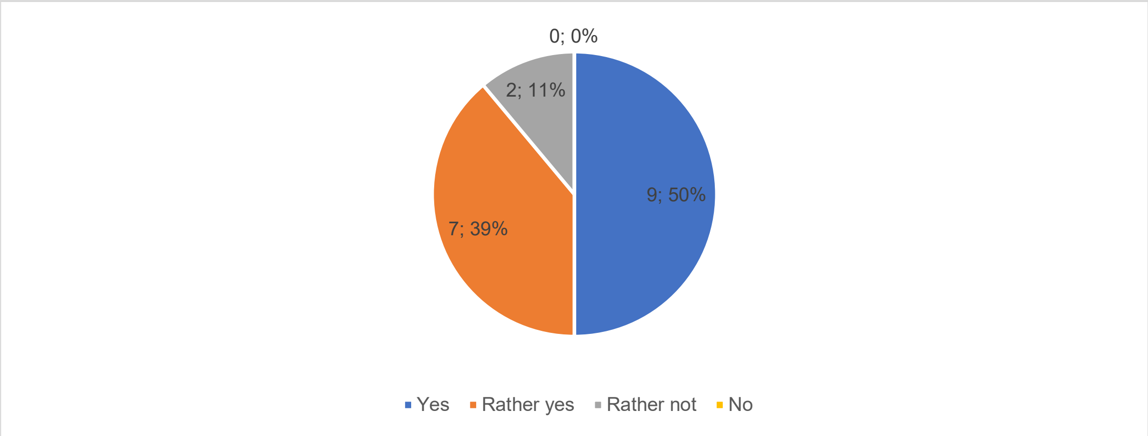


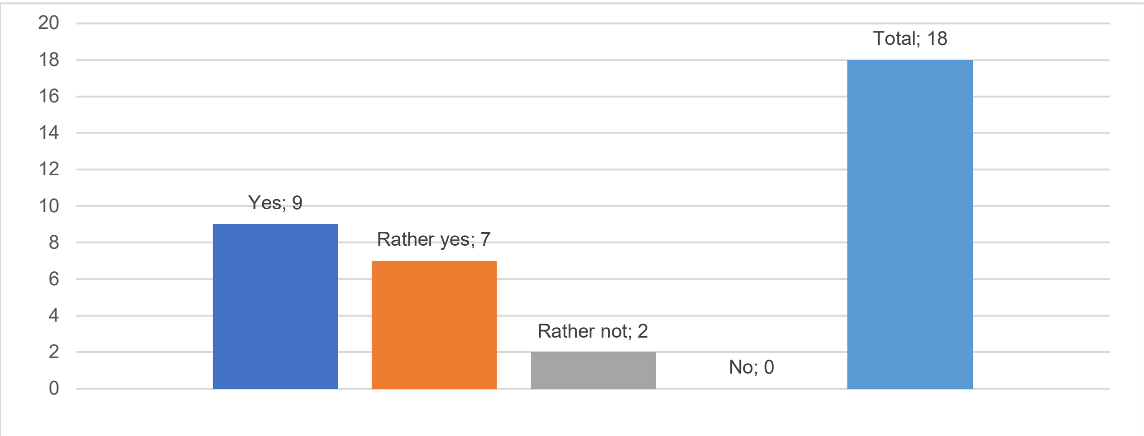
Question #13.	**The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:**
project development	0
project development and construction	5
project development and construction, building operation	13
I do not know	0
Total	**18**



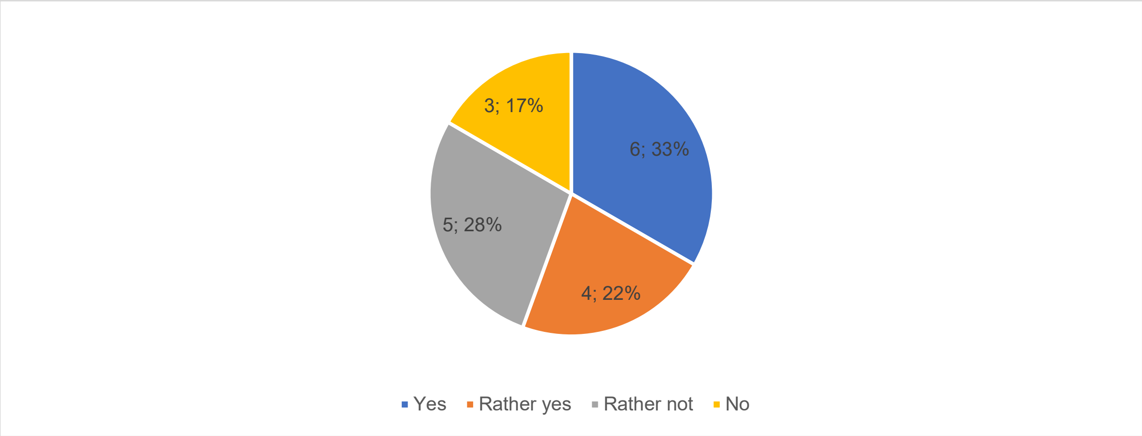


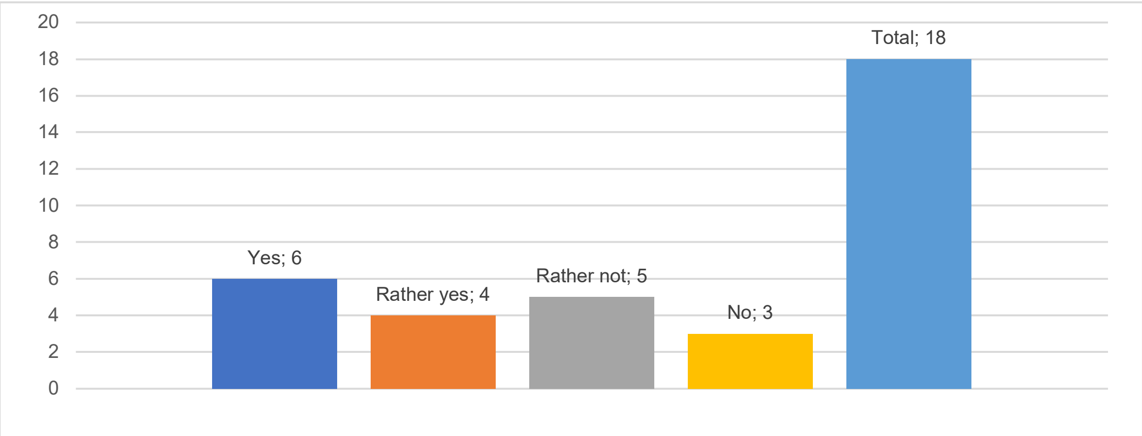
Question #14.	Using BIM, the information details in individual stages differ from those used in the conventional design process:
Yes	9
Rather yes	7
Rather not	2
No	0
Total	**18**



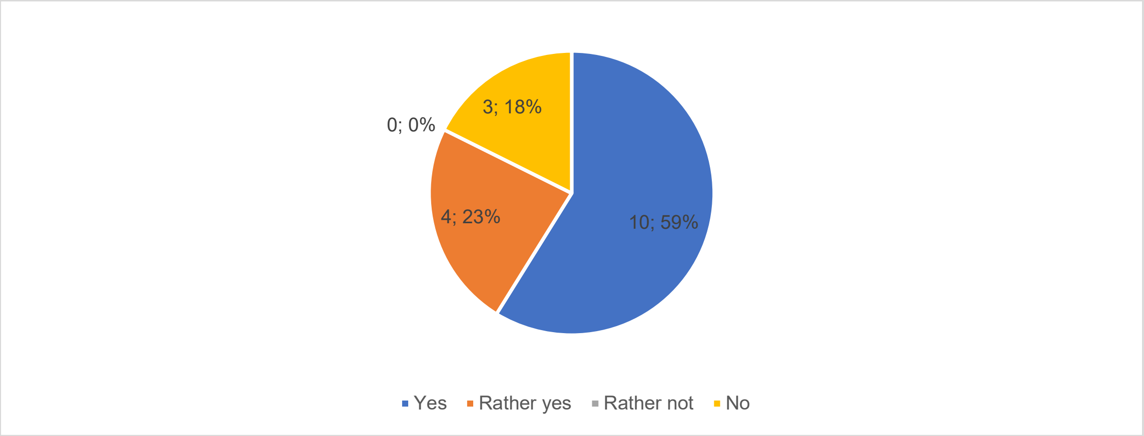


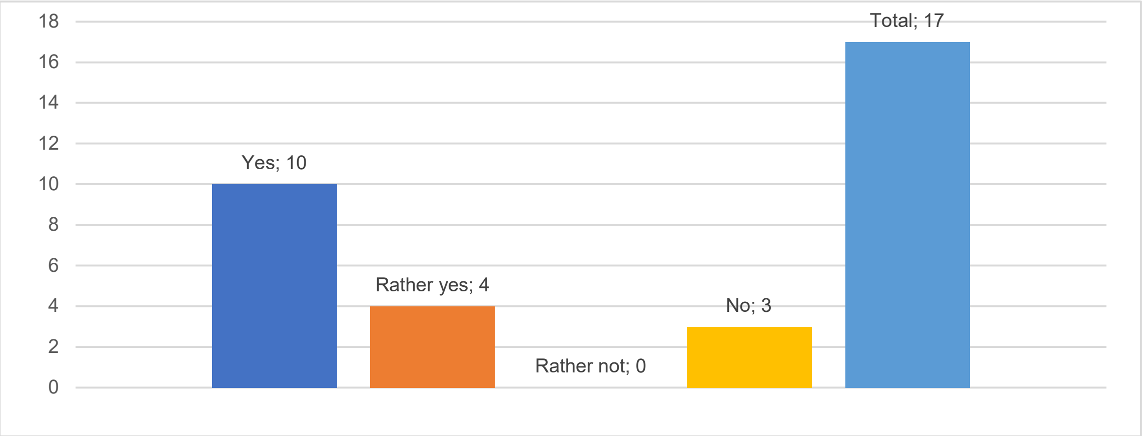
Question #15.	**Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?**
Yes	6
Rather yes	4
Rather not	5
No	3
Total	**18**





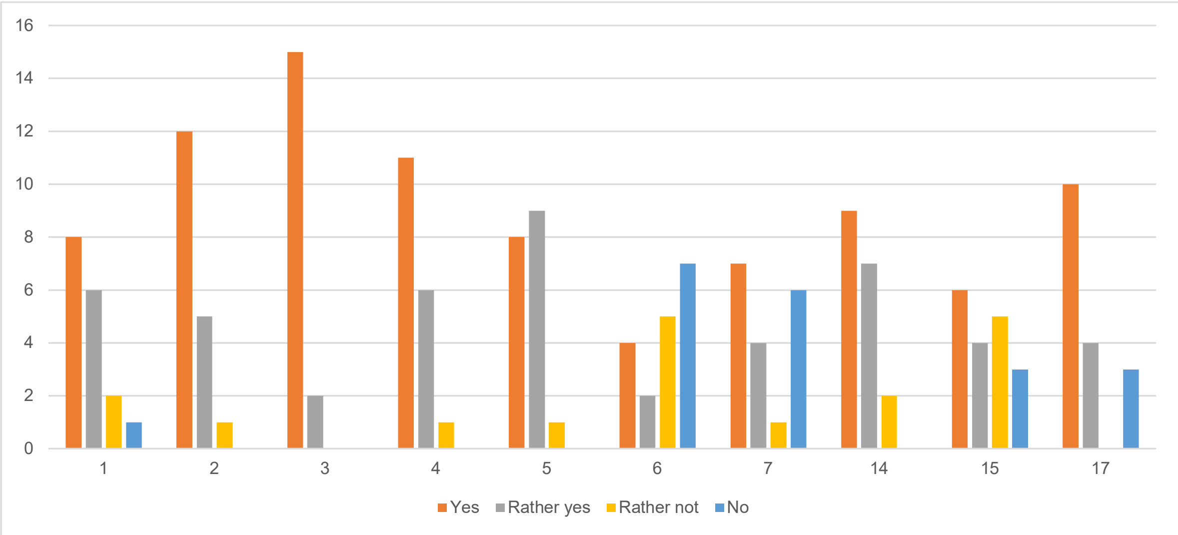
Question #17.	**I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).**
Yes	10
Rather yes	4
Rather not	0
No	3
Total	**17**

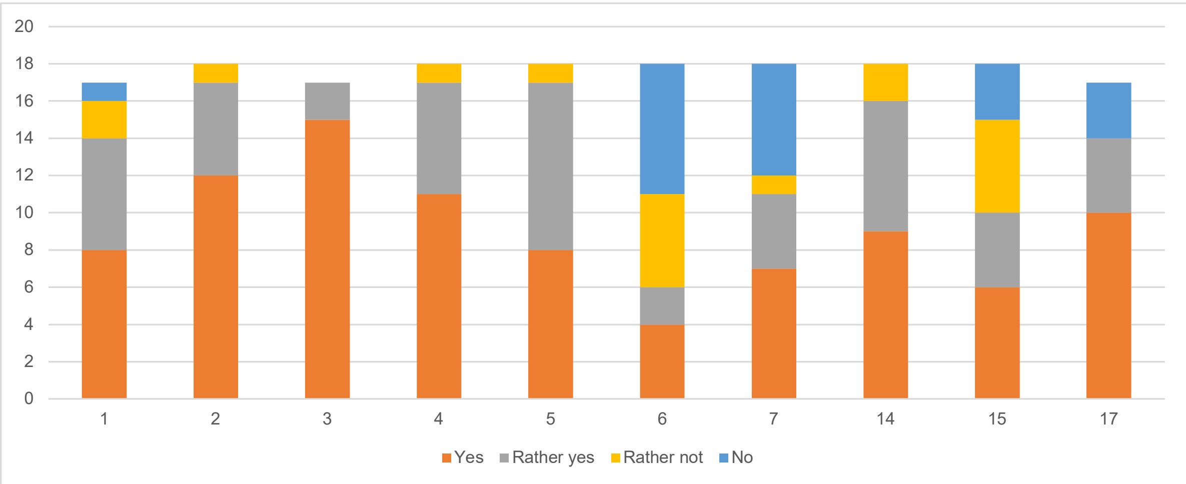




Summary Graphs

Question	1	2	3	4	5	6	7	14	15	17
Yes	8	12	15	11	8	4	7	9	6	10
Rather yes	6	5	2	6	9	2	4	7	4	4
Rather not	2	1	0	1	1	5	1	2	5	0
No	1	0	0	0	0	7	6	0	3	3
Total	**17**	**18**	**17**	**18**	**18**	**18**	**18**	**18**	**18**	**17**





Questionnaire: Clarification Replies

Question #1.

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

- Not necessary but preferable.
- Yes, for larger buildings. For smaller ones, just 2D will do.
- This is too recent. We have only been using BIM for a short time, so I can't answer - I don't know what should or could be specified in the contract.

Question #2.

I consider BIM a helpful design tool:

- Other programmes are better for early stage design. Rhino / SketchUp etc.
- It is a comprehensive capture of the project in one coherent environment. This brings huge advantages, especially in the later stages of a project, especially for information work. For the same reason, it can be limiting in the early stages of a project. Its complexity can limit the user's creativity and lead him to standardized solutions.
- Yes, extremely useful, great for checking spatial relationships and effects.

Question #3.

I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):

- BIM has a direct impact on the workflow and for this reason it is essential that the whole team works with the same data and for this reason it is necessary to have a CDE for the project.
- There's definitely a future in it, but it's not fully working yet.
- From the point of view of work I rather understand it as a complex 3D model, which will allow me to extract data and facilitate the creation of drawing documentation.

Question #4.

If BIM is used, architects must employ the BIM information model:

- It can probably be set up without but it seems like a missed opportunity. The architect's design can of course be created by other means (sketch, model). But it is necessary to have at least access to the model and the information in it.
- Yes, but it's the level of detail. It would be stupid if someone forced us to have everything precisely defined in the beginning, then one gets buried in detail and completely misses the concept, so at the beginning determine the main volumes, principles of construction and then refine.
- Here I don't understand again - When using BIM is it necessary for the architect to use BIM? Maybe the question is for another profession than the architect? But I am an architect :-) So I answer yes, because it is good if the whole design team works in it.

Question #5.

If BIM is used, architects must also employ the CDE (common data environment):

- Rather yes, preferable.
- The data environment should be the only place to exchange data and information. From this point of view, it is absolutely essential that it is used by everyone.
- Yes, it is an advantage for cooperation.
- It's more of an advantage than a necessity.

Question #6.

The scope of a project does not matter if BIM is used:

- Very small projects (e.g. domestic refurbishment projects) might not be done in BIM. But above a certain size then, yes.
- The suitability of using BIM is not directly related to the size of the project. But it is one of the factors that can influence the decision on whether to use this method.
- Depends on the size (of project). If I'm going to make a small house, it should be drawn in pencil. You don't need 3D for everything.
- If the environment is set up and ready to use, it will speed up even small projects, unless it is purely a study (I take this from an architectural point of view, where we often sketch and shape masses or try out many variants).

Question #7.

If the BIM method is used, the project typology does not matter:

- Typology does not directly influence the choice of BIM method. However, it can be a factor.
- See Question #6. Simple buildings, such as lean-tos or shelters, and others do not need it.

Question #8.

The BIM method suits the following project types:

- The BIM method will become the standard in the near future. Currently, it is possible to find projects for which it is not suitable. For example, limited financial resources for design, unpreparedness of the design team, renovation of a historicizing building that does not have a BIM focus, etc.
- It's about size and complexity.
- I assume you mean building types by function rather than project types? It seems that it is not suitable for building interior projects or projects where only a small or specific part of the building is being worked on, or renovation / refurbishment / adaptation of historic buildings etc.

Question #9.

Indicate the project stages in which developing a digital building information model makes sense:

- RIBA.2 Concept Design; RIBA.3 Spatial Coordination; RIBA.4 Technical Design; RIBA.5 Manufacturing and Construction.

- AIA.2 Design Development - Design Development onwards.
- AIA.1 Schematic Design; AIA.2 Design Development / RIBA.2 Concept Design; RIBA.3 Spatial Coordination.
- AIA.1 Schematic Design; RIBA.3 Spatial Coordination.
- AIA.1 - AIA.6, RIBA.2 - RIBA.5.
- AIA.2 - AIA.6, RIBA.2 - RIBA.5.
- AIA.2 - AIA.6.
- AIA.2 Design Development, RIBA.3 Spatial Coordination.
- The BIM method is most effective when used for all phases of a project.
- Depends on the type and size of the project.
- Ideally in all of them, but the most important thing in the end.
- It is not clear if you mean a project that is contracted for all phases or if you mean a single-phase project... at the same time I will answer in the sense of a larger project - it is certainly not worth starting a BIM model for a family house in the preparation of a contract.
    - SP 1+2 - debatable, SP 5+6 - I haven't tried it.

Question #10.
Indicate the project stages in which using the common data environment (CDE) makes sense:

- RIBA.2 Concept Design; RIBA.3 Spatial Coordination; RIBA.4 Technical Design; RIBA.5 Manufacturing and Construction.
- AIA.2 Design Development - Design Development onwards, RIBA.2 Concept Design - Concept Design onwards.
- AIA.1 - AIA.6; RIBA.2 - RIBA.7.
- AIA.1 Schematic Design; RIBA.2 Concept Design.
- AIA.1 - AIA.6, RIBA.1 - RIBA.5.
- AIA.1 - AIA.6, RIBA.1 - RIBA.5.
- AIA.2 - AIA.6.
- AIA.2 Design Development, RIBA.3 Spatial Coordination.
- The BIM method is most effective when used for all phases of a project.
- Ideally in all of them, but the most important thing in the end.
- SP2 - for large projects, otherwise not, SP6 - I haven't tried it.

Question #11.
Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

- The information model aggregates all information about the project in one place, from this point of view it is essential that everyone has direct access to the information model.
- If all the process should make sense, IMS needs to be used by everyone.

Question #12.

Indicate who must use the common data environment (CDE) for a meaningful design process:

- The information model aggregates all information about the project in one place, from this point of view it is essential that everyone has direct access to the information model.

Question #13.

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

- When used correctly, it should contribute to a greater degree of design sophistication. 3D coordination of all professions is a great advantage in design and should simplify implementation. It can be used for greater efficiency in the use of the building.
- Unless it somehow fundamentally changes technology and practices during construction :)
- Project preparation and realization of construction - I have not tried yet.

Question #14.

Using BIM, the information details in individual stages differ from those used in the conventional design process:

- Using BIM changes the workflow. Some parts of the design process have different time requirements. Generally speaking, the time requirement for starting / setting up processes increases, but at the same time the production time requirement decreases significantly. Better changes are made.
- The principle must not differ from the normal creation. BIM is only a tool, not an end in itself. The principle of going from rough concept to detail, just like painting a picture, should definitely be adhered to. First is the rough sketch, then the fine-tuned detail. Not the other way around.

Question #15.

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

- In the classical process, principles were addressed and applied to similar problems in the construction process. Since with the help of the BIM method the building is captured in all its complexity. There is a need to describe these principles in a much broader context. This fact, however, adds to the sophistication of the solution.

Question #16.

Describe briefly, if you can, what fundamental data architects should provide in different design stages if using the BIM method:

- The Level of Development (LOD) Specification (https://bimforum.org/lod/).
- See attached information 'RIBA Plan of Work.pdf'.
- RIBA.1 - RIBA.6:
    - RIBA.1
        - Consider Software usage and the implementation of digital tools. For example; how to implement Revit, Rhino, AutoCAD, etc.

        - Projects can either
        - a) Use BIM software (Revit) from the beginning.
        - b) Use 2D CAD (AutoCAD) for early sketches, transitioning to Revit at stage 2 or 3.
        - This decision will depend on the building (for example, for a masterplan at this stage, a 2D output in AutoCAD may be more efficient) and on the competence of the team in the different software. Team competence and skill availability needs to be considered. For other software, a project specific training and support plan shall be developed with the BIM Manager to manage the required support.
    - RIBA.2
        - Confirm Employers Information Requirements (EIR).
        - Agree on a Common Data Environment (CDE).
        - Complete BIM Execution Plan (BEP).
        - Complete team training plan to address team training requirements and availably digital skill for the required project delivery.
        - Ensure the Revit model files are set up from the beginning according to the SSA BIM Protocol.
        - Model elements/files should be broken into logical parts that will be manageable as the model develops through.
        - Refer to the BIM Protocol and confer with BIM Manager for appropriate file setup along with any necessary workflows specific to the project.
    - RIBA.3
        - Refer to the BIM Protocol for typical file setup at this stage.
        - Ensure the BEP is updated and reflects the status and configuration of the BIM and the file/data exchange procedures, including the CDE setup and the quality control procedures described in the BEP are being followed for model submission.
        - Check that the Master Information Delivery Plan (MIDP) reflects all of the modelled scope of our BIM and also the consultant's models too. Typical level of detail at this stage would be LOD 2 for items we are expected to model.
        - Ensure the MIDP is shared with the Specifications writer to match the format for the chosen building element division categories.
        - Check the above information with the BIM Manager.
    - RIBA.4
        - Refer to the BIM Protocol for typical file setup at this stage.
        - Ensure the BEP is updated and reflects the status and configuration of the BIM and the file/data exchange procedures, including the CDE setup and the quality control procedures described in the BEP are being followed for model submission.

        - Check the Master Information Delivery Plan (MIDP) reflects all of the modelled scope of our BIM and also the consultant's models too. Typical level of detail at this stage would be LOD 3 for items we are expected to model.
        - Ensure the MIDP is shared with the Specifications writer to match the format for the chosen building element division categories.
        - Check the above information with the BIM Manager.
    - RIBA.5
        - Confirm contractor/client Exchange Information Requirements (EIR).
        - Agree the Common Data Environment (CDE). At this stage the client or contractor would setup up a project-wide Extranet platform – the CDE for all parties and exchange procedures and file names would be requested by the contractor or client.
        - Prior to agreement of platform or procedure, these requests should be discussed with the BIM Manager.
        - Review/revise BIM Execution Plan (BEP).
        - Refer to the BIM Protocol for typical file setup at this stage.
        - The co-ordination of the BIM model is a major task that is sometimes now done by a specialist consultant and at least needs to be identified as in or out of the architect's scope.
        - Ensure the BEP is updated and reflects the status and configuration of the BIM and the file/data exchange procedures, including the CDE setup and the quality control procedures described in the BEP are being followed for model submission.
        - Check the Master Information Delivery Plan (MIDP) reflects all of the modelled scope of our BIM and also the consultant's models too. Typical level of detail at this stage would be LOD 5 for items we are expected to model.
        - LOD 6 information would typically be filled out by a contractor or client appointed BIM Manager.
        - Ensure the MIDP is shared with the specifications writer to match the format for the chosen building element division categories.
        - Check the above information with the BIM Manager.
    - RIBA.6
        - At this stage of the project the information in the BIM should reflect what is agreed in the BIM Execution Plan (BEP). The final delivery and model handover should be coordinated with the client, BIM Manager and client appointed Information Manger to effectively deliver the agreed BIM for the final stage.
        - Open file formats – PDF and IFC will likely be generated at handover to archive the project and saved for future retrieval. Handover and archiving procedures should be documented in the BEP.

- RIBA.2 - RIBA.5:
  - RIBA.2 Concept Design - lod200
  - RIBA.3 Spatial Coordination - lod300
  - RIBA.4 Technical Design - lod300-350
  - RIBA.5 Manufacturing and Construction - lod350
- RIBA.3 - RIBA.6:
  - RIBA.3 - spatial model, basic material specification
  - RIBA.4 - detailing, material spec., product specification
  - RIBA.5 - amendments, tender consideration
  - RIBA.6 - fully coordinated model
- AIA.0 - AIA.3:
  - AIA.0 - Basic Massing
  - AIA.1 - Material specifications
  - AIA.2 - Full specifications
  - AIA.3 - Finalized Specifications
- SP1:
  - The feasibility.
  - Basic information about the site, location, etc.
  - According to service standards (Czech Chamber of Architects).
- SP2:
  - Concept, vision, principles.
  - Location of the project geographically, all surveys, working with alternatives, ability to use data to create CGI's; preparation of documentation, basic area and spatial information.
  - According to service standards (Czech Chamber of Architects).
  - Rough shapes of the house volume, positions of walls, openings, cornices, roofs, stairs, slabs.
- SP3:
  - Spatial verification, basic coordination, infrastructure.
  - All documentation work. Creating the base for CGI's. Collaboration with other professions, basic spatial coordination of patch networks. Fixing the project volume.
  - According to service standards (Czech Chamber of Architects).
- SP4:
  - Construction, HVAC, coordination.
  - Refinement of documentation of architects and all professions.
  - According to service standards (Czech Chamber of Architects).
  - SP4 includes a degree more detailed information than required for a normal project without BIM; from SP4 as for a normal project without BIM only some specifications are slightly more detailed.

- SP5:
    - Standards, materials, products, details, detailed coordination of professions.
    - Refinement of documentation of architects and all professions.
    - According to service standards (Czech Chamber of Architects).
- SP6:
    - Tender documentation - specification + bill of quantities.
    - This information is part of the information model, directly linked to its 3D representation within the model.
    - According to service standards (Czech Chamber of Architects).
    - Adding descriptions of each product and detail (this is a progression from rough detail, then gradually added from the study).
- SP7:
    - Model update, implementation of supplier documentation.
    - Work with the information model on site. Blending the model with reality. Effective work with information.
    - According to service standards (Czech Chamber of Architects).
- Unfortunately, I don't think I understand the question here - from the design of the building we start to create a model and gradually refine it, which is probably obvious. I don't understand what list I should list... we model everything, from the beginning we can place some simpler families without details and then gradually replace them with more accurate ones, but it depends on the type of project.

Question #17.

I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).

- When used correctly, it should contribute to a greater degree of design sophistication. 3D coordination of all professions is a great advantage in design and should simplify implementation. It can be used to make the use of the building more efficient.

Question #18.

Describe, if you can, the basic requirements on architects' work briefly if employing the BIM design method:

- Construction experience and knowledge of supplier interfaces.
- Educated design team and client commitment to the method, extra fees.
- Architects ought to use the BIM platform as agreed in any project-specific BIM Execution Plan (BEP).
- Architects ought to use the BIM platform to collaborate with other disciplines as far as possible, and use the BIM platform as a coordination tool.
- Architects ought to use the BIM model exclusively to produce all of their drawn information, and minimise 2D work, in order that the model accurately reflects the proposal and is a useful tool in its own right.
- To produce and deliver information following the agreed BEP.

- Leading coordination of all consultants, integration of models, clash detection, integration of specifications into model, etc.
- Similar to designing without BIM , but in a different environment , different prioritization of tasks. Then it depends on the extent to which the designer and architect model is linked.
- Understanding of processes, ability to work in a BIM environment to extract data. Ideally ability to produce documentation in a BIM environment.
- BIM skills.
- Contractual agreement on BIM standards.
- Fixed outlines and site.
- Knowledge of working in the software - Revit.
- They (architects) must be able to set / follow BEP - procedures, parameters and objectives when using the capabilities of BIM software tools.
- Knowledge of construction systems & components & specifications.
- Creation of real shapes and constructions.
- It requires a certain level of technical knowledge - I don't know if an architect from UMPRUM (Academy of Arts, Architecture & Design in Prague), where the knowledge of construction sub-disciplines (statics, building environment technology, construction principles and details) is low, would be able to decide correctly what and how to make/model when creating a model.
- Structured workflow.

Question #19.

Describe the basic benefits of architects' use of the BIM design method briefly if you can:

- Detailed control over the project, including specialists.
- Minimising risk through in-depth coordination with boundary parameters and Design team (Engineers). Highly increased quality or architectural design and coordination, cost advantages during tender when providing transparent and comprehensive design quality, less contractor claims as comprehensive information was provided and level of coordination of design information is much higher than in traditional process.
- BIM can be an extremely useful tool to coordinate complex projects alongside structural engineers, mechanical engineers and other disciplines.
- When used correctly, BIM can be a time-saving device which can quickly and efficiently produce drawn and scheduled information when compared to older methods of works (CAD alongside Excel/ Word for example).
- BIM simultaneously allows architects to produce 2D information while refining a 3D model that can be used for other purposes (visualisations etc.).
- Easier coordination process and more efficient workflow for producing and delivering information. Less room for errors, which can be spotted earlier in the process.
- Ability to see issues ahead of construction. Add specificity to details not possible otherwise.
- Greater understanding of 3D situations and connections/clashes between the different expertise (structure/installations/envelop/layout/etc.).

- Possibility to add additional information to the elements, for instance on building physics or finishes.
- If the architect's and designer's model is only one, there can be an advantage in saving labour. On the other hand, it carries a big quality risk and it is unclear who is responsible for the accuracy of the model.
- Coordination of other professions in 3D. Work in only one environment where all project information is concentrated. Integration of all parts of the documentation into a single unit in which it is relatively easy to make changes.
- Control of geometry, minimization of collisions, fewer errors of material things in drawings.
- Communication and coordination with other design teams.
- Coordination with other designers, drawing organisation.
- Spatial modelling, project changes, variant solutions...
- The drawing documentation is automatically generated and updated from the model. The model can be used for visualizations and presentations. Once the model is 'finished', it is quick to write all modifications into drawings and reports. Object modelling provides efficient documentation, reporting and recording of information including edits and changes. It allows greater use of computer capabilities for mechanical activities.
- More efficient project coordination.
- Precise & accurate design; quantification of design; value engineering.
- For us, it's 3D modelling as a basis for design. I can't imagine it any other way. 3D is important for us to verify what we are actually designing, it helps us with the composition of drawings and incorporating adjustments quickly. Our profession doesn't quite have that yet.
- Time saving (creating sections, views, working across floors); huge capture (elimination) of errors due to inattention; easier creation of tables, reports, plans.
- Smooth workflow, information at hand.

Question #20.
Describe the fundamental problems of architects' use of the BIM design method briefly if you can:

- The level of information in no way corresponds to the fee schedule, already at the study level we work often with standards for building permits.
- Lack of wider design team capabilities, misunderstanding of clients of advantages and value of the methodology.
- Inefficient use of the BIM platform can result in abortive work or extremely slow workstreams.
- There is a certain scale of project at which it may not be sensible to use BIM, unless you are experienced as an individual/ practice.
- Large, complex projects, take a lot of time to organise and manage and there are complexities in the hosting and size of models which can impact team efficiency, synchronisation times etc.
- Easier coordination process and more efficient workflow for producing and delivering information. Less room for errors, which can be spotted earlier in the process.

- Additional time dedicated to ensuring the model is running appropriately, heaviness of model as consultant models are integrated, expertise overly focused on running the software as opposed to understanding the building.
- When not all advisors / participants work in the BIM or when not all parties work to the same LOD.
- Unclarity about the status of the BIM during construction related to the tendering documents/specifications/drawing set.
- The overall quality of the model, the quality and adherence to the standard of modelling and data entry by all involved, moreover in an environment without harmonisation of Czech technical standards.
- Getting lost in the complexity of problems, increase in administrative demands, inclination to systemic solutions, misunderstanding of the system.
- Ignorance of the use of BIM by all team members / subcontractors.
- Risk of excess work.
- Misunderstanding of the level of detail.
- Higher cost of software license, laboriousness of basic modelling in the initial phase, e.g. for complex historical objects/renovations.
- The architect must be able to use more complex and sophisticated software tools. The laboriousness of a BIM model that contains more information than traditional documentation would describe. In classical design, the level of information increases gradually. It is constantly possible to 'present' a project. It is quick to sketch. In BIM design it takes a long time to produce a 'presentable model'. Then it is easier to make changes, extensions, additions,...
- Lack of professionals working in BIM, limited choice.
- Data exchange, incompatible software, mutual misunderstanding of the level of detail settings (often exaggerated client requirements), inconsistencies in layers and modelling methods, transfer of know-how for free to clients (demanding element libraries, etc.).
- Already from the design of the building it requires entering a huge amount of detail and really modelling the building, which was not the case before... Basically a lot of work from later phases is moved to the beginning of the design (mostly to Preliminary – Concept Design); very clumsy testing of variants; almost impossible 'sketching', which could use some functions (e.g. dimensions), but maybe it's the ignorance of software - we use Revit.
- Different software knowledge of the different parties.

Question #21.

Briefly comment on the use of the BIM method for the project development if you can:

- BIM is a logical development of construction information generation and storage. It gives the process a comprehensive 'central nervous system' improving design and information quality by a lot. BIM can only be the future way of working, evolving the partly very insular and antiquated ways of working that still can be found in the industry.
- We employ a BIM protocol and BIM execution plan.
- See above.

- The earlier a project can onboard consultants and a contractor to utilize BIM the better.
- A trend that will grow in strength and importance.
- The BIM method will become the standard in the near future. Its biggest advantage and disadvantage is its complexity. This complexity is a huge simplification in all phases of construction. However, a lot of time and effort is invested to understand this complexity.
- Benefit for the investor and subsequent operation of the building, expected flexibility and complexity in design.
- The BIM method offers advanced options and procedures for creating documentation. BIM software is a powerful tool in the preparation of buildings. However, the information contained in the BIM model created must be fit for purpose.
- Suitable for use in large office and retail projects.
- More of a technical and quantification tool and less of a design methodology tool.
- 3D definitely yes, find a reasonable level of standard, i.e. don't overdo it right from the start, agree on interchangeable mutually compatible formats.
- Overall, of course, the advantages listed above prevail and I expect that in 5-10 years it will be the absolute majority way of designing.
- Large practices should consider building a BIM team that specializes on coordination and transfer of data, customized workflow.

Annex B
Research Data and their Evaluation

2. Questionnaires

2.2. Designers

Annex B
Research Data and their Evaluation

2. Questionnaires
2.2. Designers
2.2.1. Head Engineers

Questionnaire

Question #1

I consider BIM a helpful design tool:

a. Yes
b. Rather not
c. No
d. I do not know

Question #2

I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):

a. Yes
b. Rather not
c. No
d. I do not know

Question #3

The scope of a project does not matter if BIM is used:

a. Yes
b. Rather not
c. No
d. I do not know

Question #4

If the BIM method is used, the project typology does not matter:

a. Yes
b. Rather not
c. No
d. I do not know

Question #5

The BIM method suits the following project types:

a. residential
b. office
c. hotels
d. the type does not matter

Question #6

Indicate the project stages in which developing a digital building information model makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect's Supervision

Question #7

Indicate the project stages in which using the common data environment (CDE) makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect's Supervision

Question #8

Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #9

Indicate who must use the common data environment (CDE) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #10

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

a. project development
b. project development and construction
c. project development and construction, building operation
d. I do not know

Question #11

For expertise (daylighting, construction physics, and similar), I use the BIM digital information model:

a. Yes
b. Rather not
c. No
d. I do not know

Question #12

I use the BIM information model as a source document for BOQ:

a. Yes
b. Rather not
c. No
d. I do not know

Question #13

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

a. Yes
b. Rather not
c. No
d. I do not know

Question #14

Describe the advantages of using the BIM method in the project development briefly:

Question #15

Describe the cons of using the BIM method in the project development briefly:

Question #16

Add your brief comment to using the BIM method in the project development:

Question #17

If BIM is used, architects must employ this method too:

a. Yes
b. Rather not
c. No
d. I do not know

Question #18

If BIM is used, architects must also employ the BIM information model:

a. Yes
b. Rather not
c. No
d. I do not know

Question #19

If BIM is used, architects must also employ the CDE (common data environment):

a. Yes
b. Rather not
c. No
d. I do not know

Question #20

Using BIM, the information details in individual stages differ from those used in the conventional design process:

a. Yes
b. Rather not
c. No
d. I do not know

Question #21

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

a. Yes
b. Rather not
c. No
d. I do not know

Question #22

Describe briefly what fundamental data architects should provide in different design stages if using the BIM method:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

Question #23

Describe the basic requirements on architects' work briefly if employing the BIM design method:

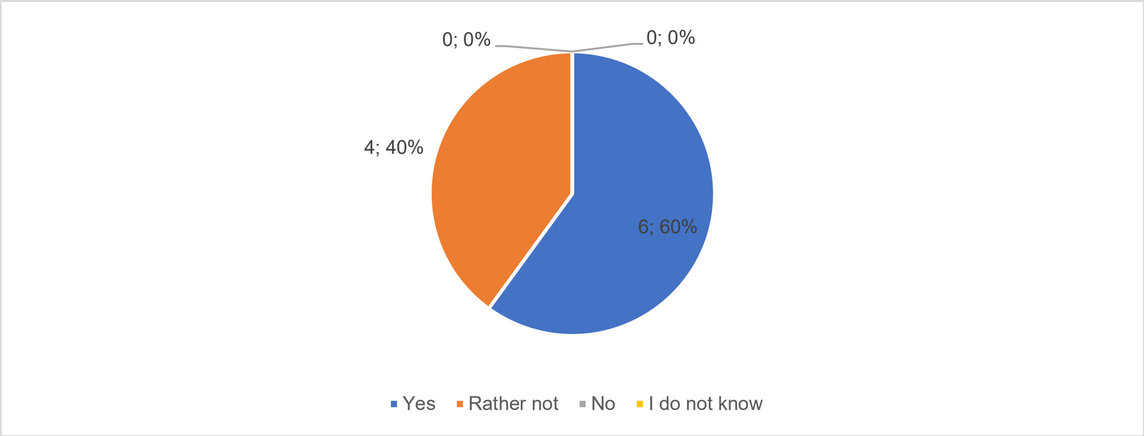
Question #24

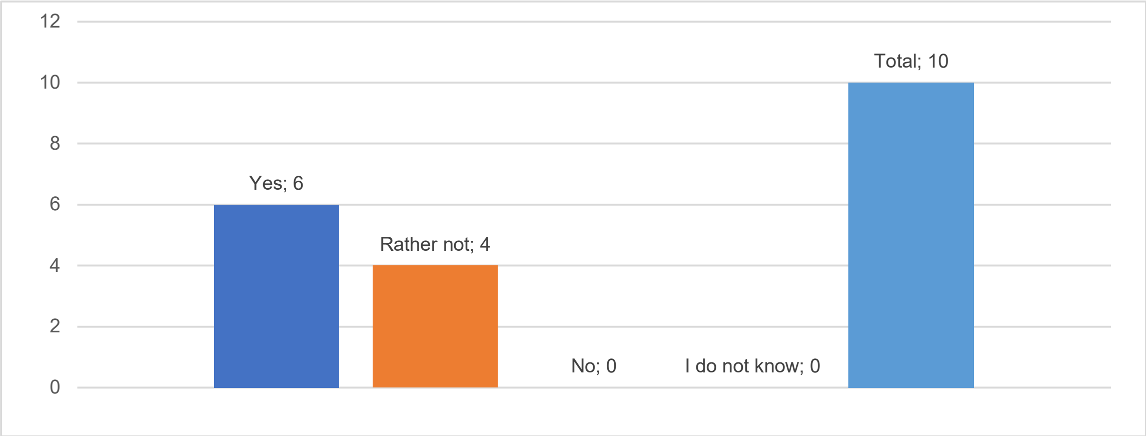
Describe the basic benefits of architects' use of the BIM design method briefly:

Question #25

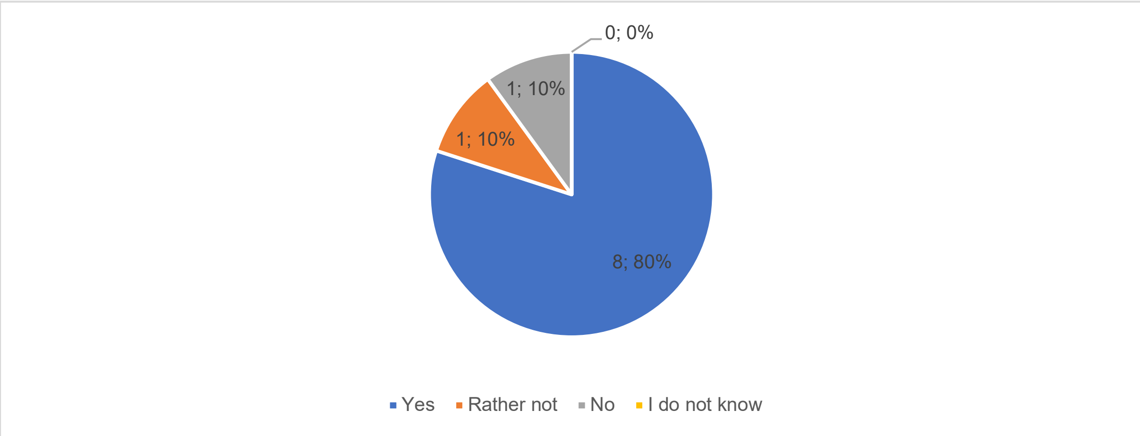
Describe the fundamental problems of architects' use of the BIM design method briefly:

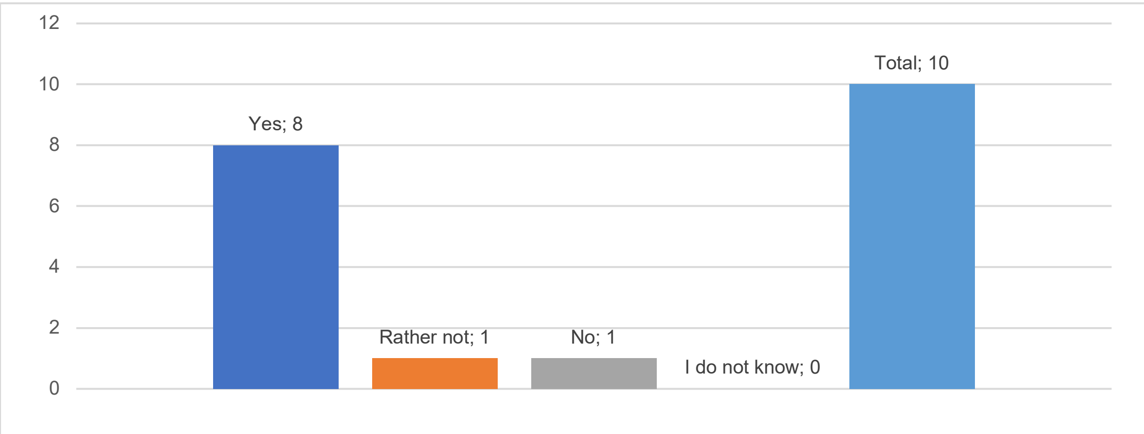
Question #1.	**I consider BIM a helpful design tool:**
Yes	6
Rather not	4
No	0
I do not know	0
Total	**10**



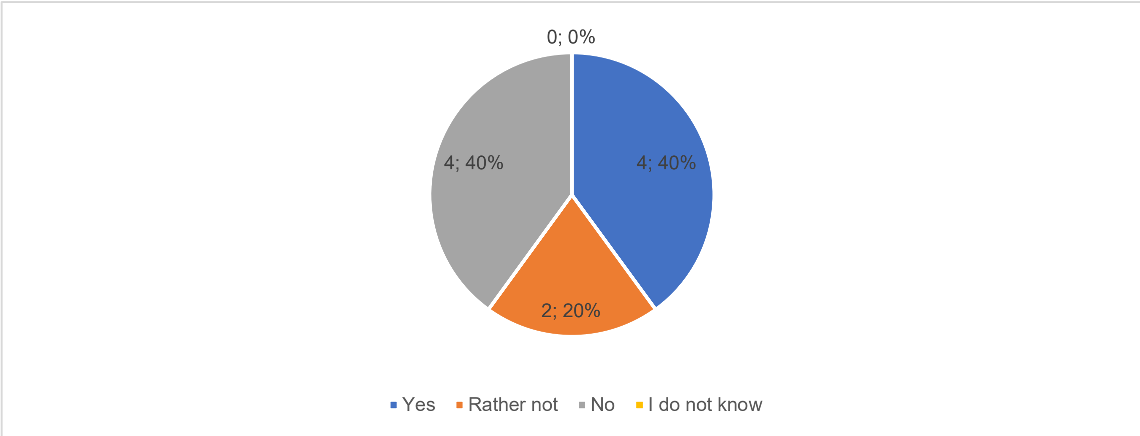


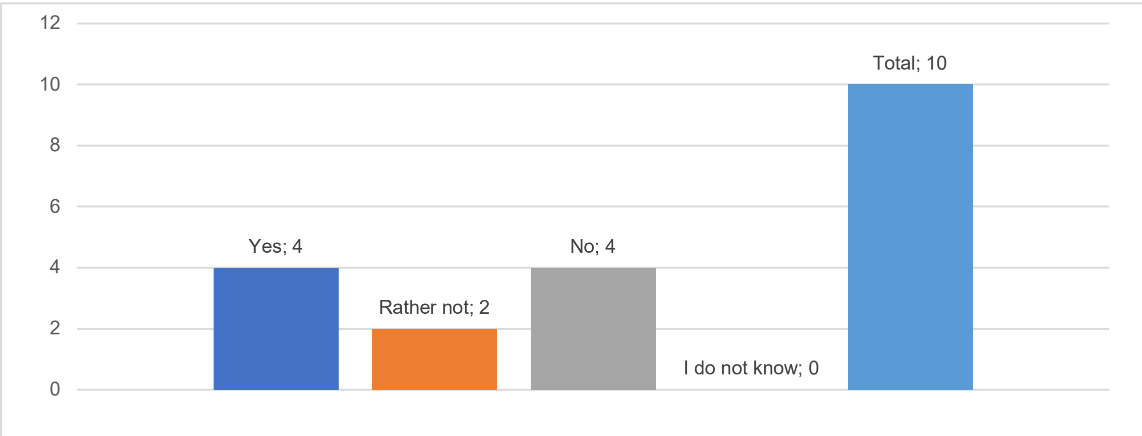
Question #2.	**I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):**
Yes	8
Rather not	1
No	1
I do not know	0
Total	**10**



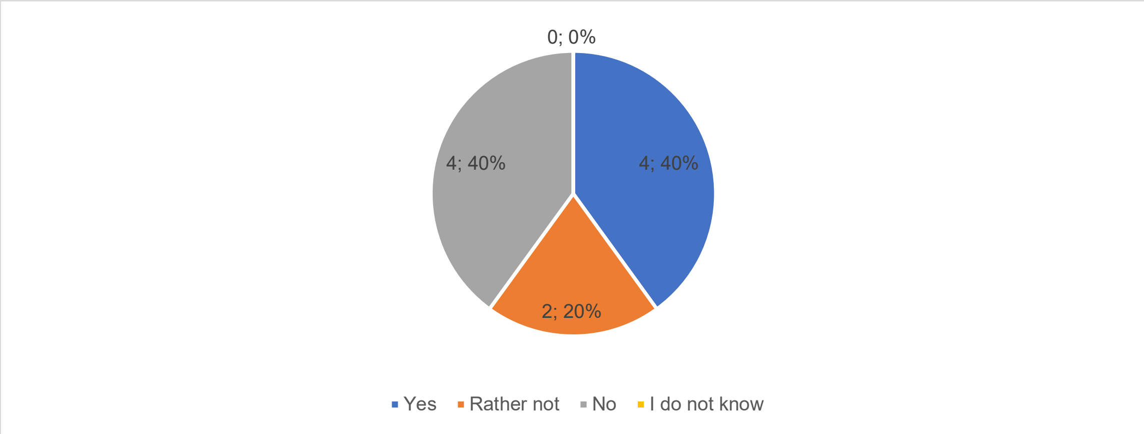


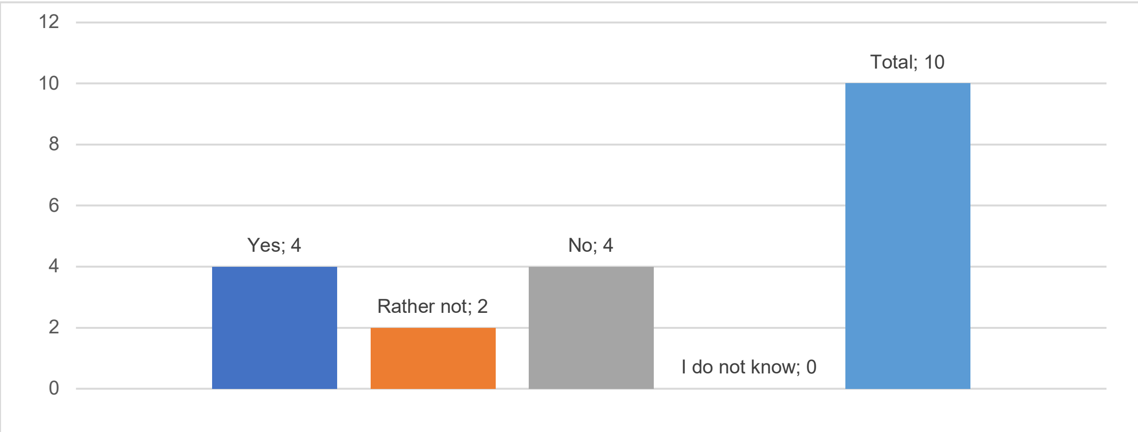
Question #3.	**The scope of a project does not matter if BIM is used:**
Yes	4
Rather not	2
No	4
I do not know	0
Total	**10**



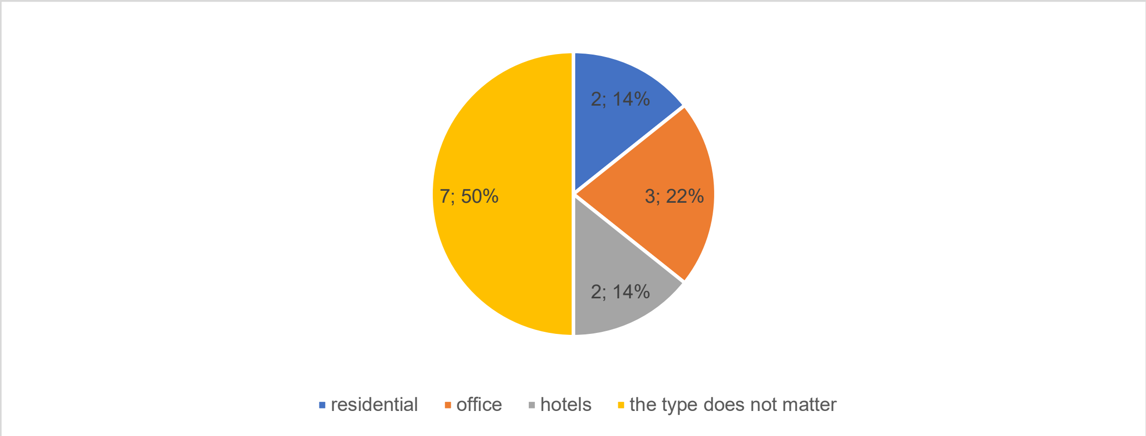


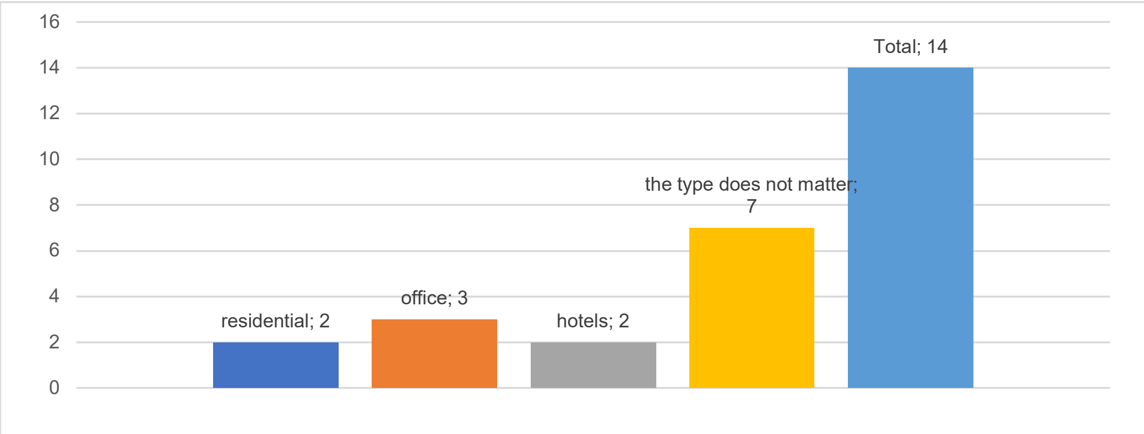
Question #4.	**If the BIM method is used, the project typology does not matter:**
Yes	4
Rather not	2
No	4
I do not know	0
Total	**10**



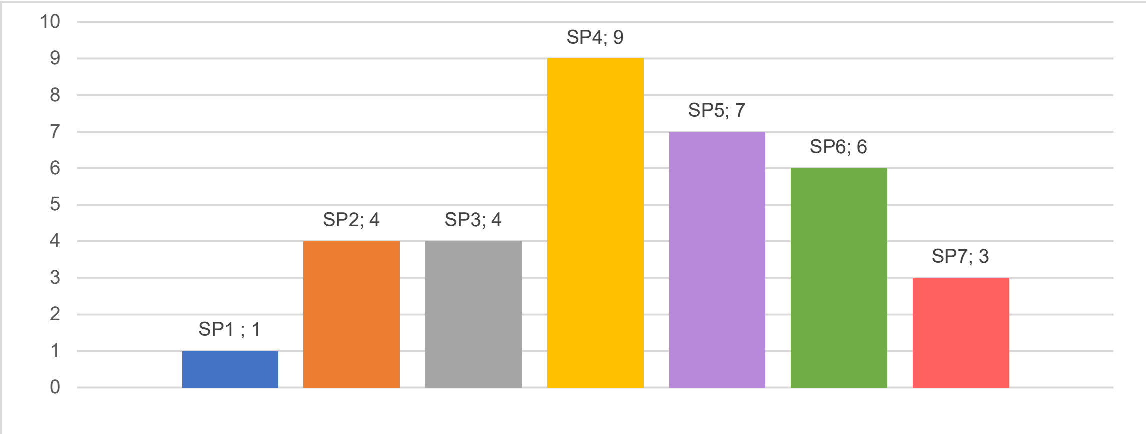


Question #5.	**The BIM method suits the following project types:**
residential	2
office	3
hotels	2
the type does not matter	7
Total	**14**

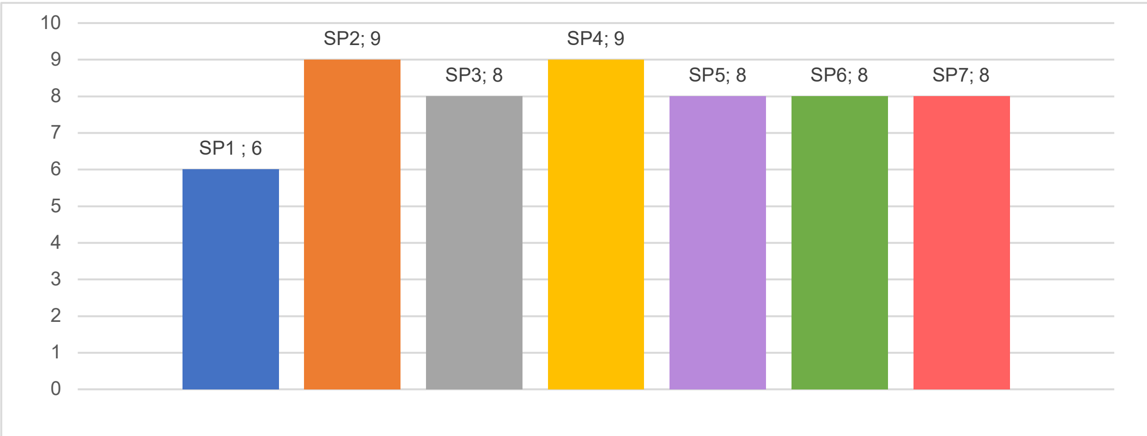




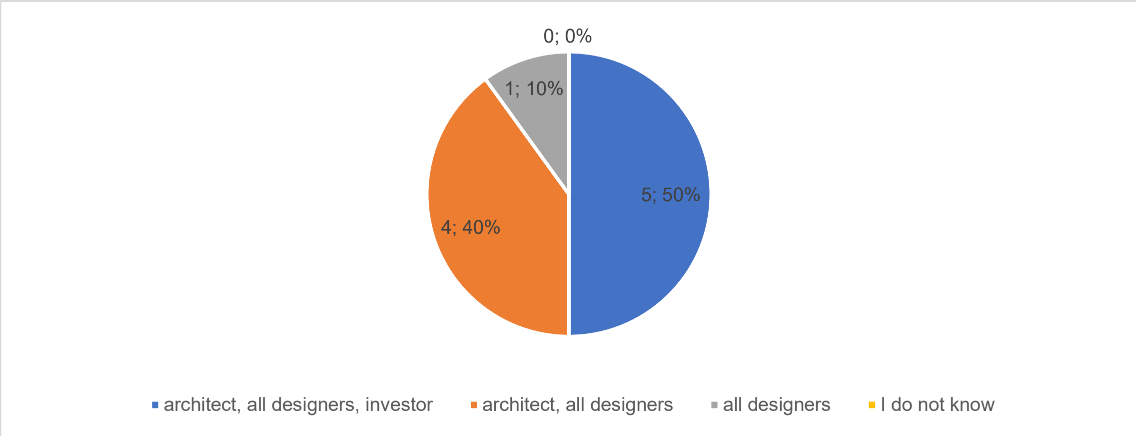
Question #6.	**Indicate the project stages in which developing a digital building information model makes sense:**	
SP1	Project Initiation	1
SP2	Preliminary – Concept Design	4
SP3	Land Zone Permit Design	4
SP4	Building Permit Developed Design	9
SP5	Detailed Design	7
SP6	List of Works and Deliverables	6
SP7	Architect's Supervision	3
Total		**34**

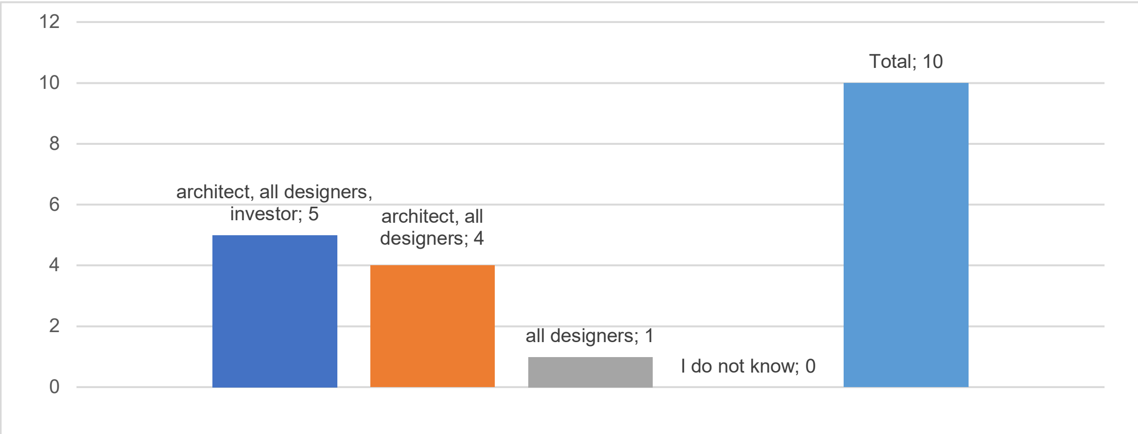


Question #7.	**Indicate the project stages in which using the common data environment (CDE) makes sense:**	
SP1	Project Initiation	6
SP2	Preliminary – Concept Design	9
SP3	Land Zone Permit Design	8
SP4	Building Permit Developed Design	9
SP5	Detailed Design	8
SP6	List of Works and Deliverables	8
SP7	Architect’s Supervision	8
Total		**56**

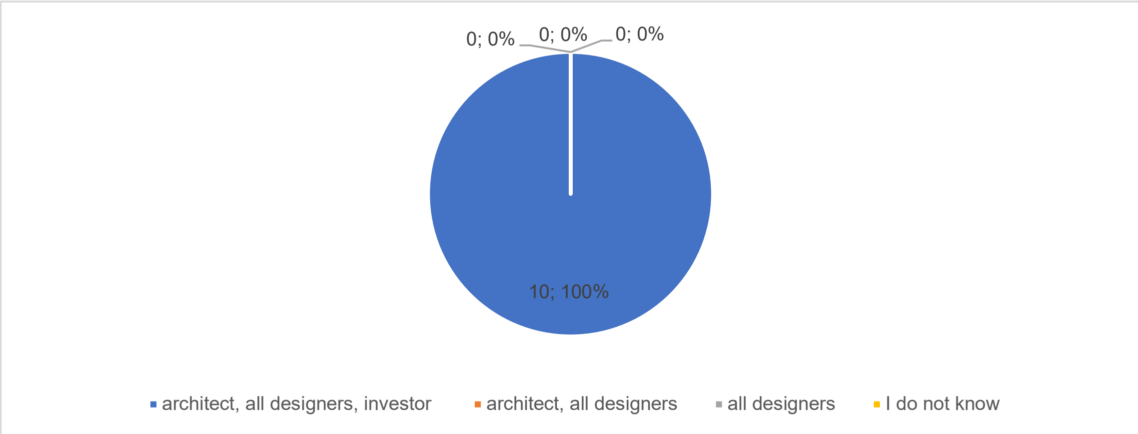


Question #8.	**Indicate who must use the (digital) building information model (IMS) for a meaningful design process:**
architect, all designers, investor	5
architect, all designers	4
all designers	1
I do not know	0
Total	**10**

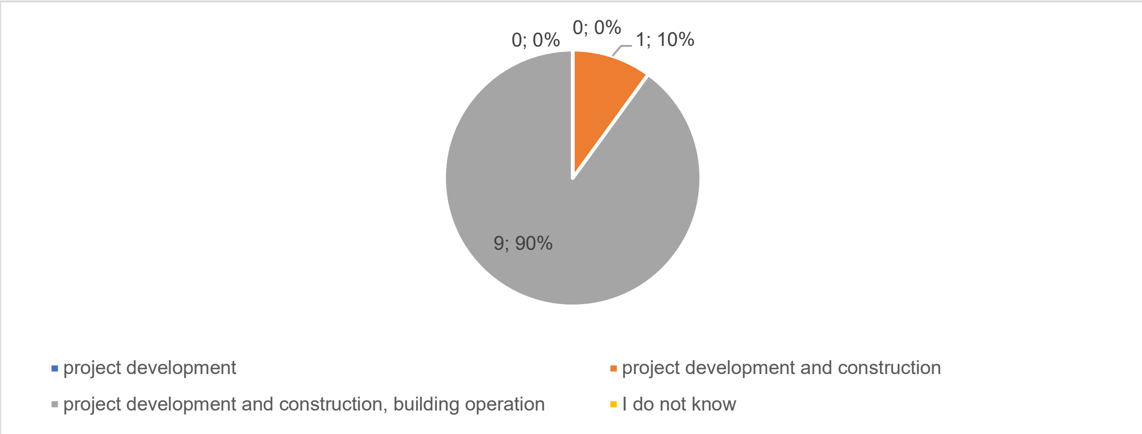


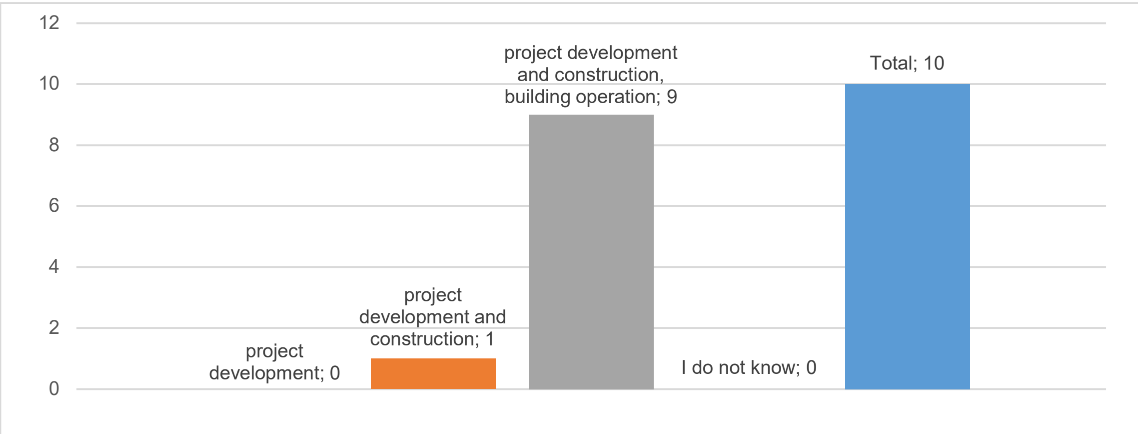


Question #9.	**Indicate who must use the common data environment (CDE) for a meaningful design process:**
architect, all designers, investor	10
architect, all designers	0
all designers	0
I do not know	0
Total	**10**

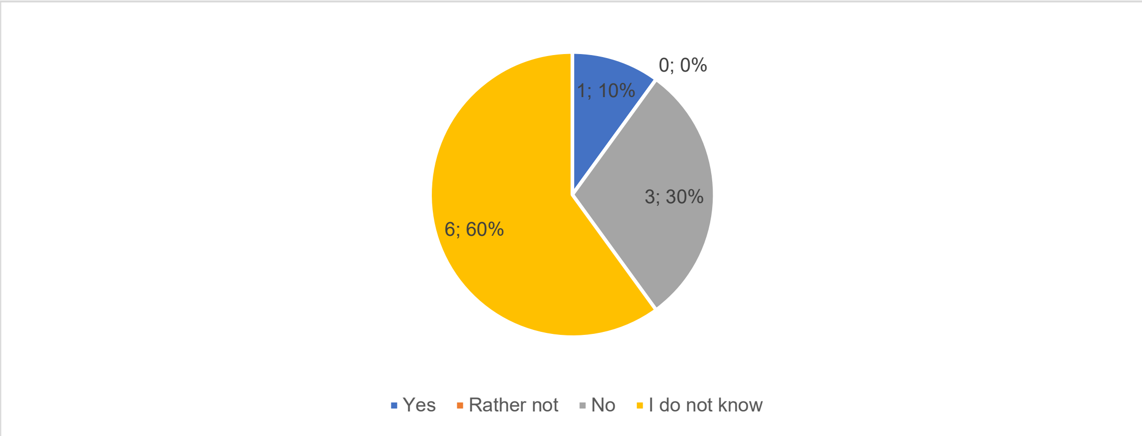


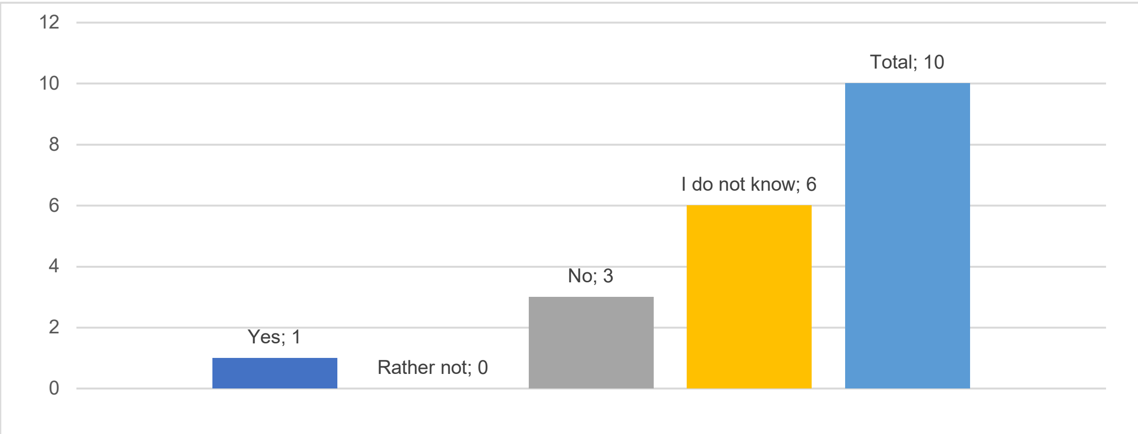
Question #10.	**The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:**
project development	0
project development and construction	1
project development and construction, building operation	9
I do not know	0
Total	**10**



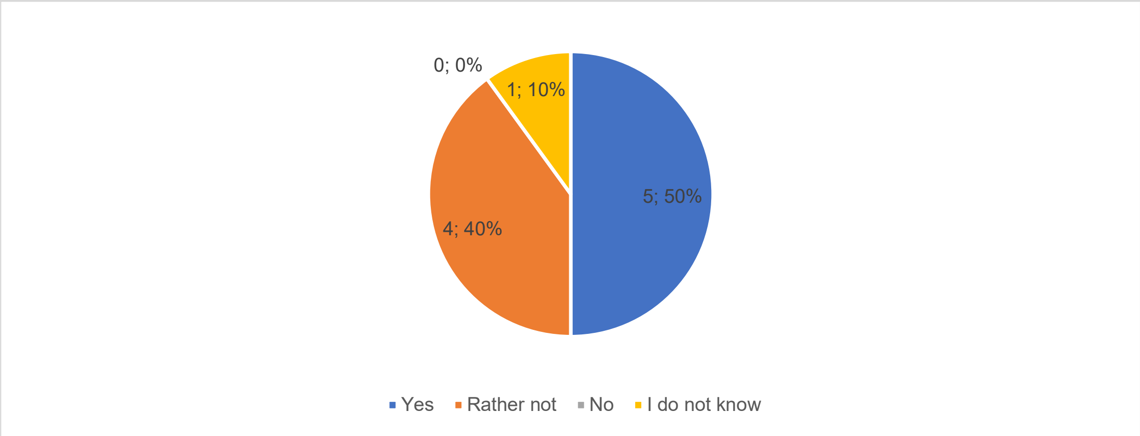


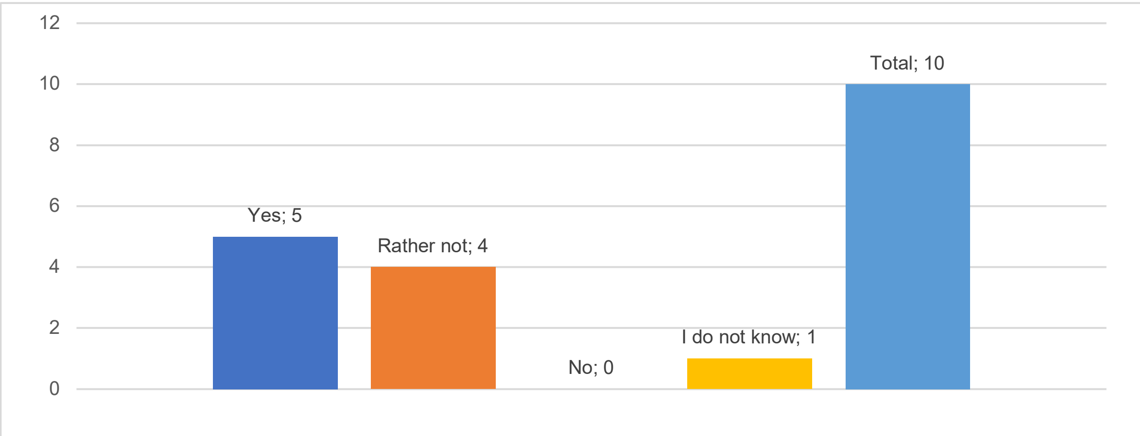
Question #11.	For expertise (daylighting, construction physics, and similar), I use the BIM digital information model:
Yes	1
Rather not	0
No	3
I do not know	6
Total	**10**



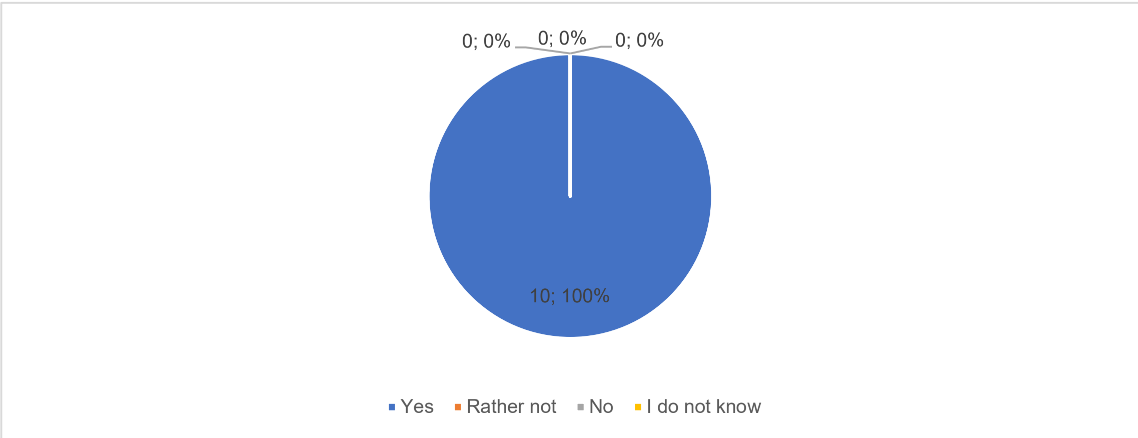


Question #12.	**I use the BIM information model as a source document for BOQ:**
Yes	5
Rather not	4
No	0
I do not know	1
Total	**10**

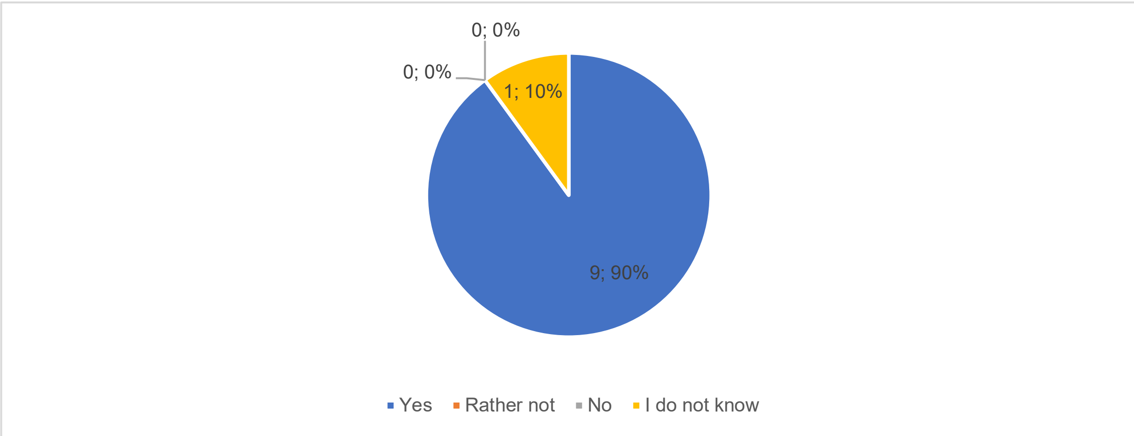


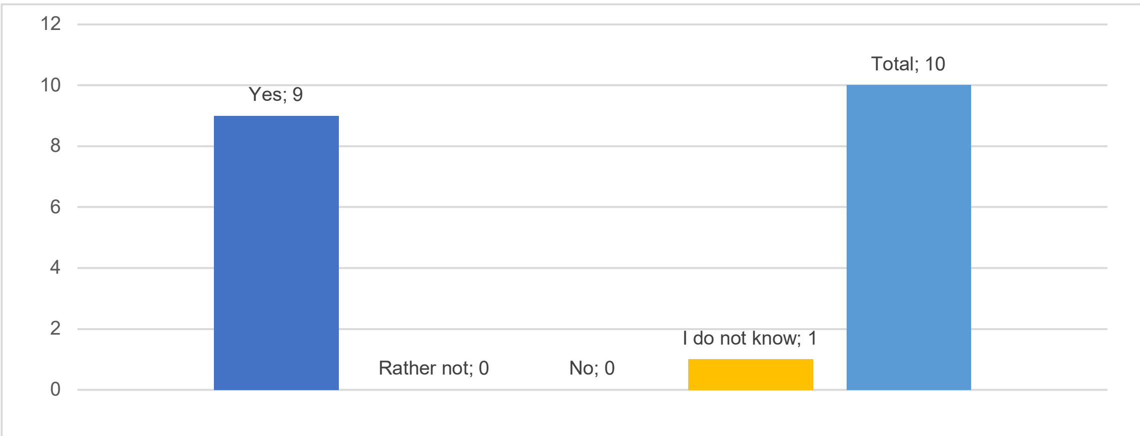


Question #13.	**Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?**
Yes	10
Rather not	0
No	0
I do not know	0
Total	**10**

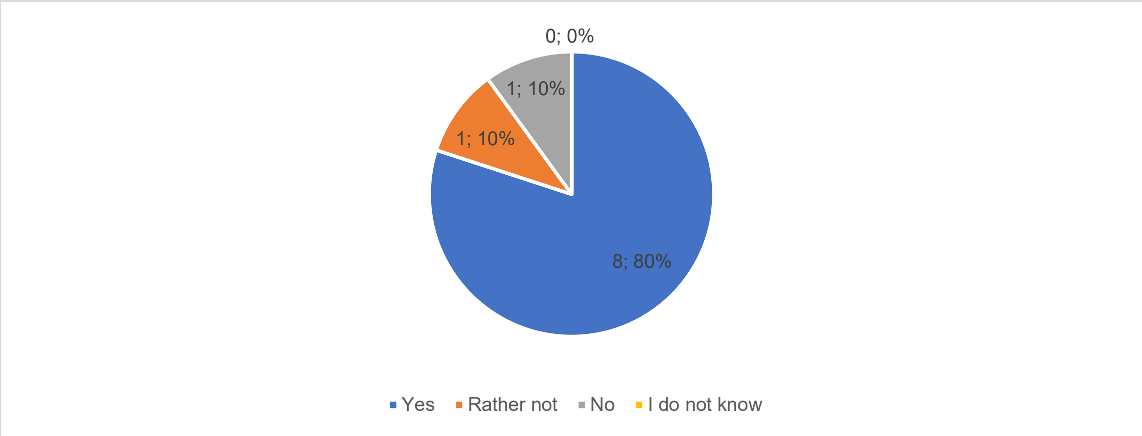


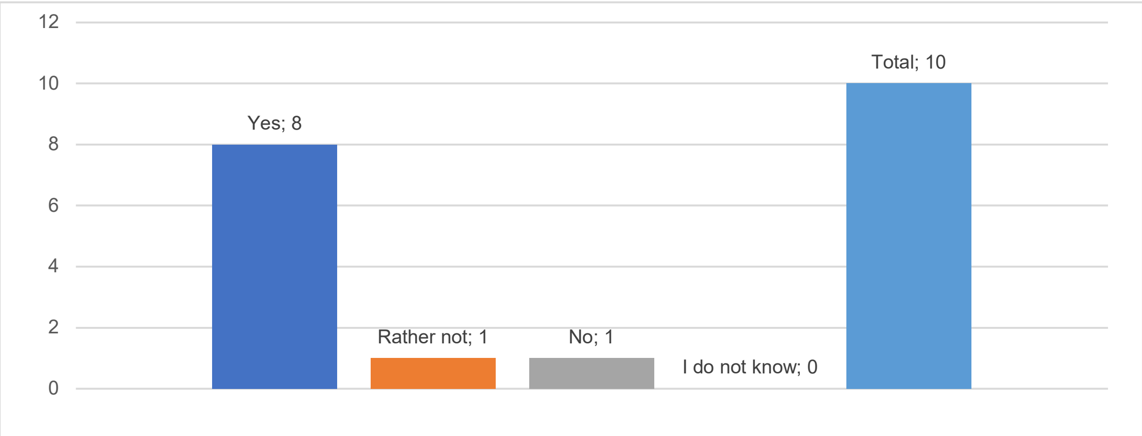
Question #17.	**If BIM is used, architects must employ this method too:**
Yes	9
Rather not	0
No	0
I do not know	1
Total	**10**



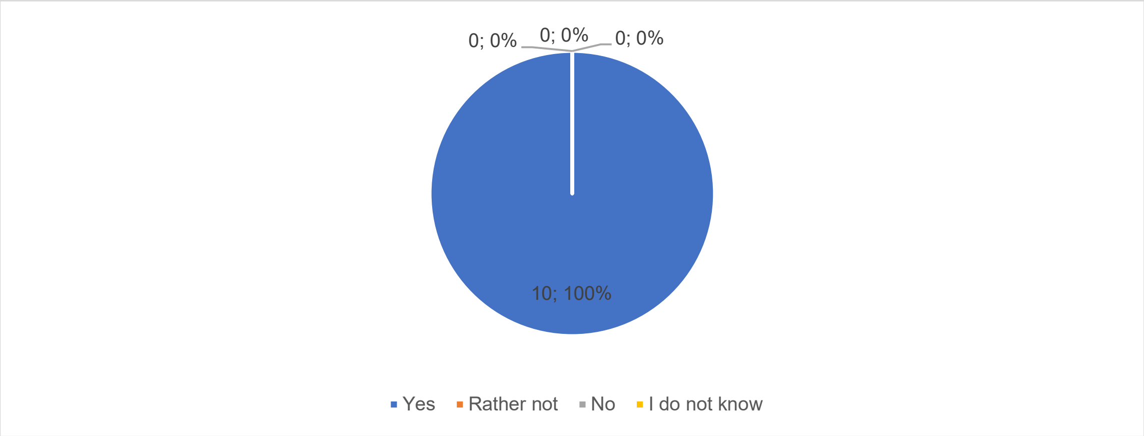


Question #18.	**If BIM is used, architects must also employ the BIM information model:**
Yes	8
Rather not	1
No	1
I do not know	0
Total	**10**

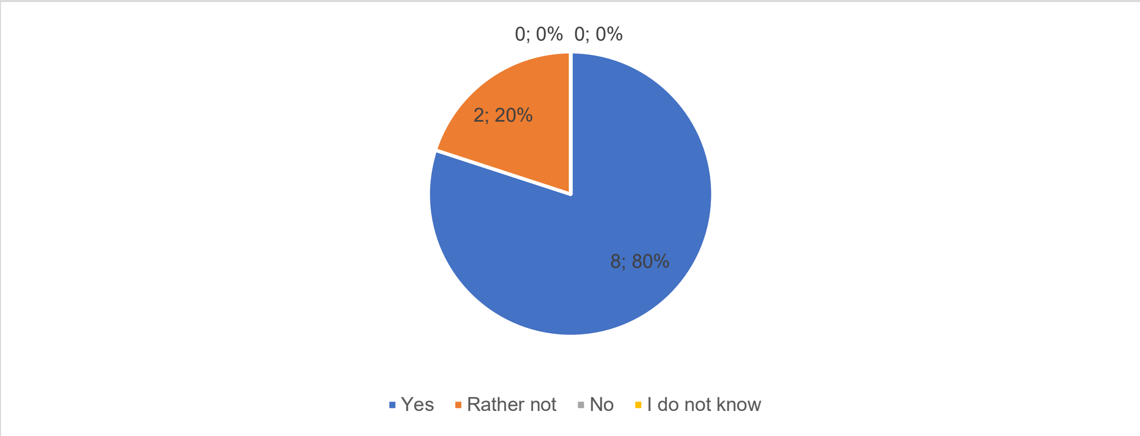


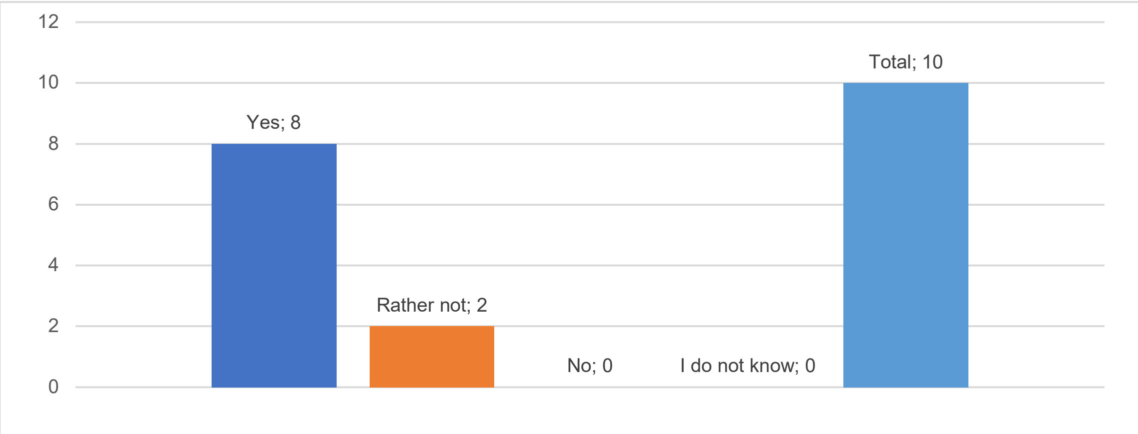


Question #19.	**If BIM is used, architects must also employ the CDE (common data environment):**
Yes	10
Rather not	0
No	0
I do not know	0
Total	**10**

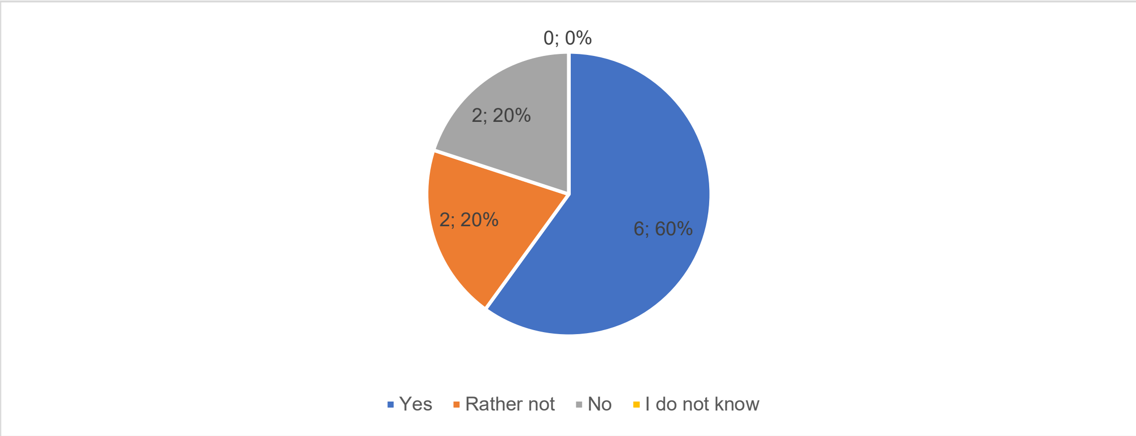


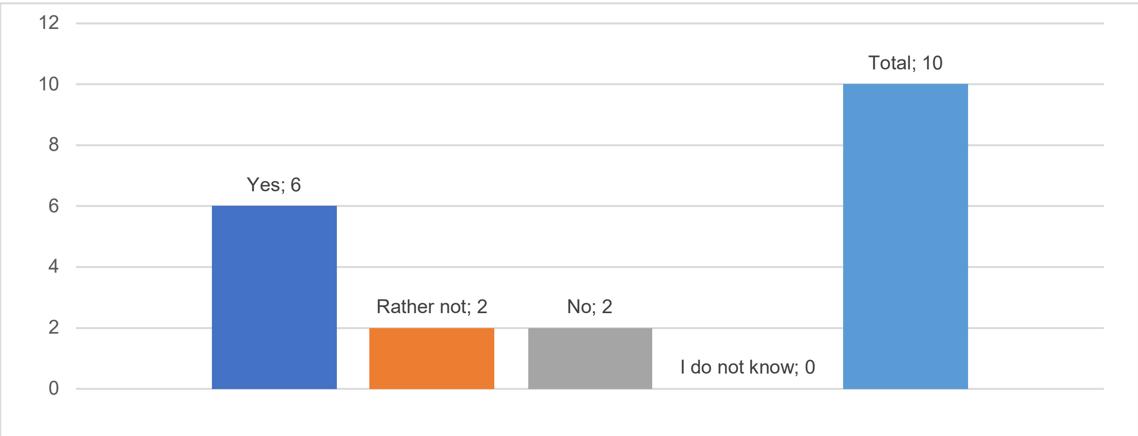
Question #20.	**Using BIM, the information details in individual stages differ from those used in the conventional design process:**
Yes	8
Rather not	2
No	0
I do not know	0
Total	**10**





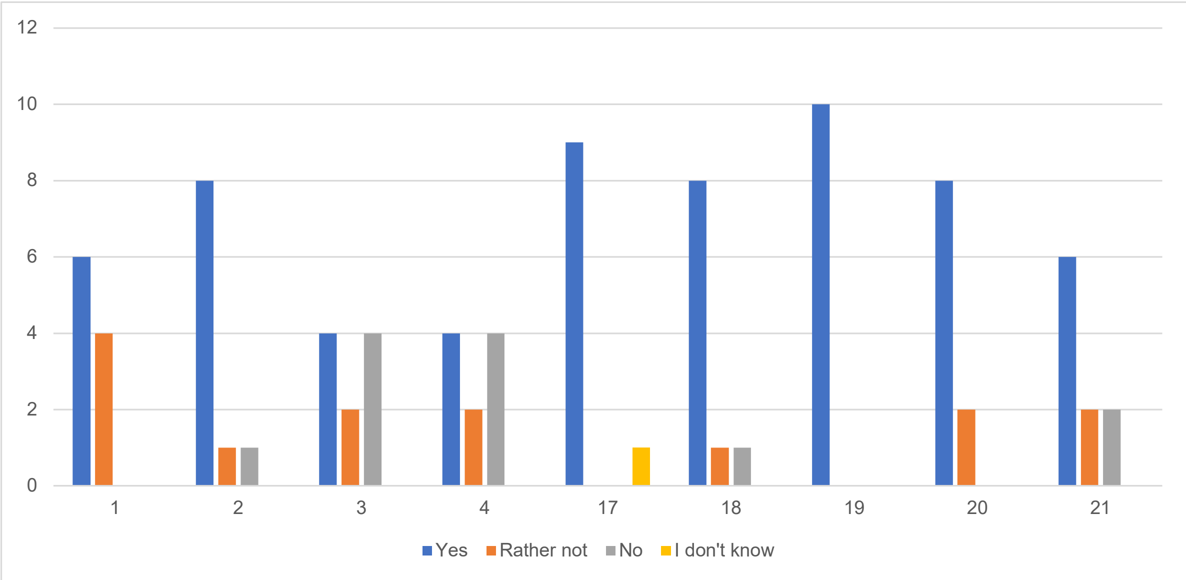
Question #21.	Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?
Yes	6
Rather not	2
No	2
I do not know	0
Total	**10**

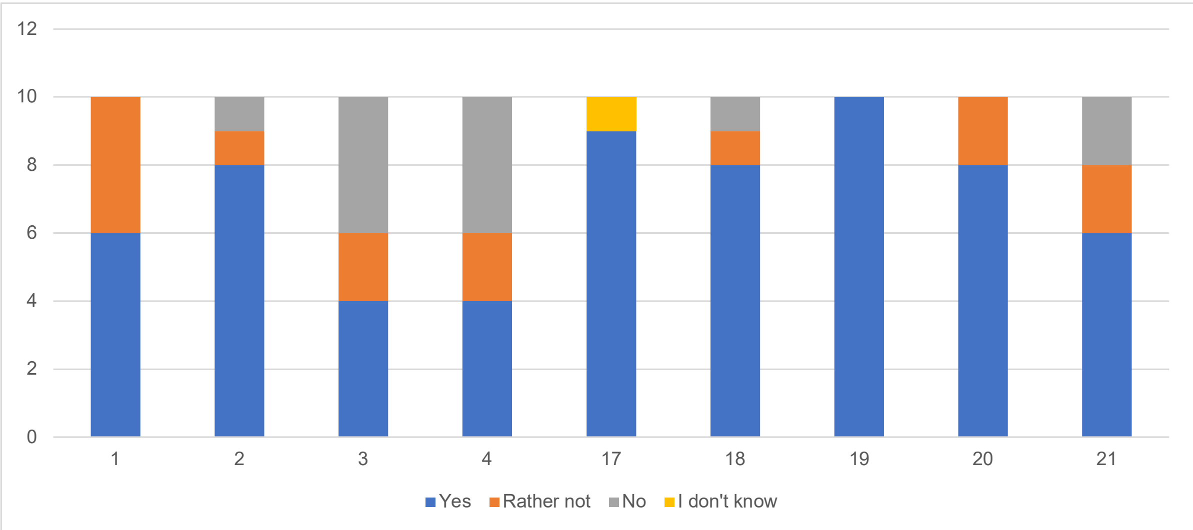




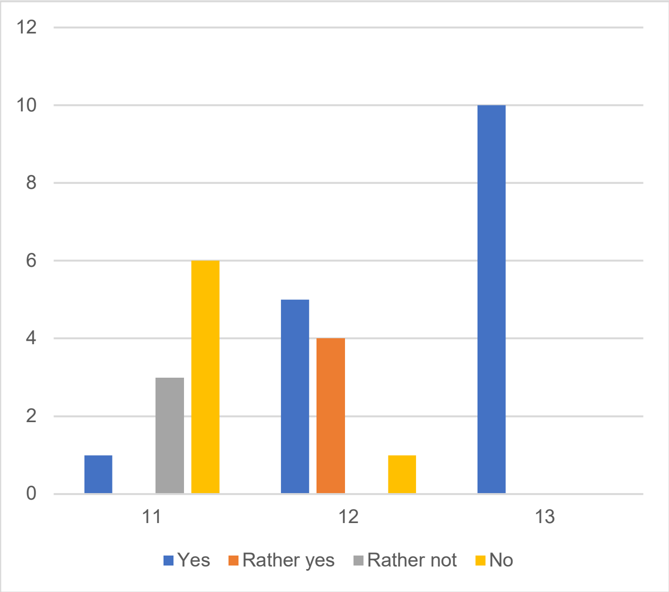
Summary Graphs

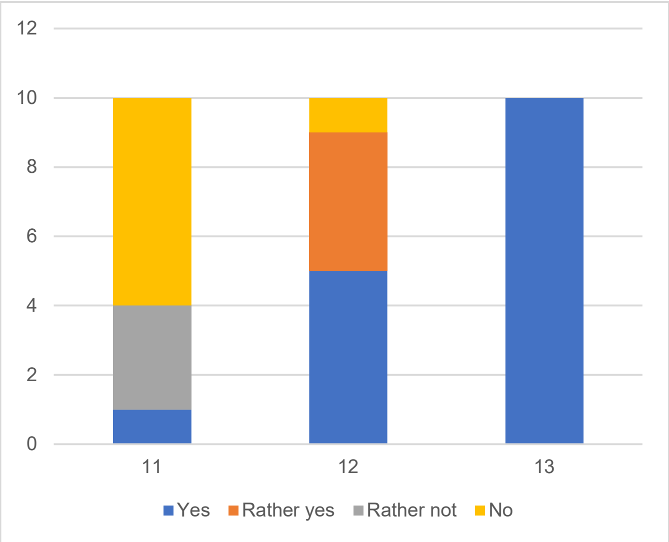
Question	1	2	3	4	17	18	19	20	21
Yes	6	8	4	4	9	8	10	8	6
Rather not	4	1	2	2	0	1	0	2	2
No	0	1	4	4	0	1	0	0	2
I don't know	0	0	0	0	1	0	0	0	0
Total	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**





Question	11	12	13
Yes	1	5	10
Rather yes	0	4	0
Rather not	3	0	0
No	6	1	0
Total	**10**	**10**	**10**





Questionnaire: Clarification Replies

Question #1

I consider BIM as a helpful design tool:

- This software does not work well (CDE and modelling); otherwise, I would say YES. However, it is very laborious and idling during synchronizing is too long.
- It depends on what it is used for and under which conditions.

Question #2.

I understand BIM as a method for the creation of an information model and data sharing via the Common Data Environment (CDE):

- OK, unless it does not bring more programming than designing
- I do not understand sharing as part of the information model; anything can be shared, for instance, an information model.

Question #3.

The scope of a project does not matter if the BIM method is used:

- No. The structure/interface of the modelled/number of models it consists of/quantity of data/size of the building also naturally matters.
- Yes, it does.
- No, it does not matter regarding the decision making whether 3D modelling should be used or not.

Question #4.

If the BIM method is used, the project typology does not matter:

- No – the structure/interface of the modelled/number of models it consists of/quantity of data/size of the building also naturally matters.
- Well, if we discuss buildings. If the project is a village technical infrastructure, it does.
- It does.
- I think it does not.

Question #5.

The BIM method suits the following project types:

- Residential, office, hotels – namely these three types are likely to be OK, but what about a renovation of a cloister?

Question #6.

Indicate the project stages in which developing a digital building information model makes sense:

- SP1:
  - It is good to have a manual specifying what we want.
  - At the level of detail of the given stage, after the software's initial troubleshooting.
- SP2:
  - Architects develop it including the terrain and context; the output is groundwork for landscaping, contour lines in the coordination site plan, a façade model, a mass design, or others, if necessary.
  - At the level of detail of the given stage, after the software's initial troubleshooting.
  - Architects develop it.
  - In the case of very complicated buildings (the Veleslavín Railway Station), the architect prepared a study in 3D Sketchup – he could not capture all tricky form issues.
- SP3:
  - Architects develop it, including the terrain and context; the output is the groundwork for landscaping, contour lines in the coordination site plan, a façade model, a mass design, or others, if necessary.
  - Architects develop it.
  - It should be further detailed as early as in the DUR (planning stage) if possible, but with more demanding clients, it can be a stage at which the job done for the stage SP4 is at risk of being thrown out.
- SP4:
  - AED+ENGINEERS+ARCH /in the form of design modifications, it does not affect the model/.
  - Normal building.
- SP5:
  - AED+ ENGINEERS+ARCH /in the form of design modifications, it does not affect the model/.
- SP6:
  - Yes, a groundwork for quantity surveyors; they can retrieve many issues from the model /partition areas, makeups/, but they usually do it on paper.
  - The model from the execution stage (DPS) is used.
- SP7:
  - Only in the case of client changes.
  - Rather not, that is not for the design team.
  - The model from the execution stage (DPS) is used.

Question #7.

Indicate the project stages in which developing a digital building information model makes sense:

- The condition is a fixed position and a clearly defined structure of accesses and the use by all members.

- However, it needs strong discipline, time, and energy to set up a reasonable structure + the SW must work as it should and not how various tools by Microsoft work today. It must be reliable.
- From the beginning, no problem if it is clearly specified who will supervise it and have it under control.
- Sharing of information on the common platform from the beginning; is the CDE a concrete common platform?

Question # 8.

Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

- With architects, it is a debatable issue.
- Architects, all designers, investors – of course, naturally, investors ideally too.
- Use in which sense? Anybody can open it for reading and in all stages, but it is not acceptable if anyone is allowed to make a mess in it uncontrollably; always one person must have it under control.
- At least the architects and all designers who design technologies.

Question # 9.

Indicate who must use the Common Data Environment (CDE) for a meaningful design process:

- If it works, then everybody can use it and ever since the beginning, no issue

Question # 10.

The advantage of using the BIM method is reflected in the following stages of the life cycle of a building:

- Regarding the building's use, it is a matter of its type.
- Project preliminaries, construction, use – the project development is more complex, and the BIM manual is substantial.
- It should be this way, and it is likely to be when the time matures.
- Advantages are clear, but there must be some for us designers too.

Question #11.

I use the BIM digital information model: for expert assessing (daylighting, construction physics, and similar):

- We can use the CDE according to the BIM definition.
- Special software does not much use the Revit model so far.
- Yes, if possible.
- Not yet.

Question # 12.

I do use the BIM information model as a source document for BOQs:

- So, yes, if possible (although not in such a way that the involved specialist asks me, after two weeks, to better send him/her drawings in the DWG format; it is just lost time then).
- Or it should be better used by an automatically unified family template and similar.

Question # 13.

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the Common Data Environment (CDE)?

- THAT IS EXACTLY THE MOST FUNDAMENTAL ITEM. EVERYTHING DEVELOPS FROM IT. BIM CANNOT BE USED BASED ON THE OLD SYSTEM OF CONTRACTS, TIME SCHEDULES, AND FOR OLD MONEY – EVERYTHING MUST BE COMPLETELY REDONE.
- Yes, if the model is to be developed.

Question # 14.

Describe the advantages of using the BIM method in the project development briefly:

- The answers concern the project development stage:
  - It is foolproof if carefully modelled and clearly structured.
  - Coordination.
  - If it is [*used*] during the project development, it helps an inexperienced investor/architect define what he/she, in fact, wants.
  - All specifications, easy generating.
  - It can help quantity surveyors if they are familiar with it.
- Possibility to self-control within a 3D perspective; possibility to coordinate in a 3D space.
- Another advantage is system enforcement to make the data system well organized. However, it brings along some restrictions too.
- I do not have any idea at this moment.
- 3D designing, possible systemization, easier browsing, spatial coordination.
- All information for other designers is, theoretically, contained in the model. Thus, theoretically, there is no need to have other supporting documents.
- Data stored in one place.
- I guess that the BIM's currently "promised/proclaimed/expected" advantage should be:
  - * Containing all crucial information on the project from the moment a contract is signed with the designer /architect to the issued operation permit (project team).
  - * Especially, to simplify, better organize, make more effective or faster the process of project development from the moment the contract is signed to the issued operation permit (project team).
  - * Providing all necessary information to settle contractual relations with the Main Contractor after issuing the final certificate and needed for possible future building acquisition (investor team).
  - * Providing all necessary documents after the final certificate is issued needed for effective facility management and operation (facility team).

    - * Providing a continuous up-to-date data information basis for all following alterations, modifications, building re-acceptation processes throughout the building's entire life cycle.
- Better and instant information on the spatial arrangement, BOQs, product schedules.
- Easier imaging of more complex buildings = 3D model.
- Coordination [*between*] architects, engineers, and the investor.
- Coordination between engineers. 4. Basic information on used technologies.
- 3D vs 2D, modification at one place, automatic projection everywhere into all drawings and tables, the possibility of block modifications, generating elevations and sections, and similar.

Question # 15.

Describe the drawbacks of using the BIM method in the project development briefly:

- The answers concern the project development stage:
    - If modelling is not carried out carefully, it is a mess, but it applies to any work or program;.
    - There are not all elements in families or are at the level of detail we do not want (kitchen equipment/technology).
- Increased need for work to develop documents, high demand of experience of designers (they must be skilled designers + master a complicated SW). Furthermore, high demands on HW (when developing large projects involving more persons, it becomes hard to use).
- Software troubleshooting (mistakes, illogic controlling, etc.) The need to adjust to SW's capabilities.
- Everything lasts much longer.
- To start working on a model, most standards must be known, at least for the architecture.
- There is pressure on the certainty of the information model regarding the project stage.
- Implementing all information into a model is lengthy; tagging all elements with specific codes is time-consuming.
- At this moment and space, I understand the BIM's drawbacks in the following manner:
    - * The system is being born, and unified terminology does not exist.
    - * All sections of the design and execution process infringe in it = designers/architects/investors/developers/state administration and others.
    - * Companies developing these systems affect the process substantially; they promise "miracles", but their only goal is to sell a "product"/fill the market.
    - * The above generates "confusion" in opinions, requirements, expectations of the entire professional and the public in construction engineering and industry.
    - * The above-mentioned "environment" creates an enormously uncomfortable environment, especially for "project developers", in which it is almost impossible to realize this system so that it would help. On the contrary, it causes misunderstanding, time delays, decreases the quality of submitted work; all that generates space for endless discussions about what the project should contain, problems with invoicing of the work done, complications on the site, and so on.

    - * The elementary drawback is the increasing number of BIM/CDE software systems on the market. This situation generates extreme, in my opinion, untenable requirements on knowledge of all design teams members if they work on several simultaneously managed projects contracted into different environments of BIM/CDE systems.
- The agreed model's content; it is difficult to estimate the necessary time and the fee: implementing alterations, comments, and so on into a 3D model needs much more time than into a 2D project; the number of requested alterations seriously matters; model's preparation needs more time to make it really reliable (in the sense of its spatial arrangement, BOQ, …).
- Wrongly selected level of detail for the given stage.
- Mode demanding coordination of engineers' work vs investor's checking.
- Time consumed vs requirements of authorities = work efficiency.
- Time consumed vs well-selected project costs.
- The need for proper preparation before the start of work = greater emphasis on the time required preparation.
- The complexity of the design in the early project stage
- Inconsistencies in the methodology between investors (LOD).

Question # 16.
Add your brief comment to using the BIM method in the project development:

- There should be a unified table for all projects and individual stages. It should be possible to tick what the investor requests for this and that project – projects are similar.
- I think that at present, it means slower work and more time spent. It is the future we cannot escape, but it is currently undergoing a tumultuous development that is hard to monitor when we need to design at the same time.
- Well-defined rules must be set, and we need highly professional BIM specialists. In my opinion, the same as each project has a Lead Engineer (construction engineer) (HIP), there must be a BIM manager available to designers devoting approximately 50 % of his/her time to the project. This person (BIM manager) should prepare modelling methods for the given building in advance + actively model more complex items with construction engineers and the Lead Engineer. Today, designers do all that while not having enough time to perform the designer's job and just construct models indiscriminately.
- As long and BIM follows such a runaway development, designers will not be able to follow it and shall flounder in it.
- I do not currently have any idea.
- If we talk about 3D (Revit, for instance), then it makes sense. But loading all data into Revit (i.e., BIM) and even those that do not necessarily have to be included wastes time and money no one will pay. Full BIM makes sense only as an as-built model, especially for government contracts where specific products must not be specified.

- If BIM is to work correctly, then the following must be achieved in my opinion:
    - * The terminology must be unified.
    - * Information that is necessary/prerequisite part of a "project" must be unambiguously categorized.
    - * Areas not directly linked to the project = facility, budgets, other commercial and operation data, must be allocated into a separate group.
    - * The information "level of detail" must be unambiguously defined for each design stage
    - * The "communication/information" contact method between all team members must be unambiguously defined, e.g.:
    - *** ... that it is not necessary to share "everything", because "sharing" needs time to sort out and load information, build address structures, control "accesses";
    - *** ... investors/contractors cannot actively enter the daily work of the design team by permanent commenting "unfinished work".
- See items 14 and 15.
- A well-selected project type.
- Investor's clear idea vs time and financial possibilities.
- Sufficient project preparation for using the BIM method.
- A well-selected project stage for effective use of the BIM method.
- A clarified LOD for the given stage.
- A well-selected CDE = all participants in the process must cooperate.
- Well-set up capacities.
- Well-set up coordination processes.
- Well-set up control processes.
- Well-set up output formats (2D prints vs 3D model).
- There is no point in just making a construction model – an MEP model must be made too, and everybody must work on the same model.
- Must be standardized according to the LOD – info and database detail.

Question # 17.

If BIM is used, architects must employ this method too:

- No, hand sketching is the best method.
- No later than in the planning stage (DUR), then stop; not from the building permission stage onwards.
- It is not necessary; it is recommendable that he/she can at least read the model.

Question # 18.

If BIM is used, architects must also employ the BIM information model:

- Yes, but just for "reading".
- It is not necessary, but it is recommendable that he/she can at least read the model.

Question # 19.

If BIM is used, architects must also employ the CDE (Common Data Environment):

- Perhaps yes if every participant in the project does it.

Question # 20.

Using BIM, the information details in individual stages differ from those used in a conventional design process:

- Yes – data contained in the model must be specified from the beginning.
- Yes, but for worse for us = see Question #13.
- Doors are defined in 2D as a line and an arch; in 3D, a specific type of door is inserted in the model:
    - In documents for building permission (DSP), the information from 3D is redundant, and in execution documentation (DPS), it can even be wrong and will have to be changed;
    - 2D data from building permission (DSP) to execution documentation (DPS) will simply be extended in the door schedule.

Question # 21.

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

- No, but it should be provided even if we do not use BIM; nevertheless, it rarely happens.
- Sometimes and it depends on the type of information provided.
- Considering item 4, it would be welcome in DSP (documentation for building permission); nevertheless, I am afraid that it is unrealistic:
    - I would not expect that more detailed information is needed.

Question # 22.

Describe briefly what fundamental data architects should provide in different design stages if using the BIM method:

- SP1:
    - Elaborate a BIM manual together with AED.
    - Competition study.
    - I cannot describe it now, but it is perhaps very individual from case to case; I cannot answer briefly now.
    - Briefing standards.
    - The same as without the BIM method – see according to 7./8./9. (= 23., 24., 25.).
    - Idea.
    - Whether he/she is going to do it in BIM.
- SP2:
    - Architects develop it, including the terrain and context; the output is the groundwork for landscaping, contour lines in the coordination site plan, a façade model, a mass design, or others, if necessary.
    - A study, ideally including the architect's model.

    - I cannot describe it now, but it is perhaps very individual from case to case; I cannot answer briefly now.
    - Capacity data – required quantities of individual functions and similar.
    - The same as without the BIM method – see according to 7./8./9. (= 23., 24., 25.).
    - Layouts, the building's heigh, positioning in the context.
    - Design.
    - A Basic 3D model considering structural and technology requirements, a basic layout, material design requirements.
- SP3:
    - Architects develop it, including the terrain and context; the output is the groundwork for landscaping, contour lines in the coordination site plan, a façade model, a mass design, or others, if necessary.
    - Outputs from the architect's model.
    - I cannot describe it now, but it is perhaps very individual from case to case; I cannot answer briefly now.
    - Construction limits (plan and height).
    - The same as without the BIM method – see according to 7./8./9. (= 23., 24., 25.).
    - Follow the information from the study.
    - A check-up of the project regarding the legislation.
    - The same, there is no difference between STS and DUR (study and documentation for planning permission).
- SP4:
    - Layout design, including checking of standard requirements, coordination of end elements, requirements on makeups, a compilation of architect specifications of engineers' sections of the project, architectural details
    - Designers will prepare the model, but the architect should communicate over the model (comments, suggestions, responses to questions) aside from [*preparing*] standard documents for the given stage
    - I cannot describe it now, but it is perhaps very individual from case to case; I cannot answer briefly now
    - complete construction standards
    - The same as without the BIM method – see according to 7./8./9. (= 23., 24., 25.)
    - Follow the information from the planning documentation, products' shape, designed materials
    - Information on materials, colours, layouts, and others
    - Layout requirements on interior materials
- SP5:
    - A confirmation of building permit documents (DSP); added pattern drawings (tiles and other materials or structures); a book of interior elements including their description), design of bespoke products; anchorage and connections details to other structures/trades.

    - Designers will prepare the model, but architects should communicate over the model (comments, suggestions, responses to questions) aside from [*preparing*] standard documents for the given stage.
    - I cannot describe it now, but it is perhaps very individual from case to case; I cannot answer briefly now.
    - Complete architecture standards.
    - The same as without the BIM method – see according to 7./8./9. (= 23., 24., 25.).
    - Shape and surface of products, makeups' surfaces, positions of end elements.
    - Similar specification, functional details.
    - At the beginning of the interior execution project, the standard of elements.
- SP6:
    - Preparation of sampling if contracted.
    - Designers will prepare the model, but architects should communicate over the model (comments, suggestions, responses to questions) aside from [*preparing*] standard documents for the given stage.
    - I cannot describe it now, but it is perhaps very individual from case to case; I cannot answer briefly now.
    - Everything he/she has not provided so far.
    - The same as without the BIM method – see according to 7./8./9. (= 23., 24., 25.)
    - Elements schemes.
- SP7:
    - Architects and designers should use the latest DPS model for ADT architect's supervision.
    - I cannot describe it now, but it is perhaps very individual from case to case; I cannot answer briefly now.
    - Nothing should change now.
    - The same as without the BIM method – see according to 7./8./9. (= 23., 24., 25.).
    - Comments to samples and shop drawings.
    - The built project should be checked and compared with the concept design.
- I cannot describe it now, but it is perhaps very individual from case to case; I cannot answer briefly now.

Question # 23.

Describe the basic requirements on architects' work briefly if employing the BIM design method:

- Architects should not be demanding (idiots) – and that applies even to projects processed in AutoCAD.
- They should be skilled with working with the model and prepare – see the previous stages SP2-SP5.
- A – they should develop their model in a study first and then cooperate and communicate over the designers' model. + Standard design cooperation. B – Communicating via the CDE the same as all other participants.
- Do not interfere with the model.

- Respect and honour technical standards.
- BIM applies to everyone the same because architects deliver sections of projects.
- The same as without the BIM method – provided it is true that architects are not "creators" of project documents but only establish the brief for what will be designed.
- Architects should be able to orientate and thus use the model; I would not expect any infringing into the model.
- The handover of architect designs.
- The coordination of designs vs technical solutions.
- Knowledge of standards and BIM methodology per stage.
- LOD.

Question # 24.

Describe the basic benefits of architects' use of the BIM design method briefly:

- It should be possible to use it for elementary modelling and volumetric design.
- It should be possible to use it for visualizations and the following the definition of facades, glazing, materialization, links to the terrain and similar. That is why architects should model stages SP2-SP3.
- A – It should speed up communication in the framework of the digital model. Especially at the time when the model is being developed, 2D paper outputs are confused and imperfect. Therefore, the preparation of 2D outputs is a double activity. B – using the CDE should help to maintain a clear and valid architecture brief.
- They continuously monitor whether others understand their intention, do not bring any input into the model, just note.
- A project is developed into "one direction" from the beginning; nothing must be additionally redone.
- A storage site, 3D model (I do not see any advantages of BIM).
- The same as without the BIM method – provided it is true that architects are not "creators" of project documents but only establish the brief for what is designed.
- Perhaps easier discovering of conflicting areas.
- A better understanding of project ideas.
- Easier communication – the 3D interface is adjusted, time saved, exporting, 2D working with PDFs, and so on.
- Online sharing of information.

Question # 25.

Describe the fundamental problems of architects' use of the BIM design method briefly:

- See Question #7 – demanding architect.
- They do not want or cannot learn the software.
- Money spent on licenses – they can do with cheaper software.
- I cannot tell. I suppose their situation is the same as ours. The problem with SW-related restrictions (or perhaps complicated modelling of bespoke structures). The increased

laboriousness of modelling. If it is to look nice, it will be limited by SW restrictions + SW will not allow them into visual optimization ☺).

- One fundamental problem – architects must not infringe on the model from a specific defined stage onwards (architects usually end after the planning stage (DUR), and AED keeps modelling from the building permission stage (DSP)).
- Architects do not respect technical standards and generally applicable rules.
- Unfinished, immature architectural design later generating alterations in the execution stage (DPS).
- The same as without the BIM method – provided it is true that architects are not "creators" of project documents but only establish the brief for what is designed.
- Emphasizing excessive LOD in the stage.
- Time-consuming requested altering and modifying.
- They do not know this SW or are familiar with some other (ArchiCAD).
- Different LOD.
- Moreover, they lack basic knowledge of requirements on dimensions of structures.
- Architects give up "responsibility" for spatial design. Instead, they rely on BIM to solve it for them.

Annex B
Research Data and their Evaluation

2. Questionnaires
2.2. Designers
2.2.2. Designers in Charge

Questionnaire

Question #1

I consider BIM a helpful design tool:

a. Yes
b. Rather not
c. No
d. I do not know

Question #2

I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):

a. Yes
b. Rather not
c. No
d. I do not know

Question #3

The scope of a project does not matter if BIM is used:

a. Yes
b. Rather not
c. No
d. I do not know

Question #4

If the BIM method is used, the project typology does not matter:

a. Yes
b. Rather not
c. No
d. I do not know

Question #5

The BIM method suits the following project types:

a. residential
b. office
c. hotels
d. the type does not matter

Question #6

Indicate the project stages in which developing a digital building information model makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

Question #7

Indicate the project stages in which using the common data environment (CDE) makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

Question #8

Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

a. architect, all designers, investor

b. architect, all designers

c. all designers

d. I do not know

Question #9

Indicate who must use the common data environment (CDE) for a meaningful design process:

a. architect, all designers, investor

b. architect, all designers

c. all designers

d. I do not know

Question #10

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

a. project development
b. project development and construction
c. project development and construction, building operation
d. I do not know

Question #11

For expertise (daylighting, construction physics, and similar), I use the BIM digital information model:

a. Yes
b. Rather not
c. No
d. I do not know

Question #12

I use the BIM information model as a source document for BOQ:

a. Yes
b. Rather not
c. No
d. I do not know

Question #13

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

a. Yes
b. Rather not
c. No
d. I do not know

Question #14

Describe the advantages of using the BIM method in the project development briefly:

Question #15

Describe the cons of using the BIM method in the project development briefly:

Question #16

Add your brief comment to using the BIM method in the project development:

Question #17

If BIM is used, architects must employ this method too:

a. Yes
b. Rather not
c. No
d. I do not know

Question #18

If BIM is used, architects must also employ the BIM information model:

a. Yes
b. Rather not
c. No
d. I do not know

Question #19

If BIM is used, architects must also employ the CDE (common data environment):

a. Yes
b. Rather not
c. No
d. I do not know

Question #20

Using BIM, the information details in individual stages differ from those used in the conventional design process:

a. Yes
b. Rather not
c. No
d. I do not know

Question #21

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

a. Yes
b. Rather not
c. No
d. I do not know

Question #22

Describe briefly what fundamental data architects should provide in different design stages if using the BIM method:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

Question #23

Describe the basic requirements on architects' work briefly if employing the BIM design method:

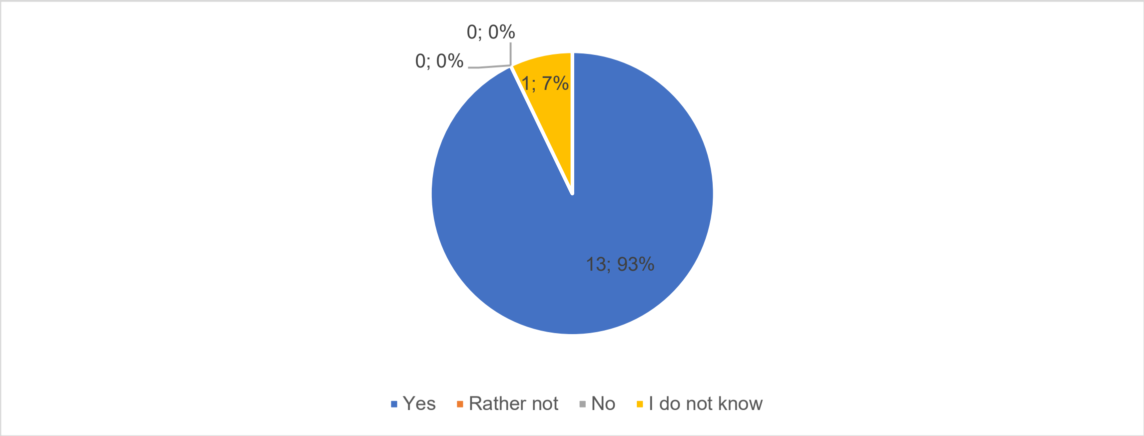
Question #24

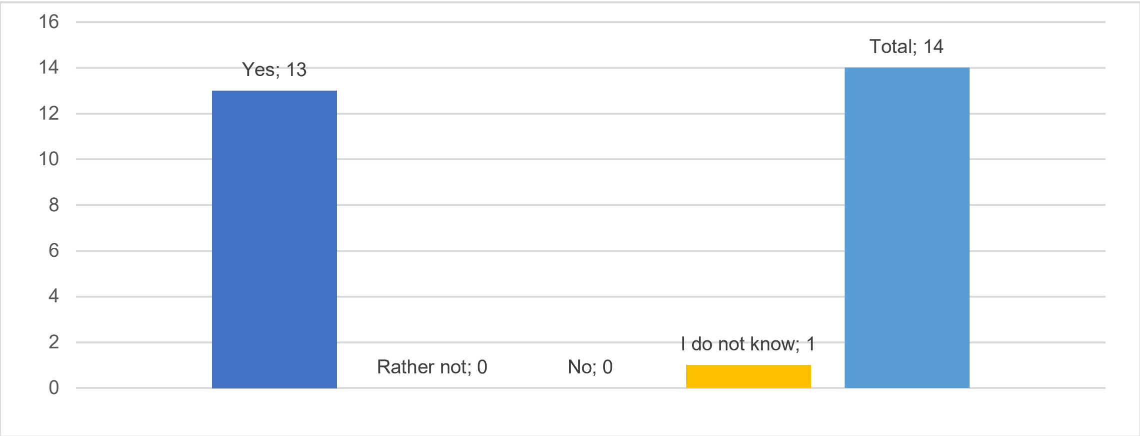
Describe the basic benefits of architects' use of the BIM design method briefly:

Question #25

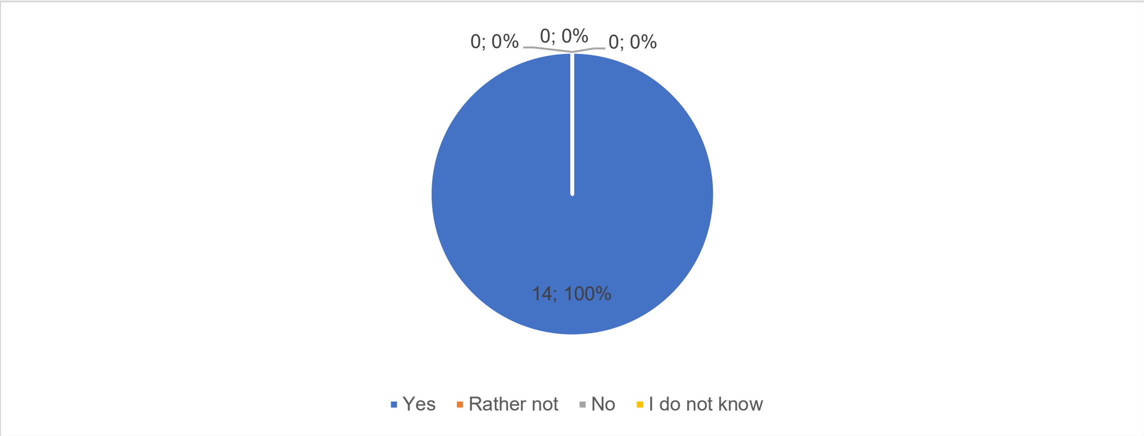
Describe the fundamental problems of architects' use of the BIM design method briefly:

Question #1.	**I consider BIM a helpful design tool:**
Yes	13
Rather not	0
No	0
I do not know	1
Total	**14**

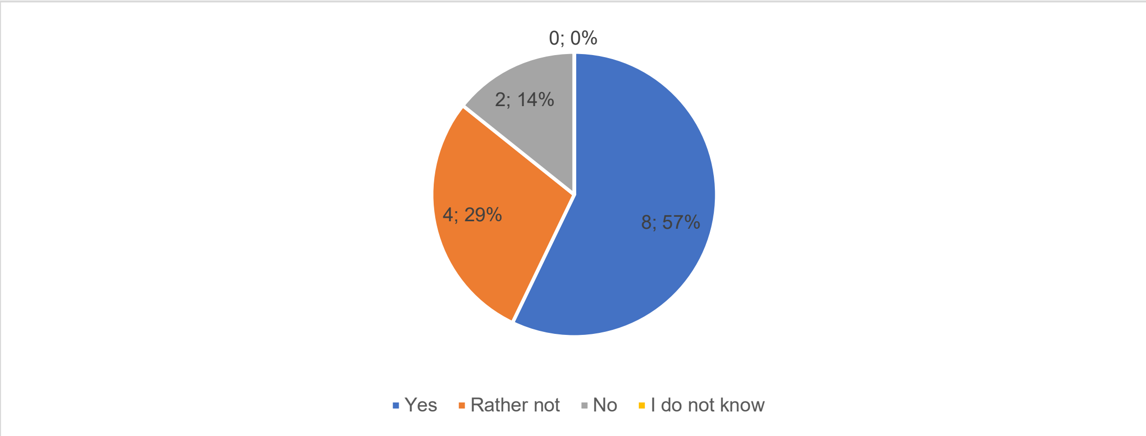


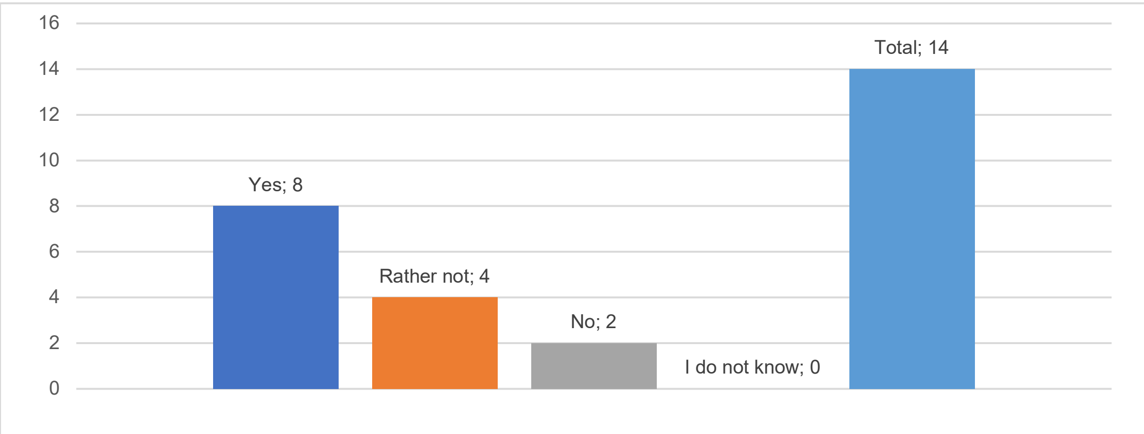


Question #2.	**I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):**
Yes	14
Rather not	0
No	0
I do not know	0
Total	**14**

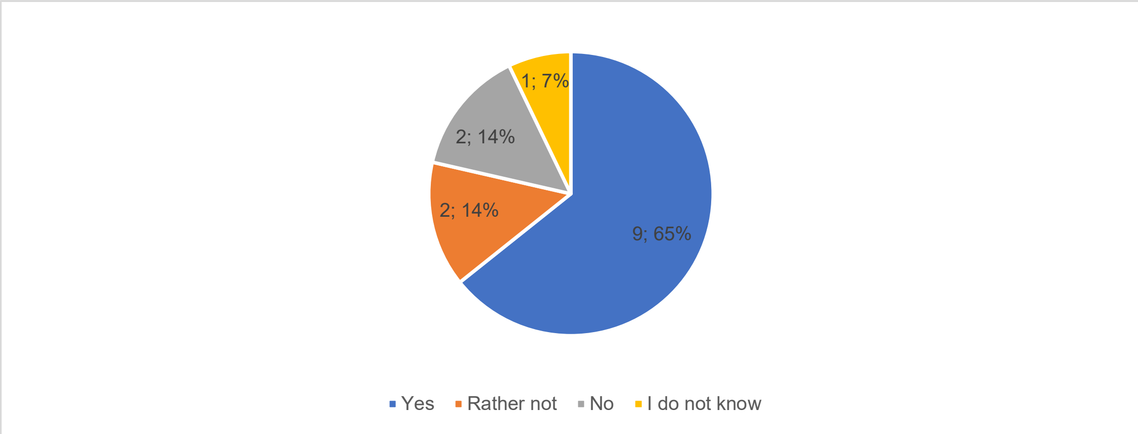


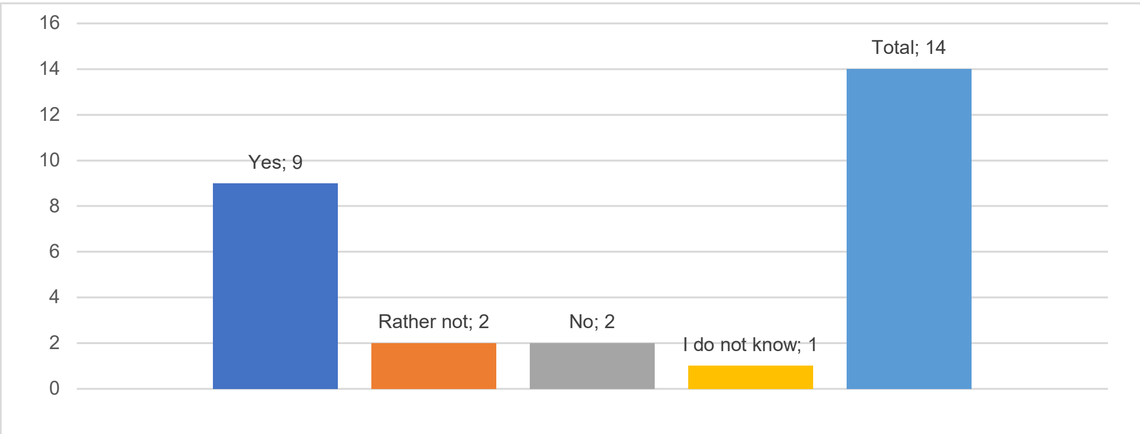
Question #3.	The scope of a project does not matter if BIM is used:
Yes	8
Rather not	4
No	2
I do not know	0
Total	**14**



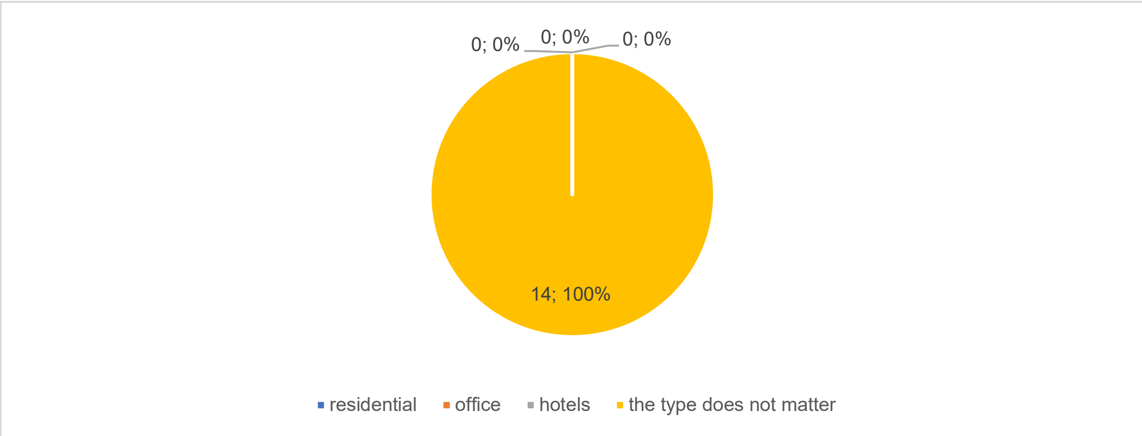


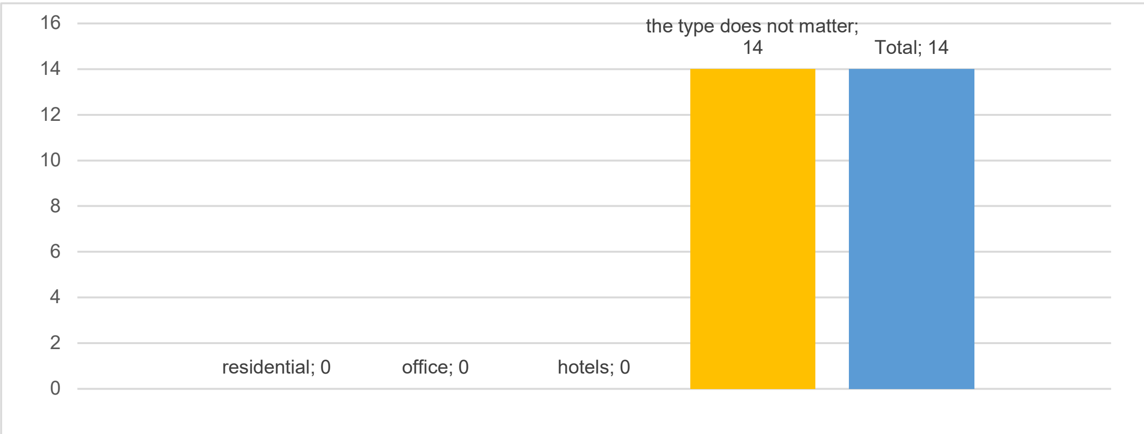
Question #4.	If the BIM method is used, the project typology does not matter:
Yes	9
Rather not	2
No	2
I do not know	1
Total	**14**



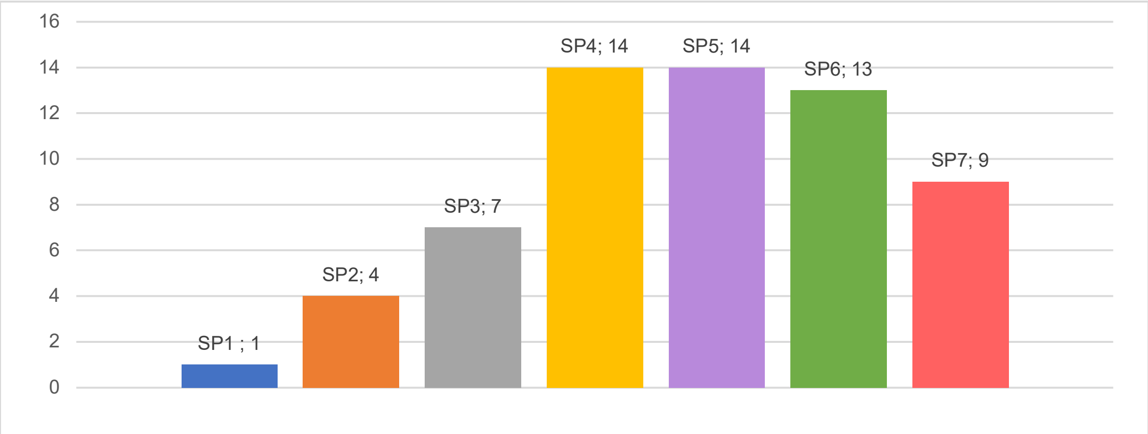


Question #5.	**The BIM method suits the following project types:**
residential	0
office	0
hotels	0
the type does not matter	14
Total	**14**

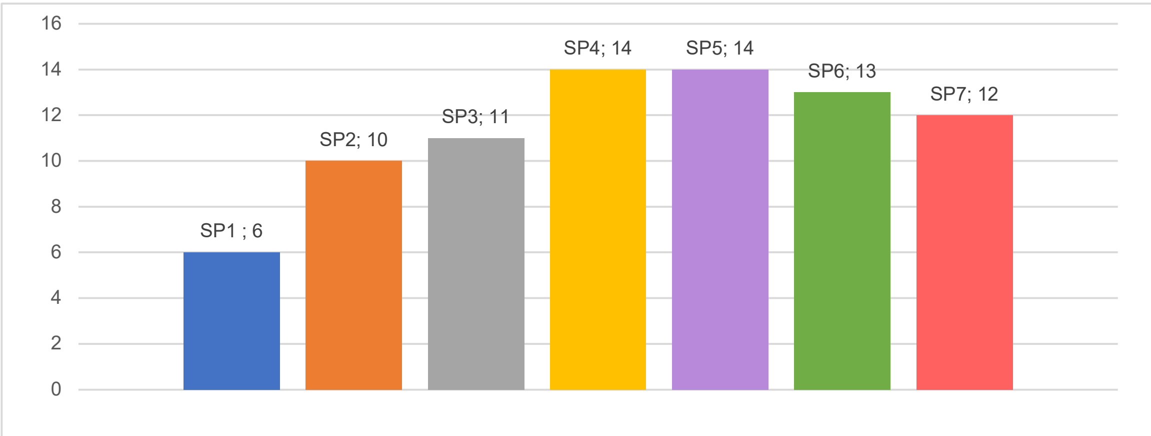




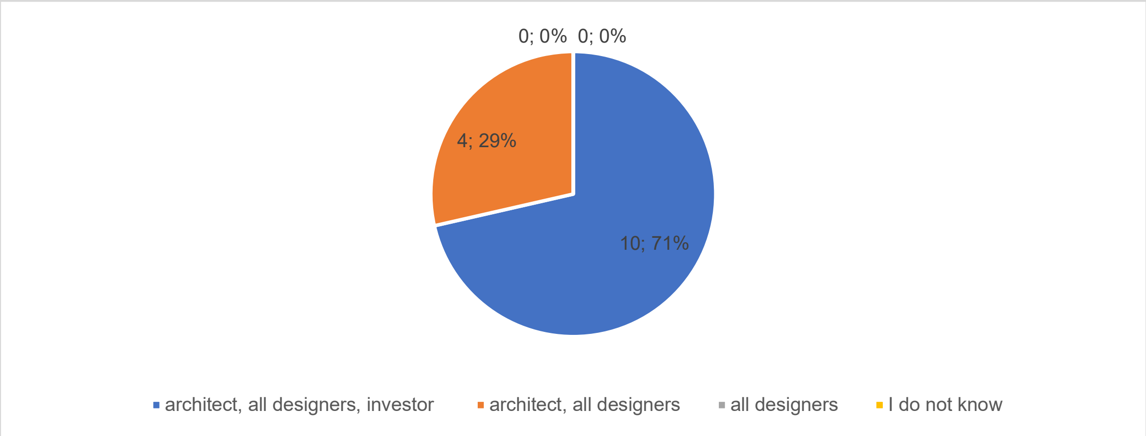
Question #6.	**Indicate the project stages in which developing a digital building information model makes sense:**	
SP1	Project Initiation	1
SP2	Preliminary – Concept Design	4
SP3	Land Zone Permit Design	7
SP4	Building Permit Developed Design	14
SP5	Detailed Design	14
SP6	List of Works and Deliverables	13
SP7	Architect's Supervision	9
Total		**62**

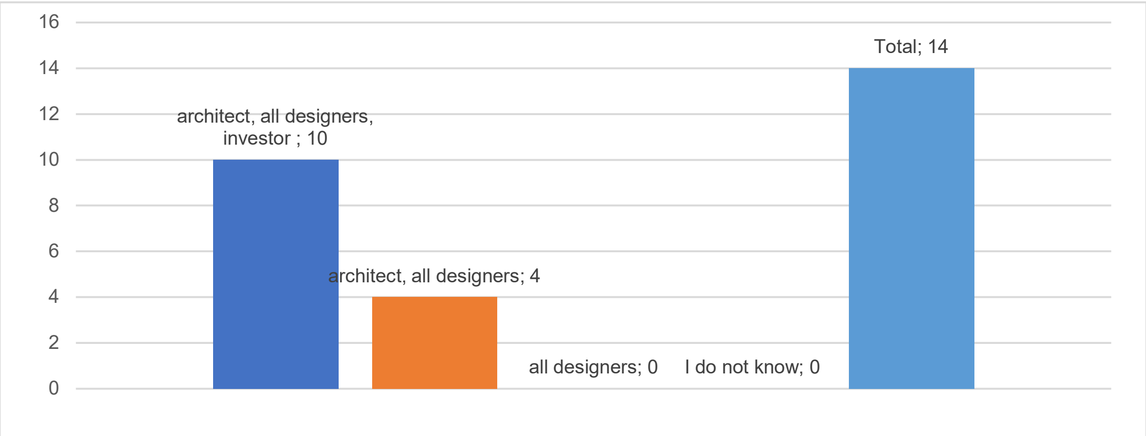


Question #7.	**Indicate the project stages in which using the common data environment (CDE) makes sense:**	
SP1	Project Initiation	6
SP2	Preliminary – Concept Design	10
SP3	Land Zone Permit Design	11
SP4	Building Permit Developed Design	14
SP5	Detailed Design	14
SP6	List of Works and Deliverables	13
SP7	Architect's Supervision	12
Total		**80**

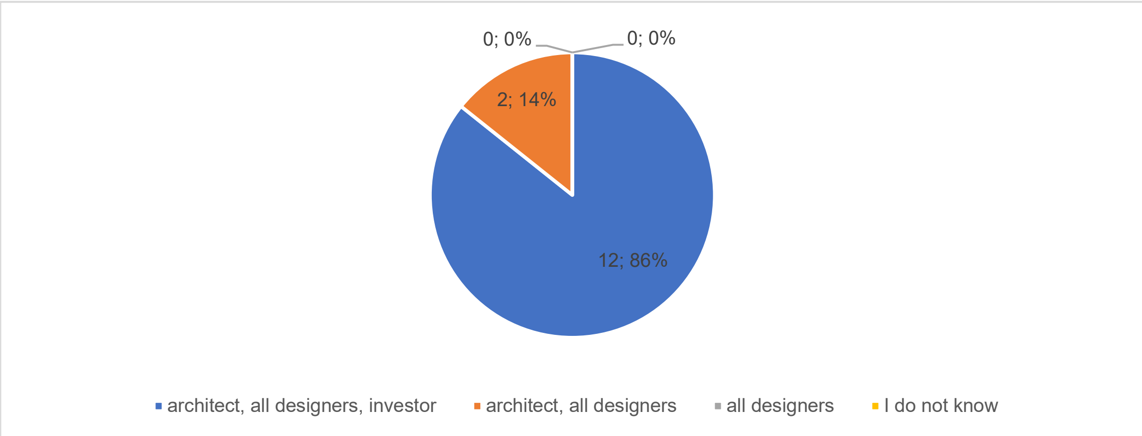


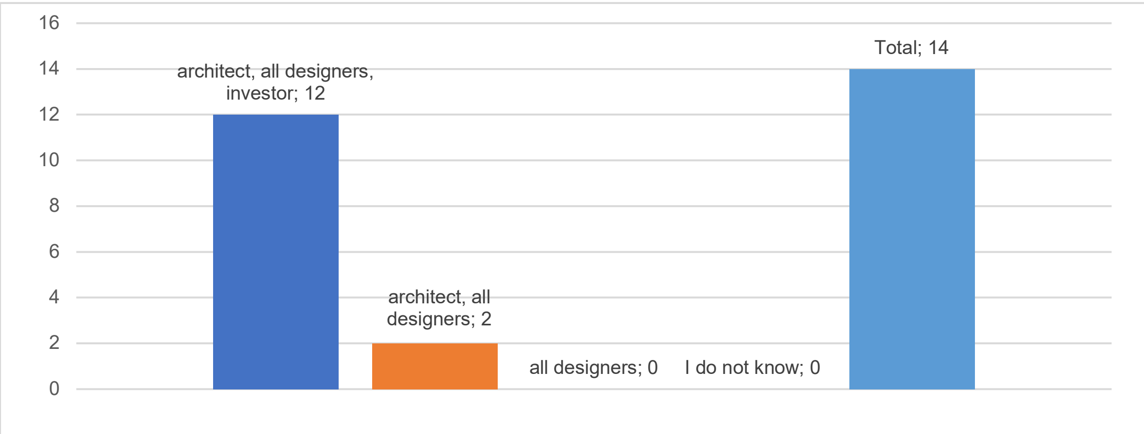
Question #8.	**Indicate who must use the (digital) building information model (IMS) for a meaningful design process:**
architect, all designers, investor	10
architect, all designers	4
all designers	0
I do not know	0
Total	**14**



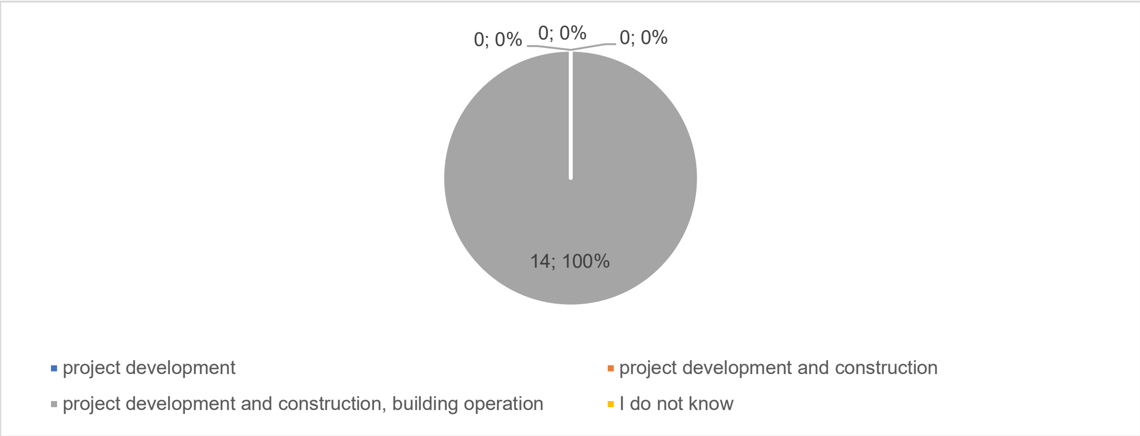


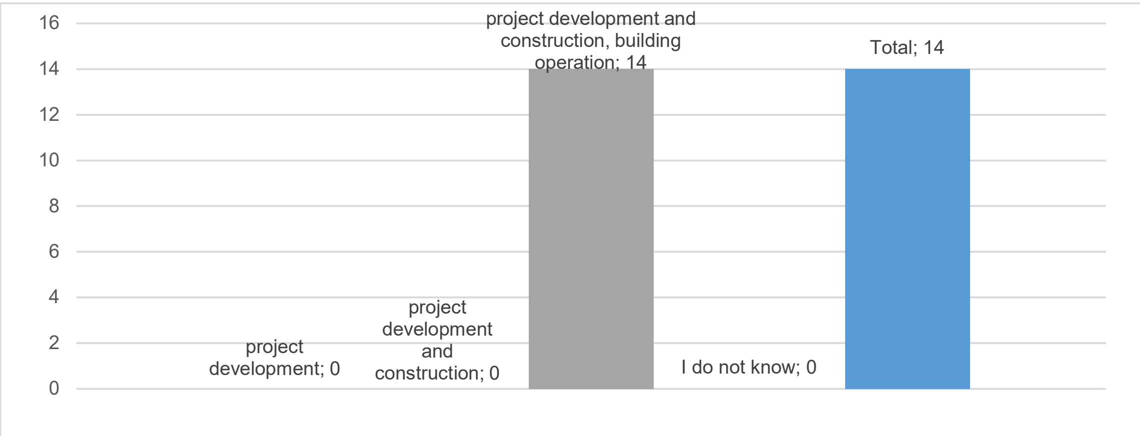
Question #9.	**Indicate who must use the common data environment (CDE) for a meaningful design process:**
architect, all designers, investor	12
architect, all designers	2
all designers	0
I do not know	0
Total	**14**



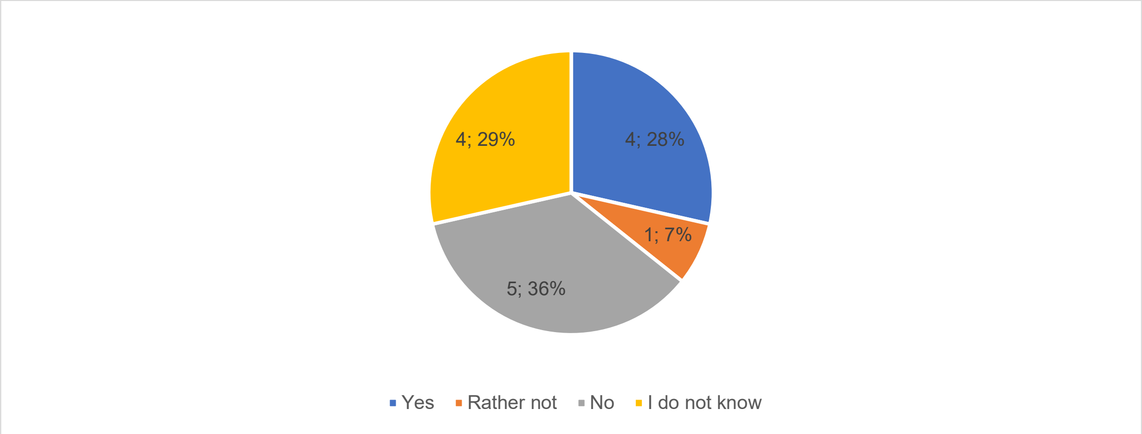


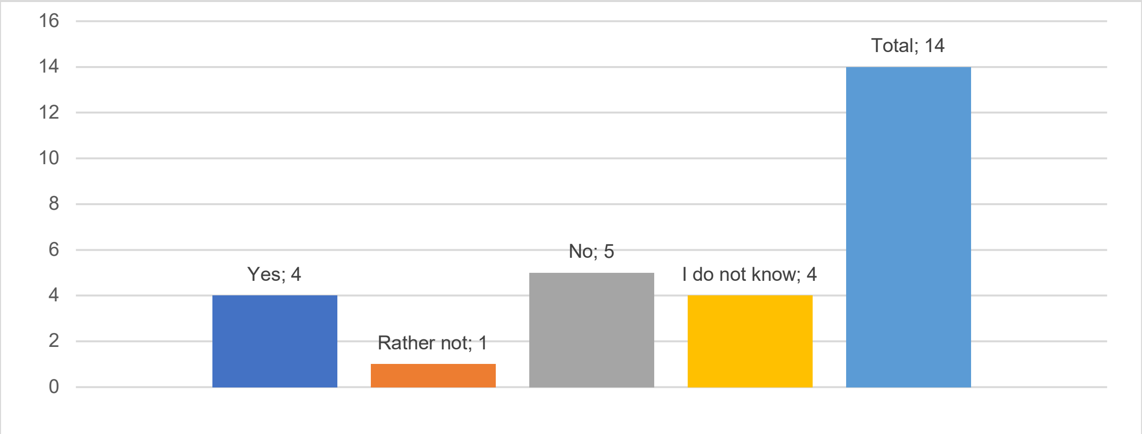
Question #10.	**The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:**
project development	0
project development and construction	0
project development and construction, building operation	14
I do not know	0
Total	**14**



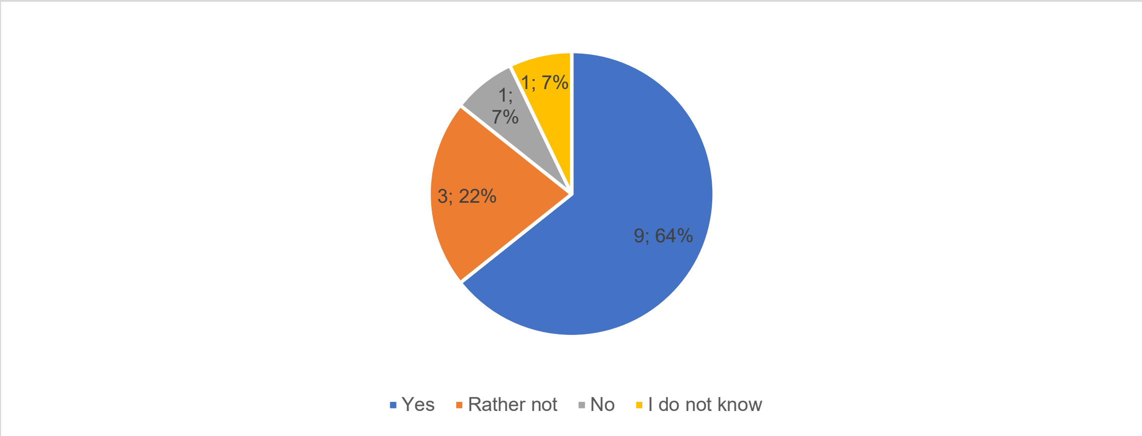


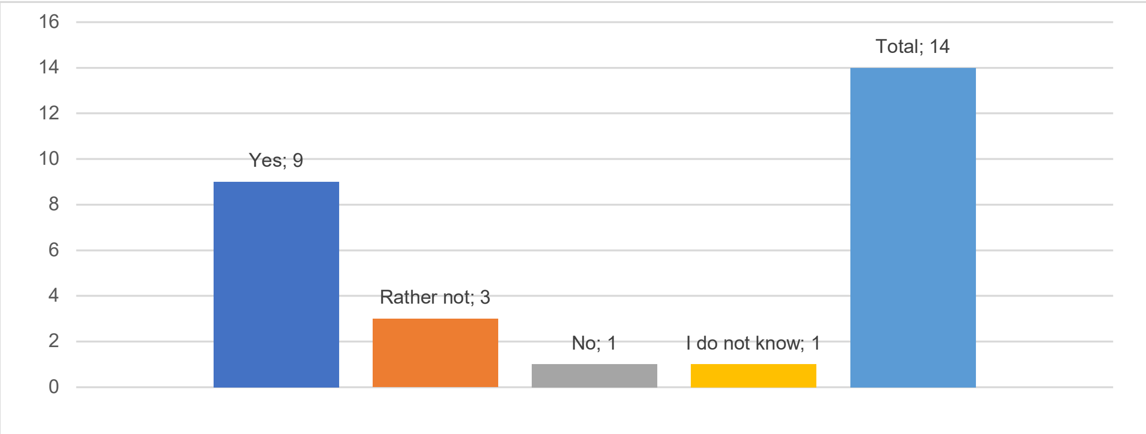
Question #11.	For expertise (daylighting, construction physics, and similar), I use the BIM digital information model:
Yes	4
Rather not	1
No	5
I do not know	4
Total	**14**



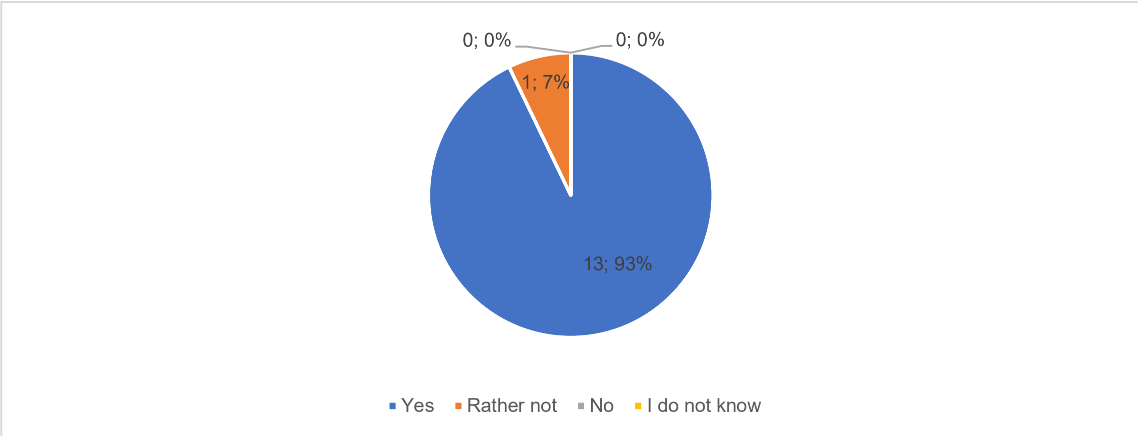


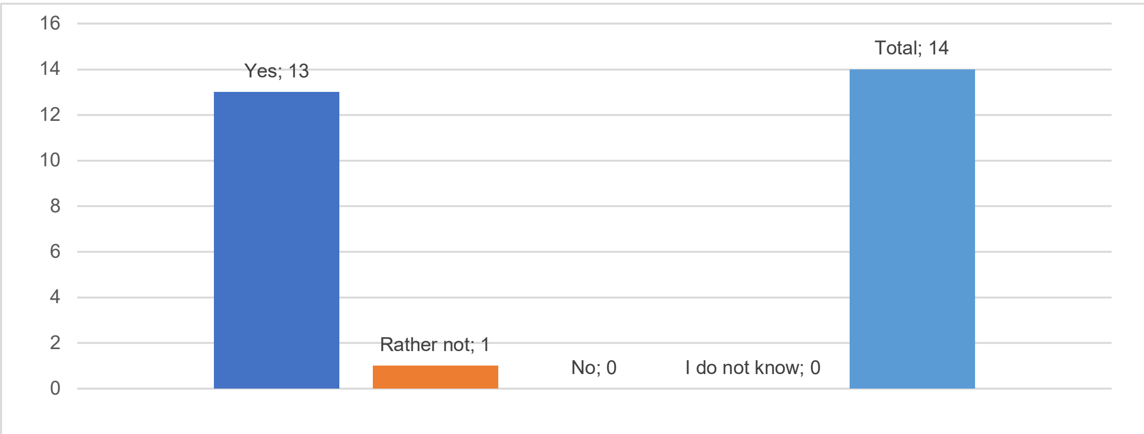
Question #12.	I use the BIM information model as a source document for BOQ:
Yes	9
Rather not	3
No	1
I do not know	1
Total	**14**



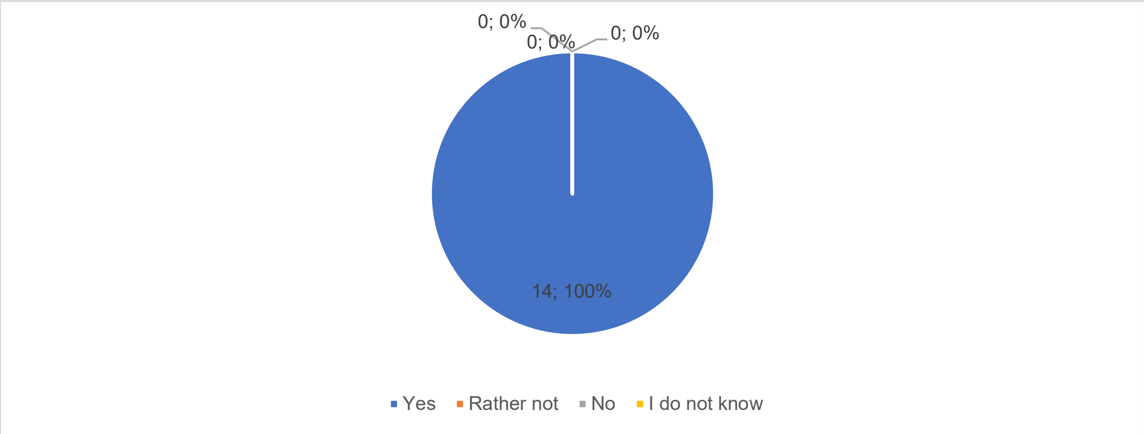


Question #13.	Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?
Yes	13
Rather not	1
No	0
I do not know	0
Total	**14**

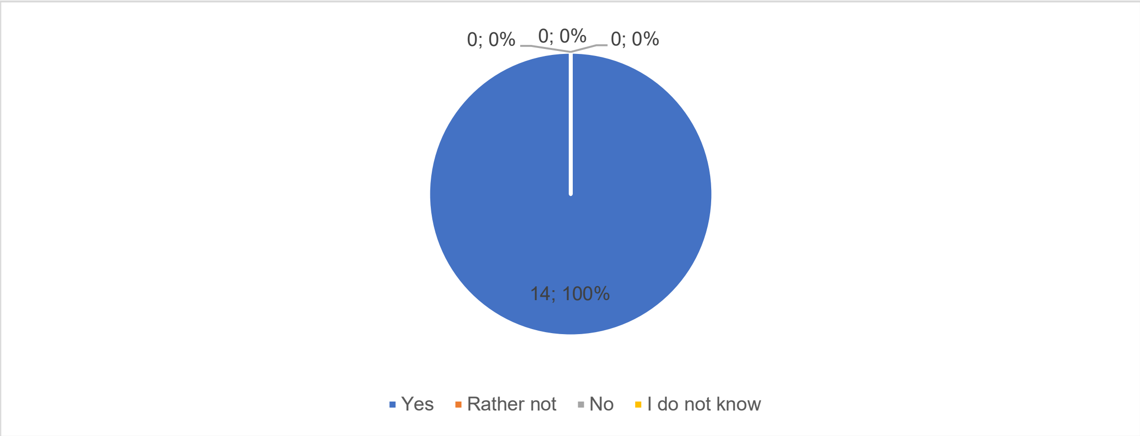


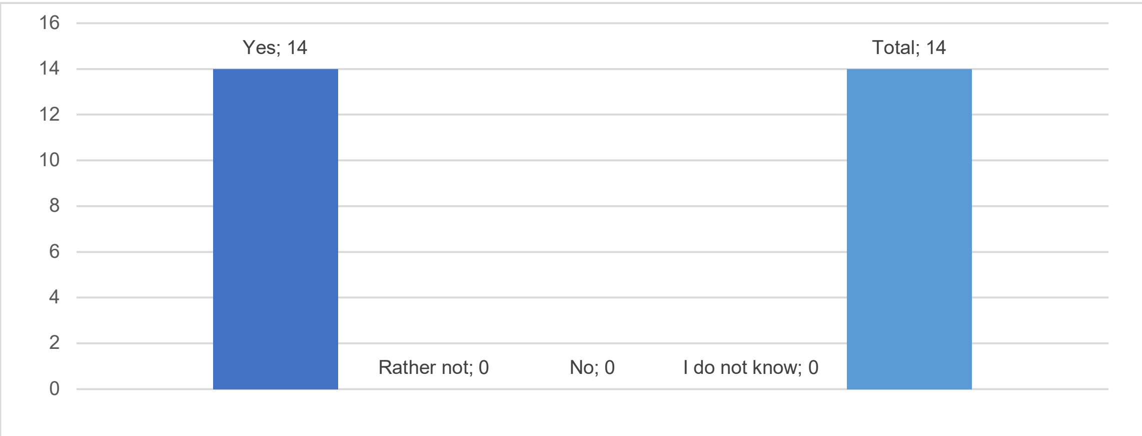


Question #17.	**If BIM is used, architects must employ this method too:**
Yes	14
Rather not	0
No	0
I do not know	0
Total	**14**

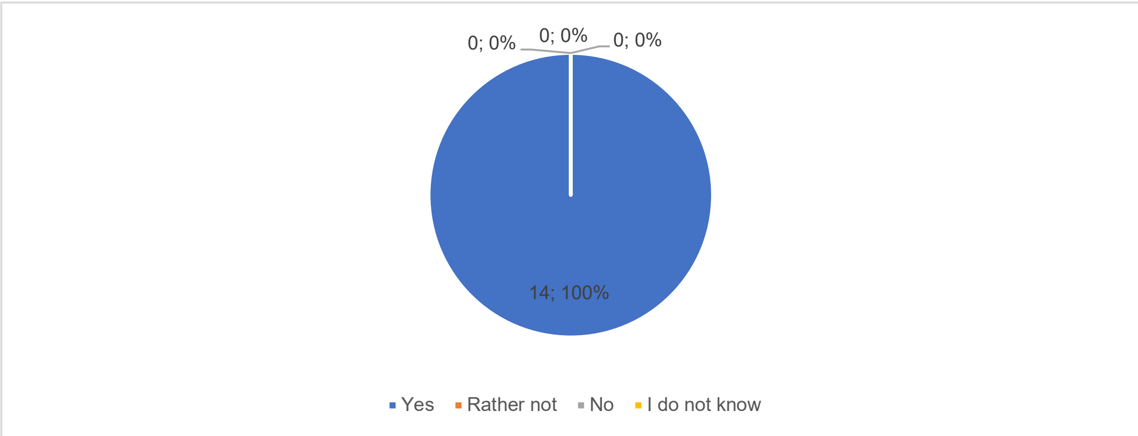


Question #18.	**If BIM is used, architects must also employ the BIM information model:**
Yes	14
Rather not	0
No	0
I do not know	0
Total	**14**

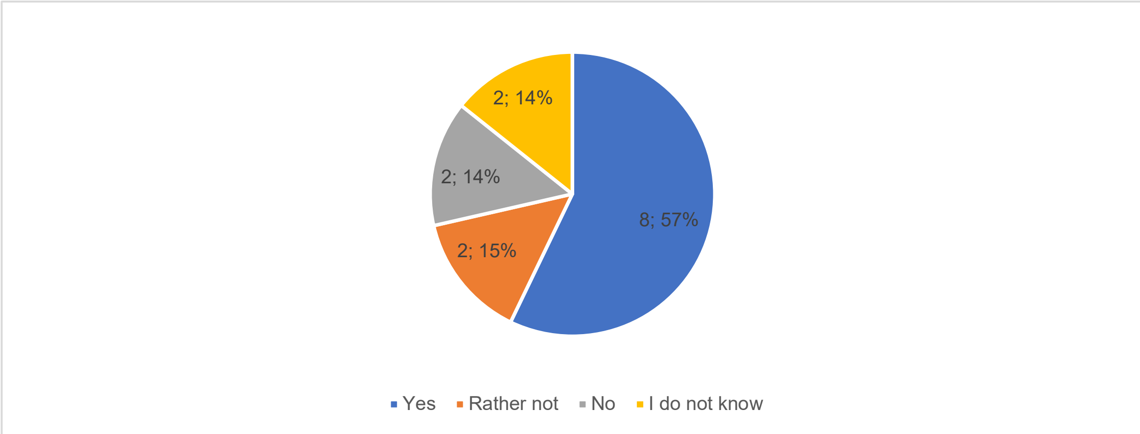


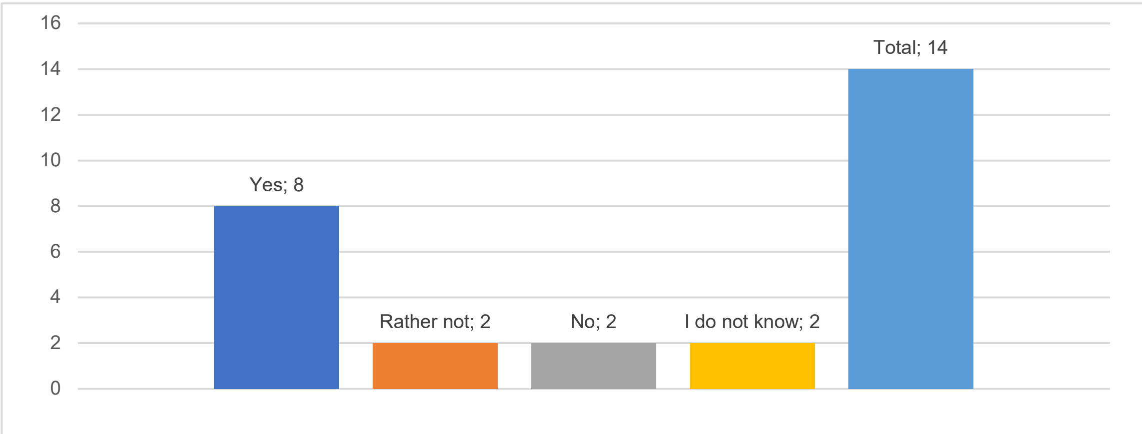


Question #19.	**If BIM is used, architects must also employ the CDE (common data environment):**
Yes	14
Rather not	0
No	0
I do not know	0
Total	**14**

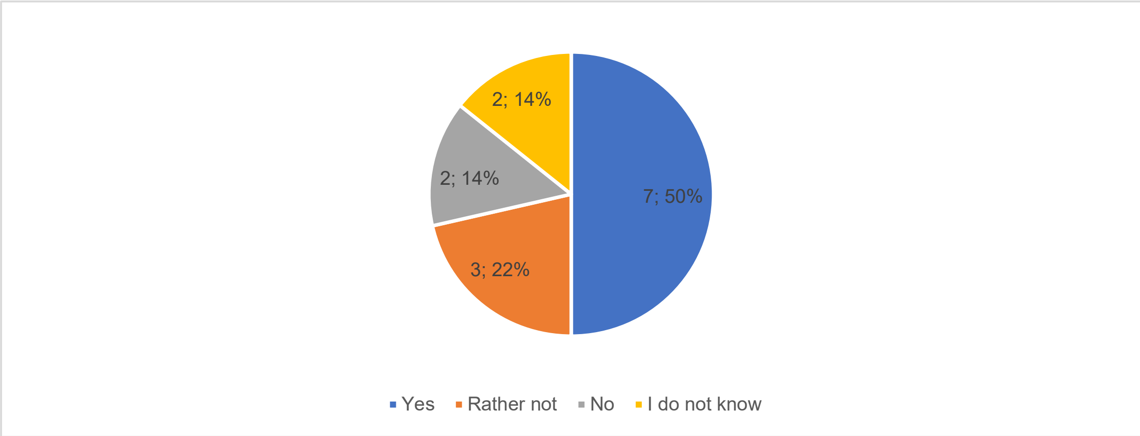


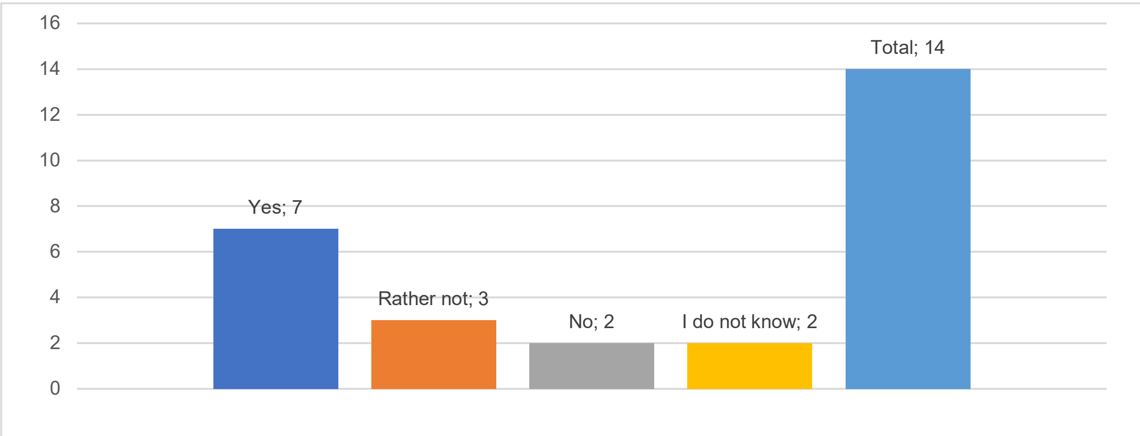
Question #20.	**Using BIM, the information details in individual stages differ from those used in the conventional design process:**
Yes	8
Rather not	2
No	2
I do not know	2
Total	**14**





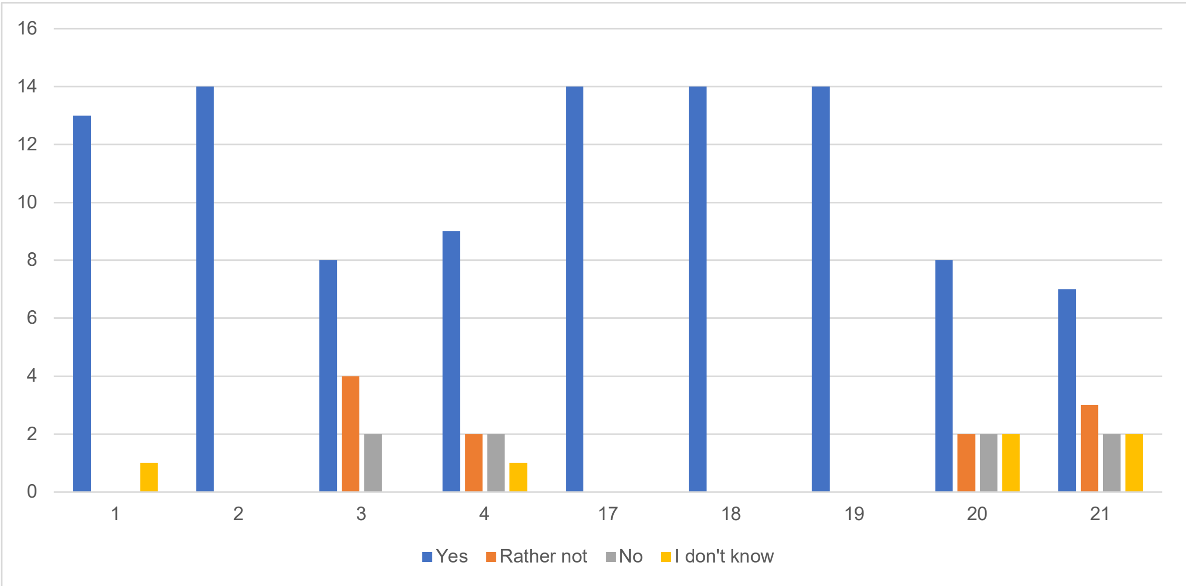
Question #21.	**Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?**
Yes	7
Rather not	3
No	2
I do not know	2
Total	**14**

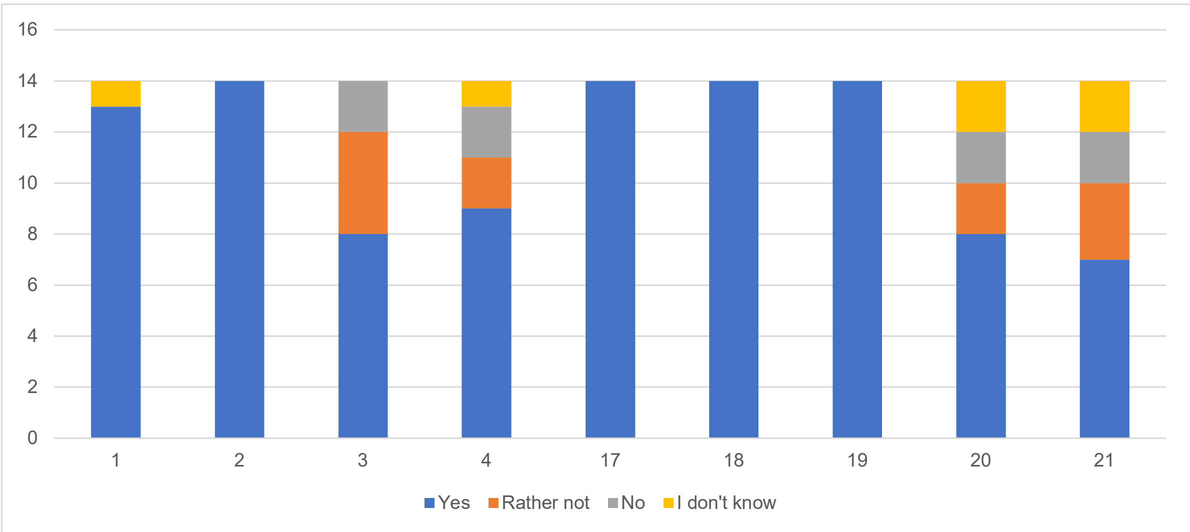




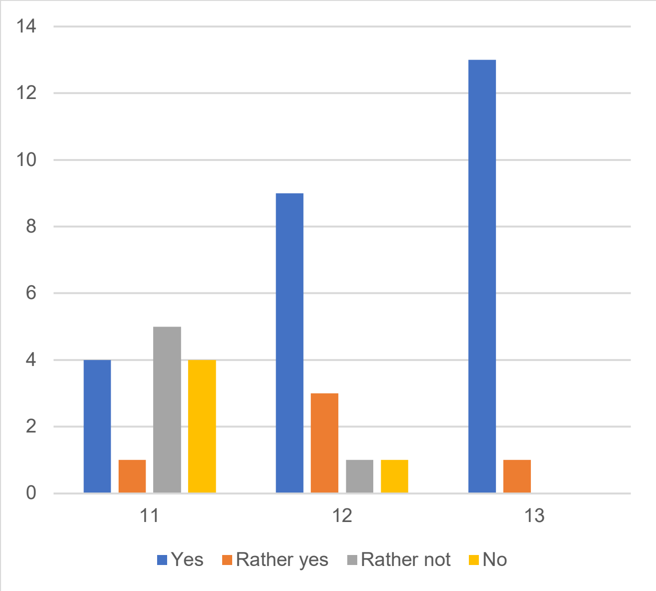
Summary Graphs

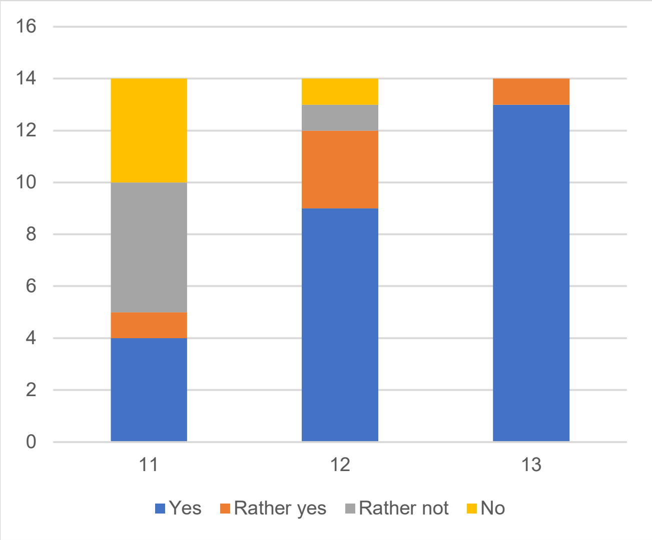
Question	1	2	3	4	17	18	19	20	21
Yes	13	14	8	9	14	14	14	8	7
Rather not	0	0	4	2	0	0	0	2	3
No	0	0	2	2	0	0	0	2	2
I don't know	1	0	0	1	0	0	0	2	2
Total	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**





Question	11	12	13
Yes	4	9	13
Rather yes	1	3	1
Rather not	5	1	0
No	4	1	0
Total	**14**	**14**	**14**





Questionnaire: Clarification Replies

Question #3

The scope of a project does not matter if BIM is used:

- Yes, it does not.

Question #4

If the BIM method is used, the project typology does not matter:

- What is project typology?

Question #11

For expertise (daylighting, construction physics, and similar), I use the BIM digital information model:

- I did not deal with this topic, but I would try to use it.

Question #12

I use the BIM information model as a source document for BOQ:

- So, yes, but they always request PDF documents, too, so the magic vanishes a little.

Question #14

Describe the advantages of using the BIM method in the project development briefly:

- Easier coordination with other disciplines (collision control).
- Fast drawing of the basic model; fast searching if elements are indexed; quick understanding of the building, links.
- If templates are set up well and the project then logically modelled, it can be more easily adjusted in later stages and better organized in reference to products/elements or modified; simpler, faster developing of sections, formatting.
- Better spatial orientation when designing backbone routes, a structural system, complicated architecture, links to the surroundings, induced investment.
- Due to the need to design in 3D, most critical issues can be discovered that would otherwise be lost in 2D if the information is entered; generating tables, source documents for the budget, coordination of services in 3D; if it is designed in one's brain, it can be quickly modelled too.
- Data sharing.
- Simultaneous sharing of information; better spatial idea for solving collisions.
- Complexity, control, collisions; BIM cannot be much cheated.
- 3D model, design alternatives, development of details, makeups, information shared between all disciplines.
- Everything is in 3D (evident, clear cut); everything can be displayed – each building's section. 2D projects solve only selected areas (horizontal sections on one level, the same with vertical sections – only a few) – they cannot cover all critical areas.

- MEP coordination = fewer extra costs on the site. Generally, more issues are solved "on paper" before construction than in a 2D project.
- A BOQ from the model as a groundwork for a budget – however, under development.
- Projects can be presented and continuously shown to investors in 3D and virtual reality – better idea of problems and space (architecture). VR could also be used for the building's final users or sale of flats, offices, etc. (potential).
- All participants can communicate better due to the CDE – in an ideal world.
- It simplifies and fastens designer work in certain design stages – various plug-ins, automatic dimensioning, and mass marking (windows, doors, rooms … everything).
- After the building is completed, the model can be used for facility management – the model is stuffed with information from the project, and it can also contain valuable information from the construction phase.
- Control of the project, better chances to discover mistakes.
- Saved time in most cases.
- Conflicting issues and collisions, dysfunctional structures and others can be discovered much earlier than they can in 2D documentation.
- Bloomers cannot be left uncorrected to the next stage.
- Spatial coordination.
- Output standard and project quality.
- The appearance of drawings and many others.
- Possibility to detect collisions; prevention of collisions on the site if all designers use it.
- Possibility to use automation.
- More exact control of performed work.

Question #15

Describe the cons of using the BIM method in the project development briefly:

- Time-consuming altering permanently requested by investors; the possibility to control issues not important at all for the given stage and are requested to be corrected/implemented; exaggerated requirements to load information into the model; the fact that not all participants in the project use the BIM model; …
- More processes around it, I cannot think of anything else.
- Challenging preparation, setup, project management in the first stage. Another disadvantage – many models for one building.
- It consumes more time; the model is "imperfectly" displayed at the beginning – because detailed engineer projects are absent; a contact on the level of detail and its rendering is necessary – haggling about what should be modelled and what should not.
- Suppose you have a small house having every window, door, and other families you need are such that you cannot use your own families, and some sections need more complex modelling, perhaps even with programming. In that case, it will take a long time and, therefore, be expensive.

- I do not know; I have no experience using the BIM method, so I do not know its specific advantages/disadvantages.
- Current low spread among all participants in project preparation and use of the building.
- The occasional need to get stuck in a higher level of detail than necessary at that moment. Investors' ideas of detailing and the scope of the information they can get. Give someone an inch, and they'll take a mile. Or we bounce into the program's limits of what it can provide without any harm. The development of publishable drawings from the model is a pretty long and laborious issue.
- All disciplines should be congruous; investor and architect briefs should be complete and fixed; PC equipment; more time for modelling and parameterization.
- More time-consuming, more problems must be solved – however, the quality of projects is higher, saving construction costs.
- Low spread among engineers so far – they often cannot design using the BIM method.
- BIM has still been developing; sometimes, the software is not used efficiently.
- Complications with transferring between different SWs – the IFCs are not perfect.
- There is not ideal SW for designing with BIM. For instance, working in Revit is sometimes like scratching with a right hand behind your left ear.
- Like any innovation, even BIM has its teething pains, but perhaps, they can be solved during future development.
- Not all engineers can use this method, but it is getting better all the time – we keep on learning too.
- The higher the project's LOD, the more time-consuming altering.
- Certain types of buildings are less suitable for processing in BIM, and inevitable compromises must be adopted; Revit is good, although not perfect software.
- Costs.
- The DSP stage (building permission) is more time-consuming compared with documents prepared in 2D.
- Shifted design stages – investors request more information than needed for the given stage. That affects the Time Plan.
- Exporting into other files – dwg, etc.

Question #16

Add your brief comment to using the BIM method in the project development:

- It is very time-consuming with the current "not set up" standard for designing with the BIM method; if at least a corporate standard is set up functioning on all projects, everything would be simpler and faster.
- I enjoy working with the BIM method.
- Templates, families should be correctly set up, …
- The future, a connecting step in VR designing; one needs to become familiar with the user environment and be able to manage projects in it and control – engineers – designers.
- Thinks that seem relatively simple as a task sometimes take quite a long time.

- I do not know; I have no experience working with BIM; therefore, I do not see how it works or should work in practice. But it should most likely mean sharing project data and information from the investor + architect + designer side.
- I do not know; I have not used the BIM method yet.
- It is OK if layouts and masses are at least roughly fixed because permanent remodelling, no matter how minor, is a way to perdition regarding deadlines. So, from DSP on. And everybody must agree that this method needs more time in the beginning and not, for instance, push on basic drawings, because engineers will die modelling and soon send us to blazes. Furthermore, it would be good to harmonize cooperation with engineers so that we would not have to figure out what needs to be done in fact. See the structural project. It needs to be reckoned that a finished model is not a finished set of documents; preparing drawings and exporting them requires a lot of time and re-checking before each export. Generally: THE ALREADY DEVELOPED THINGS SHOULD NOT BE REINVENTED, AND UNAMBIGUOUS STANDARDS SHOULD BE AVAILABLE.
- Here, I cannot understand the model's splitting into AST, STA, and FAS when structural engineers work with 2D and we model it here instead of them – related unnecessary synchronizing between models and linked complications – non-compliance when connecting walls, and similar.
- Permanent alterations requested by the investor, architect and, therefore, an unfinished study. Uncooperating engineers, their excessive workload and short deadlines resulting in imperfect work; non-cooperation of engineers, selection of cheap engineers who do not work with BIM and we must provide other documents differently (IFC, dwg, pdf).
- Slow PC hardware, network, cloud.
- See previous items.
- It is a step in the right direction, a development in project development, no matter some related pitfalls.
- Produced project documents are submitted on a high-quality level polished according to the particular design stage.
- It makes sense.

Question #17

If BIM is used, architects must employ this method too:

- Yes, to check whether the building works well.
- Not necessary, but recommendable … or at least the CDE for more efficient communication.

Question #18

If BIM is used, architects must also employ the BIM information model:

- It is not necessary but recommendable.

Question #19

If BIM is used, architects must also employ the CDE (Common Data Environment):

- See Question #1.

Question #20

Using BIM, the information details in individual stages differ from those used in the conventional design process:

- Yes, sometimes the LOD is unnecessarily high; a more detailed brief is needed.

Question #22

Describe briefly what fundamental data architects should provide in different design stages if using the BIM method:

- SP1:
    - This stage without BIM.
    - Basic information, concept, visualization.
    - It may not be BIM.
    - Without BIM.
- SP2:
    - This stage without BIM.
    - Specification of basic information.
    - Shape and spatial imaging.
    - It may not be BIM.
    - The volumetric model linked to the context.
    - Without BIM.
- SP3:
    - Standards setup, the brief of clearly defined layouts according to current standards and regulations (cores above each other, restrooms meeting all necessary requirements, corridors and staircases the same, and similar)
    - Ideally, the building's 3D model with roughly designed layouts
    - Further specified stage SP2 and a basic spatial concept
    - Functioning building layouts, main mass, positioning into the landscape
    - Building's rough shapes
    - A volumetric model for visualization; structural concept model
    - Design of buildings according to the investor brief and elementary functional links [*should/must be*] followed, such as the structural system, staircases, lifts, cores.
- SP4:
    - Elaborating and closing of layouts according to data/information/design obtained from other engineers.
    - Ideally, a 3D model with solved layout, elevations, lighting.
    - Compact and technically approved layouts + shape and spatial design. Products (doors, windows, jalousies, surfaces, and similar).
    - Elaboration of the SP3 stage and development of details of functions/purposes.

- Basic standards, fixed layout, materials.
  - Plans, sections, elevations, materials, commenting of the architecture project, special projects.
  - Information needed to develop the project, an aggregated BOQ, elementary structural coordination.
  - Elaboration of designed documents, elaboration of layouts, cores, and similar.
- SP5:
  - Just a check-up or cooperation, if requested.
  - Pattern drawings, elevations, façade, specification of products.
  - Design of details and their architectural impact – skirting, stairs, grates in suspended ceilings, surfaces, and similar.
  - Specification of SP4 and structural and material specifications.
  - Details, surfaces, products (if architect requests something).
  - Standards of surfaces, materials, products, details, interior design.
  - The groundwork for spatial coordination, BOQ, specifications of elements for the project.
  - Checking and specification as requested by the architect.
- SP6:
  - Only checking.
  - Further specification of product data.
  - Mode details to material specs.
  - Only checking.
  - Elaboration of DPS.
  - Checking and specification as requested by the designer.
- SP7:
  - Only checking.
  - Checking.
  - Help to solve pickles.
  - Cooperation during the sampling process.
  - Only checking.
  - Checking and specification as requested by the designer.
- I do not know.

Question #23.

Describe the basic requirements on architects' work briefly if employing the BIM design method:

- Architects should be allowed access to the model just for browsing. Everything must be re-drawn after architects are involved -> briefing in 2D is enough.
- They should know what they want.
- Checking of shapes and adding design/architecture solutions of deformations created during the technical design process.
- Studies should be developed according to "rules" that currently exist, perhaps on the local level only (JTSK, the method of constructing elements in the model, terminology, creating of families).

- Handed-over information how [*the project/building*] should look like – materials, architecture details
- I do not know; I have no experience working with BIM; therefore, I do not know what requirements architects should fulfil.
- A summary of all items SP2 – SP6.
- A handover of a functional and complete design brief.
- A brief thoroughly solved in a study – volumes, positioning in the landscape, layouts, coordination with all disciplines and the implementation of their requests.
- I do not know.
- 1. Ability to open and comment building model, be at ease with working in the environment; 2. They should know in advance how designing in BIM works, why we do it and what documents will be needed from them at a particular time.
- Handing over relevant information to develop a building information model.
- A development of own model of the designed model in the DUR (planning permission) stage; hand it over to us and use as a groundwork for developing a construction model in the DSP (building permission) stage. In an ideal world, you could continue [*working*] on a model from the DUR stage, but the reality is different and altering or modifying a model is more laborious than developing a new one for which a civil engineer is then responsible.
- If someone uses them, they should know them.

Question #24.

Describe the basic benefits of architects' use of the BIM design method briefly:

- I do not see any advantage of architects working with BIM.
- Faster communication of information.
- Shape and layout design – heights, ramps, connected MEP services, and we can see that it really cannot fit in.
- An instant possibility to show discussed areas, visualize designed spaces and see whether their function is appropriate; present to the investor; speed up rendering within one software; generally better possibility to "control" what designers do and continuously control/discuss why the development happens the way it does.
- If something cannot be designed/built, it is displayed, and we can see it.
- I do not know; I have no experience working with BIM; therefore, I do not have an idea what are the advantages /disadvantages of architects' involvement.
- Shared Data Environment.
- Theoretically, fewer skeletons should fall out of the closet.
- After a study is developed and approved, cooperation should proceed to refine details and the design, speeding up all project stages.
- They try to communicate information, explain problems, find solutions.
- It saves their and our time; we do not have to prepare many documents for their decisions; architects can see the project's current state anytime.
- It speeds up and further specifies the information flow, ditto.

- A functional design can be developed, and data used contained in the model. The investor's content with the spatial and visual section.
- Architects do not need to use it, but they are a substantial advantage for projects; it especially saves a lot of time between exports, sometimes confusing and wrong source documents.

Question #25.

Describe the fundamental problems of architects' use of the BIM design method briefly:

- I do not have any experience with architects working with the BIM method, and, in fact, I do not want to have any.
- They do not understand the issue.
- That is individual. I work, more or less, in ArchiCAD, which is also a form of BIM, so they should theoretically also master it. However, even designers often cannot work with BIM.
- It is more challenging when organic architecture is designed; it needs a bit better technology (PC), closer cooperation with designers, knowledge of issues of the following stages, and structuring of the model for each engineering discipline.
- They do not use it.
- I do not know; I have no experience working with BIM; therefore, I do not have an idea what are the advantages /disadvantages of architects' involvement.
- I do not know.
- Requirements in the level of particulars and detail are sometimes unnecessary. Sometimes we come up with the limits of the SW trying to satisfy the architect. Or, on the contrary, we need to fix specific issues and architects did not think of them or keep creating.
- An incomplete brief in the study, no cooperation, impossibilities, or complications during the design process and execution, making the project more expensive.
- Architects usually use different SW than BIM – that means that the model must be converted between different SWs.
- It is rather a mistrust, novel feeling, unwillingness to get used to something new; it is a matter of their approach to cooperating, whether they treat us as partners for a common objective or a bow to the inevitable.
- Discipline.
- It must be clear that architects design the model until the DUR stage (planning), and civil engineers take it over from then from the DSP stage (building permission). Architects may infringe on the model only if civil engineers request it.
- I do not know about any.

Annex B
Research Data and their Evaluation

Questionnaire

Question #1

I consider BIM a helpful design tool:

a. Yes
b. Rather not
c. No
d. I do not know

Question #2

I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):

a. Yes
b. Rather not
c. No
d. I do not know

Question #3

The scope of a project does not matter if BIM is used:

a. Yes
b. Rather not
c. No
d. I do not know

Question #4

If the BIM method is used, the project typology does not matter:

a. Yes
b. Rather not
c. No
d. I do not know

Question #5

The BIM method suits the following project types:

a. residential
b. office
c. hotels
d. the type does not matter

Question #6

Indicate the project stages in which developing a digital building information model makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect's Supervision

Question #7

Indicate the project stages in which using the common data environment (CDE) makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect's Supervision

Question #8

Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #9

Indicate who must use the common data environment (CDE) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #10

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

a. project development
b. project development and construction
c. project development and construction, building operation
d. I do not know

Question #11

For expertise (daylighting, construction physics, and similar), I use the BIM digital information model:

a. Yes
b. Rather not
c. No
d. I do not know

Question #12

I use the BIM information model as a source document for BOQ:

a. Yes
b. Rather not
c. No
d. I do not know

Question #13

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

a. Yes
b. Rather not
c. No
d. I do not know

Question #14

Describe the advantages of using the BIM method in the project development briefly:

Question #15

Describe the cons of using the BIM method in the project development briefly:

Question #16

Add your brief comment to using the BIM method in the project development:

Question #17

If BIM is used, architects must employ this method too:

a. Yes
b. Rather not
c. No
d. I do not know

Question #18

If BIM is used, architects must also employ the BIM information model:

a. Yes
b. Rather not
c. No
d. I do not know

Question #19

If BIM is used, architects must also employ the CDE (common data environment):

a. Yes
b. Rather not
c. No
d. I do not know

Question #20

Using BIM, the information details in individual stages differ from those used in the conventional design process:

a. Yes
b. Rather not
c. No
d. I do not know

Question #21

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

a. Yes
b. Rather not
c. No
d. I do not know

Question #22

Describe briefly what fundamental data architects should provide in different design stages if using the BIM method:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

Question #23

Describe the basic requirements on architects' work briefly if employing the BIM design method:

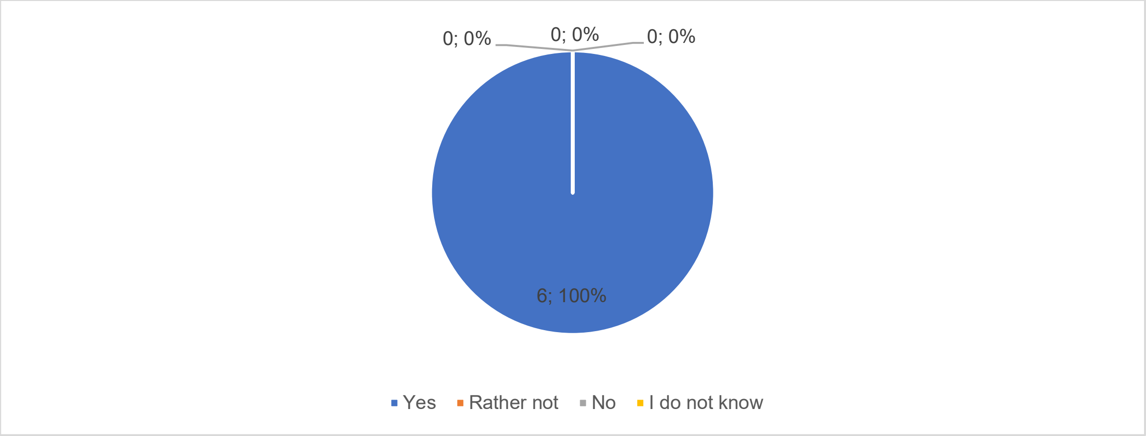
Question #24

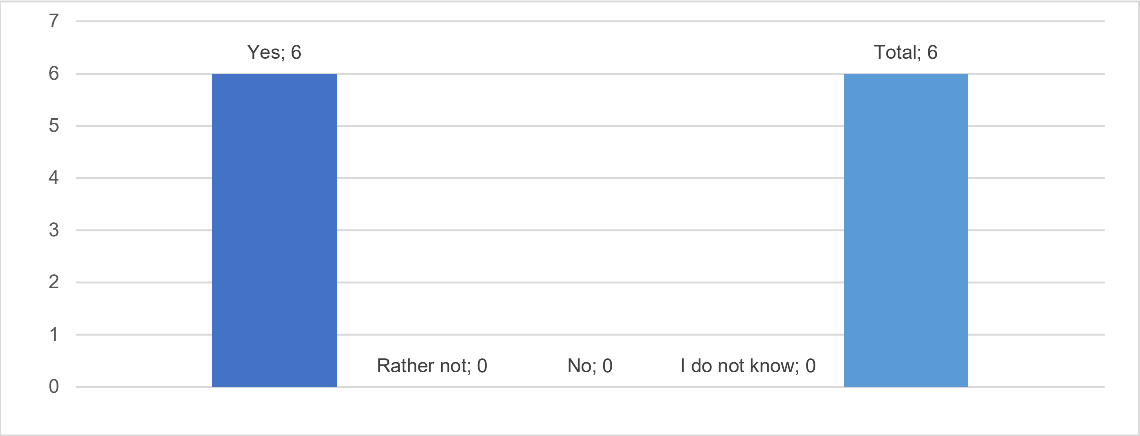
Describe the basic benefits of architects' use of the BIM design method briefly:

Question #25

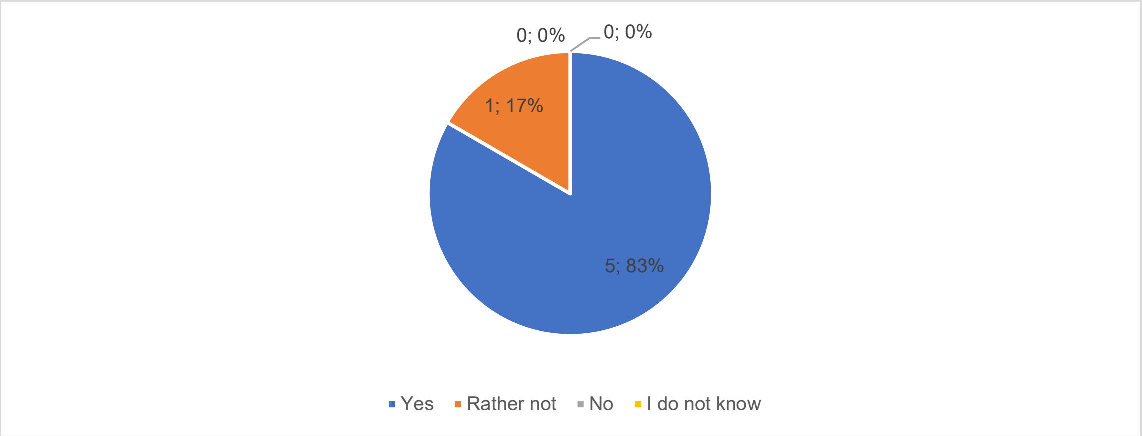
Describe the fundamental problems of architects' use of the BIM design method briefly:

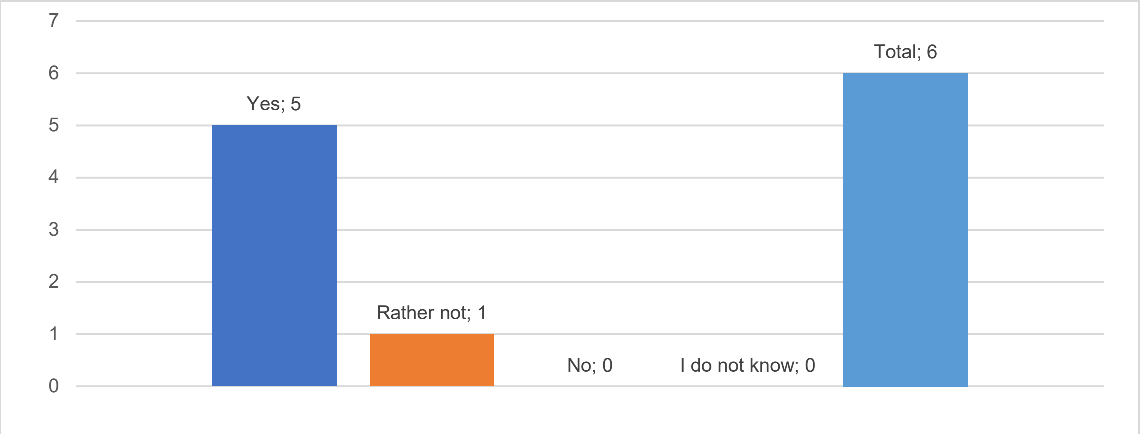
Question #1.	**I consider BIM a helpful design tool:**
Yes	6
Rather not	0
No	0
I do not know	0
Total	**6**



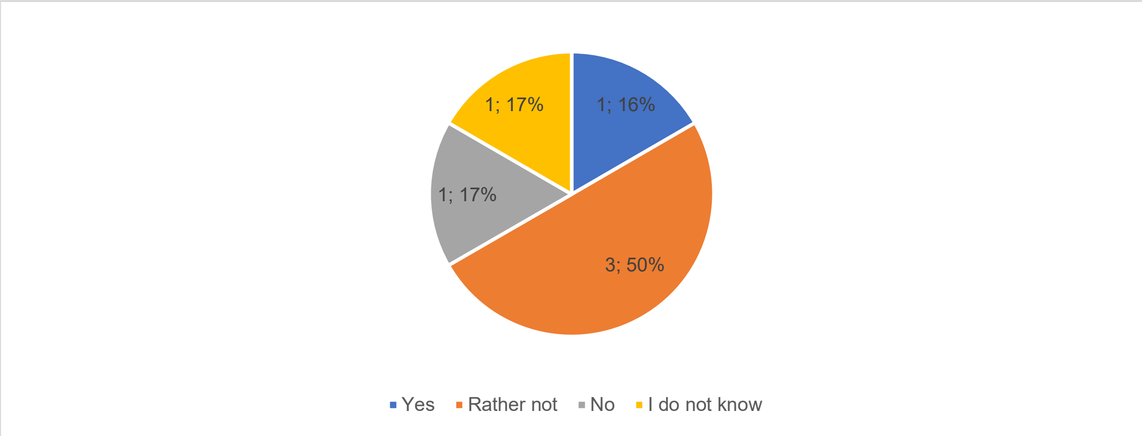


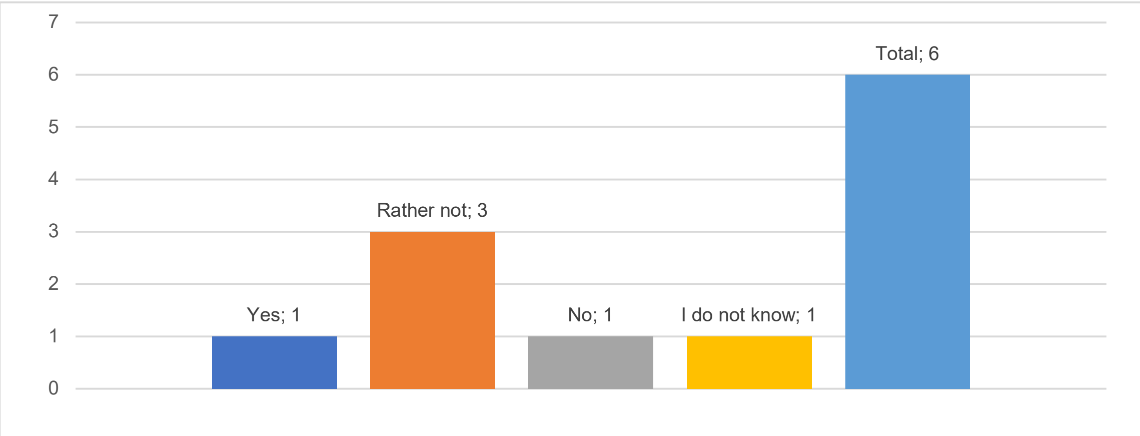
Question #2.	**I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):**
Yes	5
Rather not	1
No	0
I do not know	0
Total	**6**



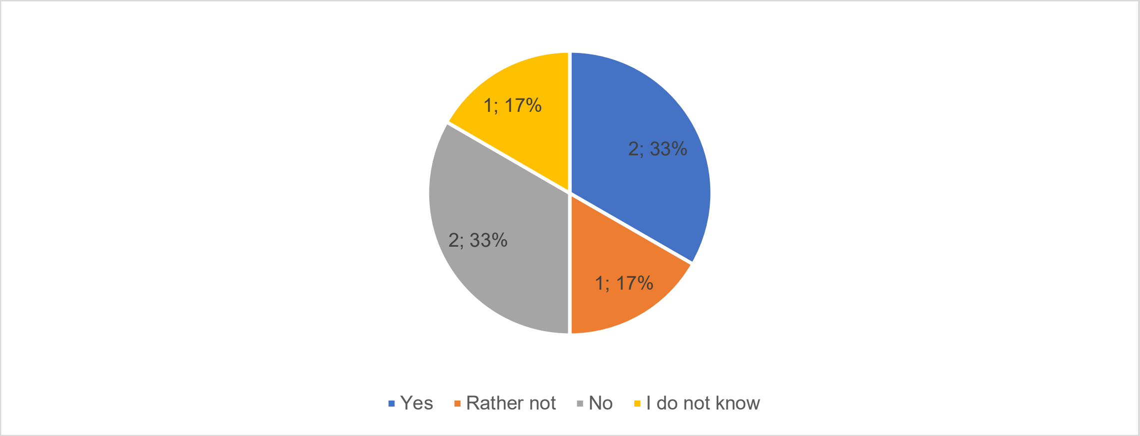


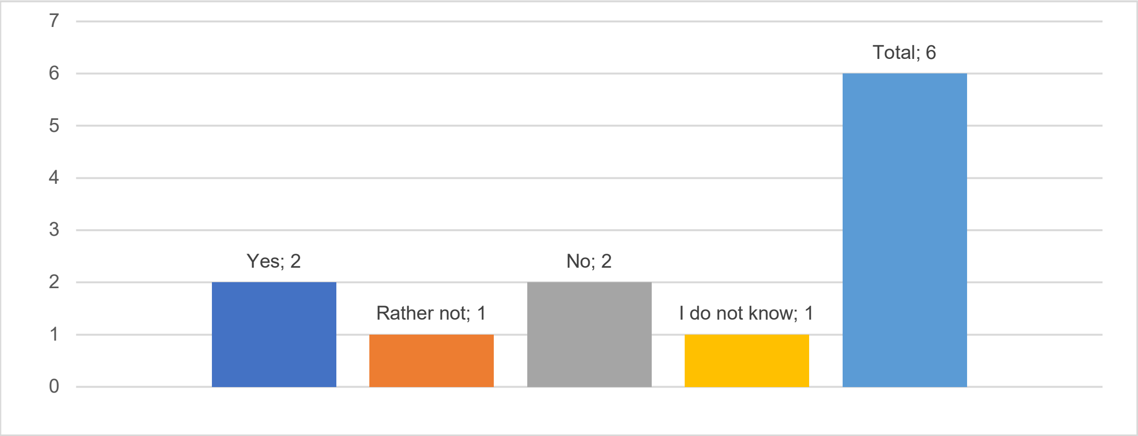
Question #3.	**The scope of a project does not matter if BIM is used:**
Yes	1
Rather not	3
No	1
I do not know	1
Total	**6**



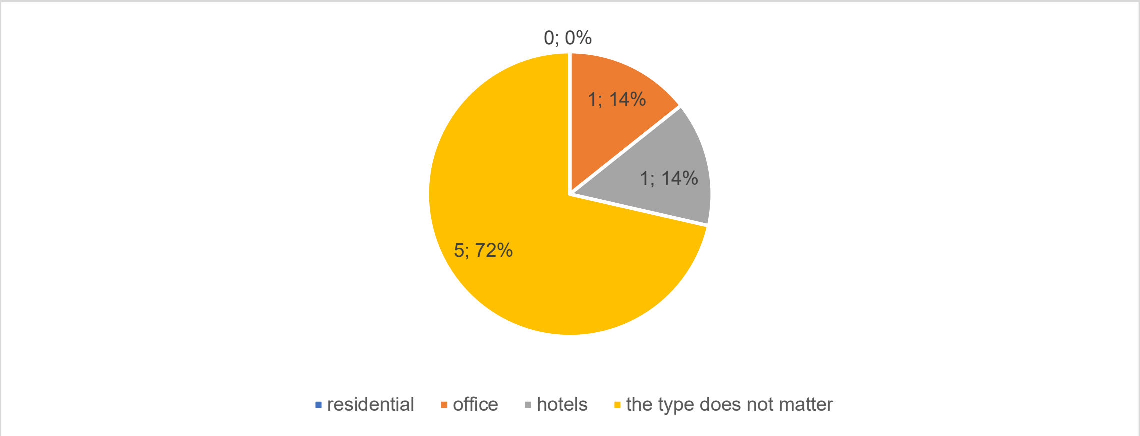


Question #4.	**If the BIM method is used, the project typology does not matter:**
Yes	2
Rather not	1
No	2
I do not know	1
Total	**6**

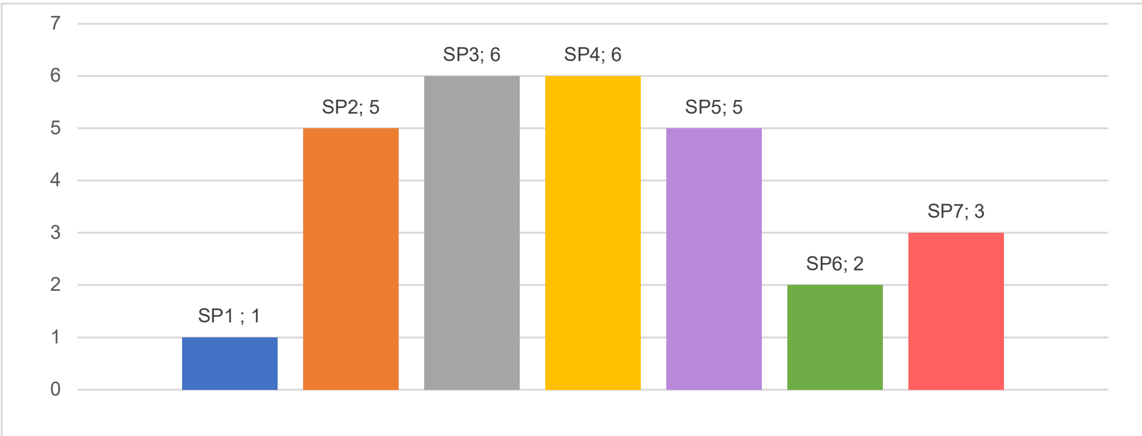




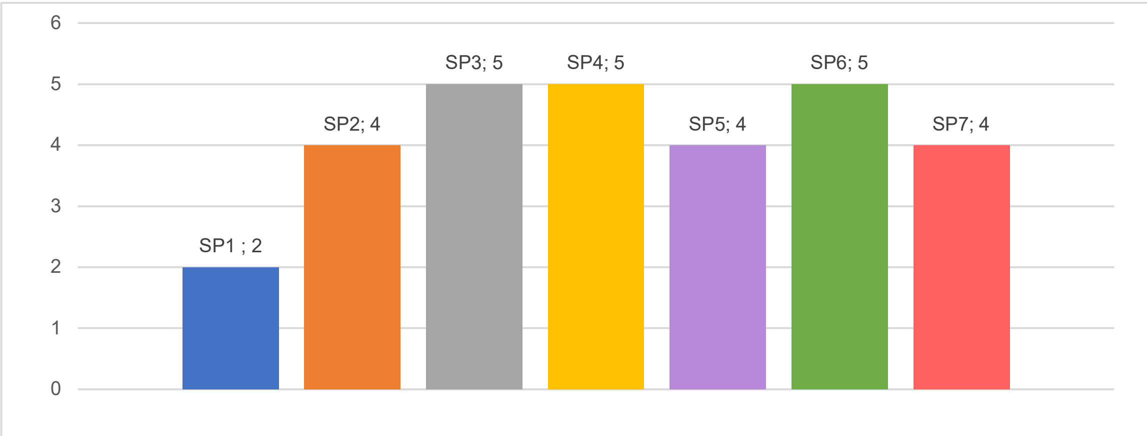
Question #5.	The BIM method suits the following project types:
residential	0
office	1
hotels	1
the type does not matter	5
Total	**7**



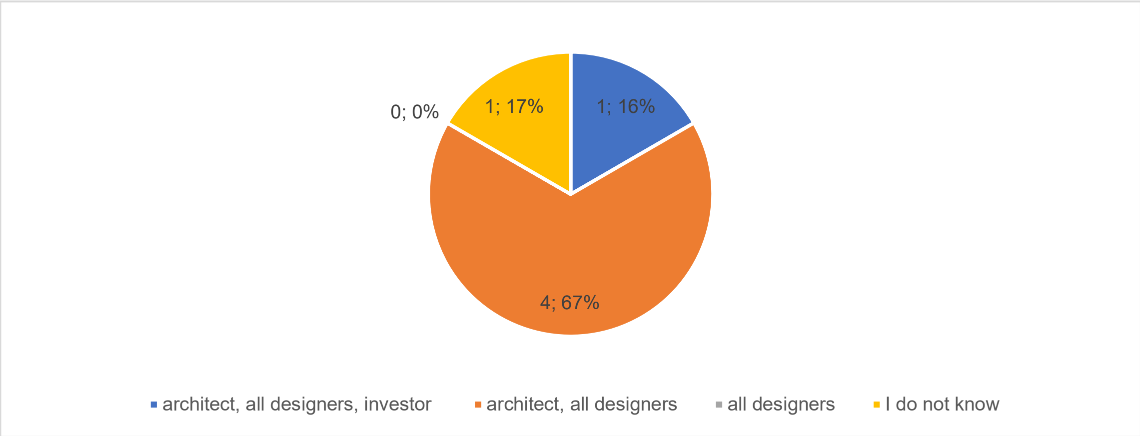
Question #6.	**Indicate the project stages in which developing a digital building information model makes sense:**	
SP1	Project Initiation	1
SP2	Preliminary – Concept Design	5
SP3	Land Zone Permit Design	6
SP4	Building Permit Developed Design	6
SP5	Detailed Design	5
SP6	List of Works and Deliverables	2
SP7	Architect's Supervision	3
Total		**28**

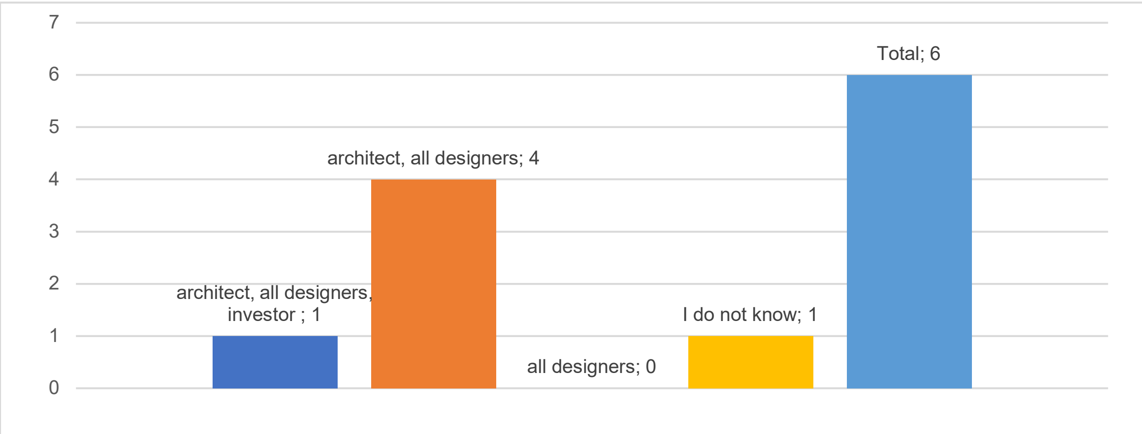


Question #7.	**Indicate the project stages in which using the common data environment (CDE) makes sense:**	
SP1	Project Initiation	2
SP2	Preliminary – Concept Design	4
SP3	Land Zone Permit Design	5
SP4	Building Permit Developed Design	5
SP5	Detailed Design	4
SP6	List of Works and Deliverables	5
SP7	Architect’s Supervision	4
Total		**29**

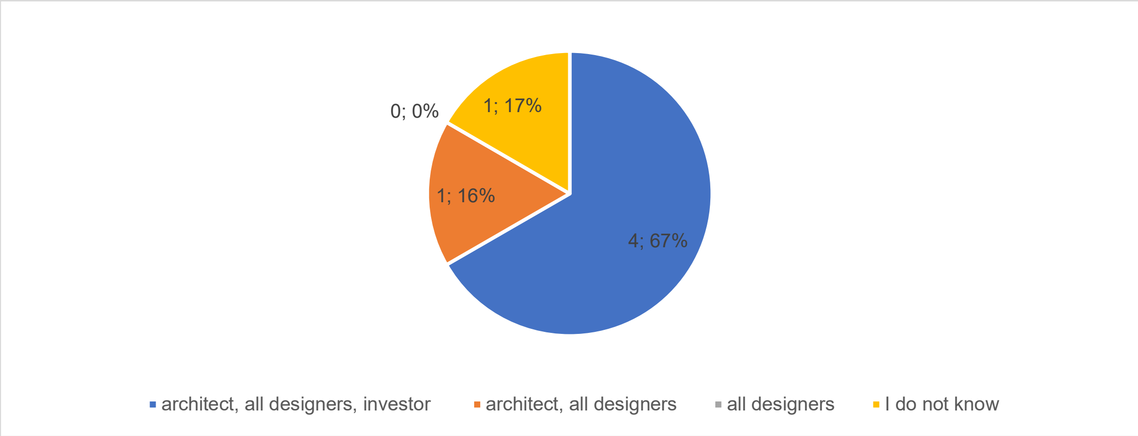


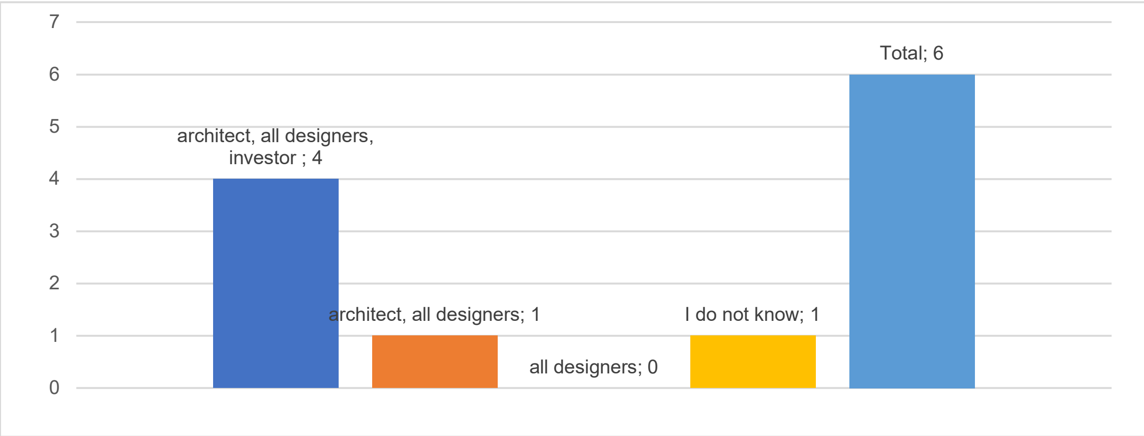
Question #8.	**Indicate who must use the (digital) building information model (IMS) for a meaningful design process:**
architect, all designers, investor	1
architect, all designers	4
all designers	0
I do not know	1
Total	**6**



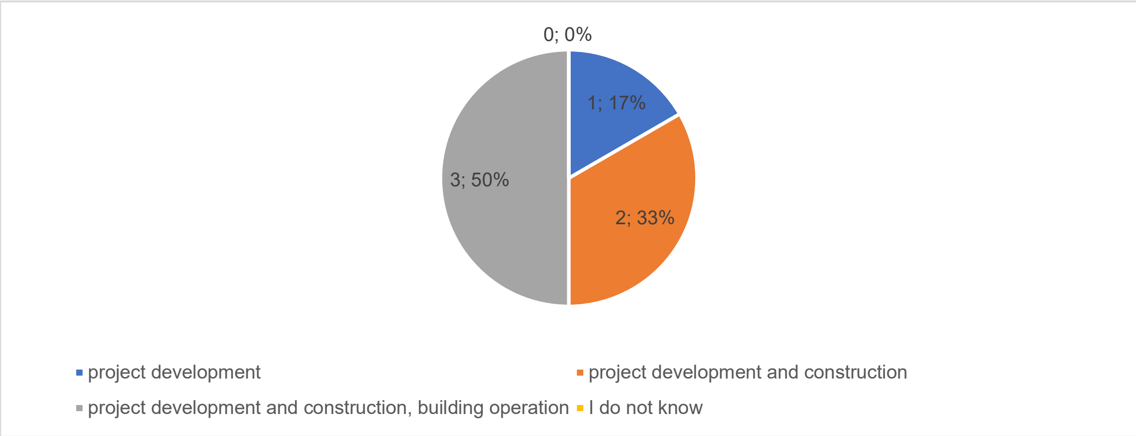


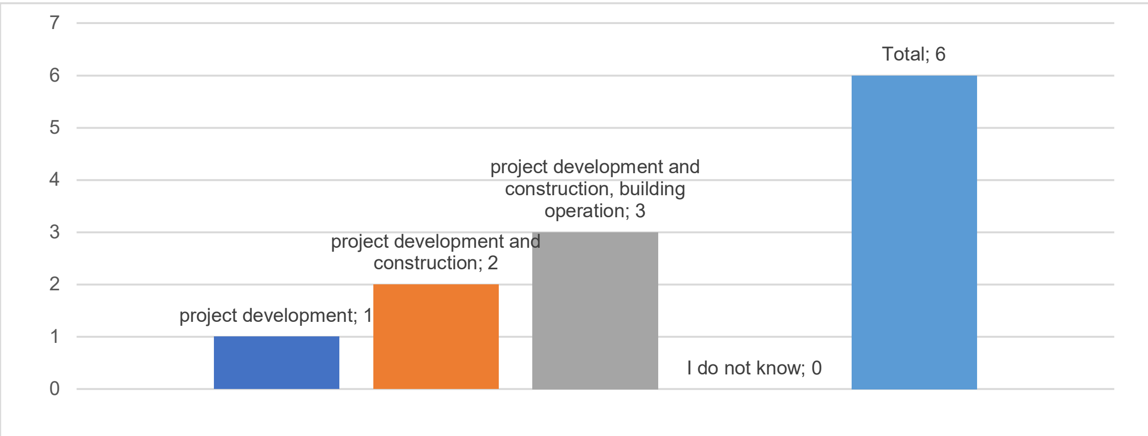
Question #9.	**Indicate who must use the common data environment (CDE) for a meaningful design process:**
architect, all designers, investor	4
architect, all designers	1
all designers	0
I do not know	1
Total	**6**



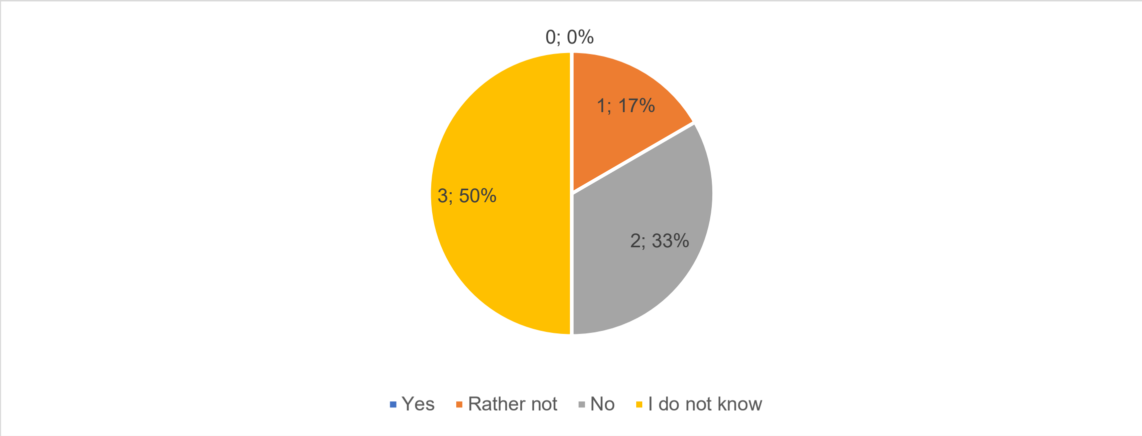


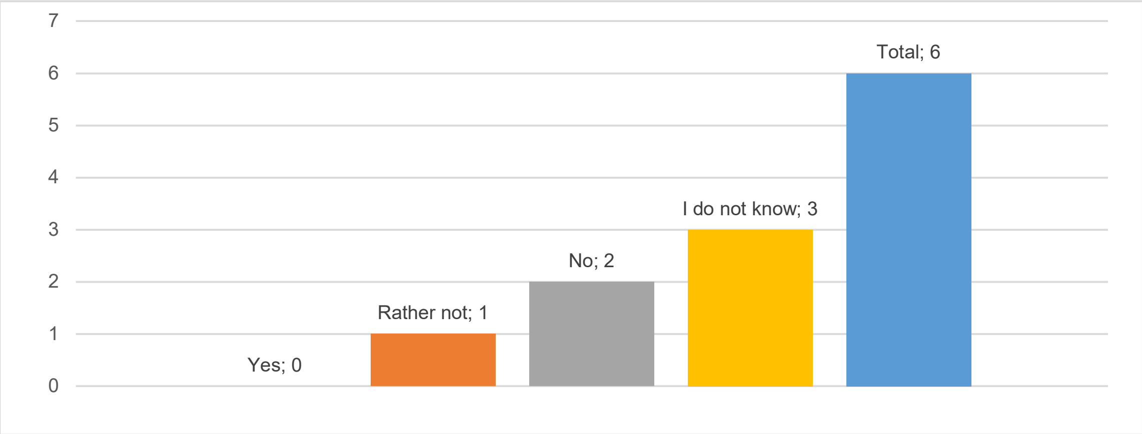
Question #10.	**The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:**
project development	1
project development and construction	2
project development and construction, building operation	3
I do not know	0
Total	**6**



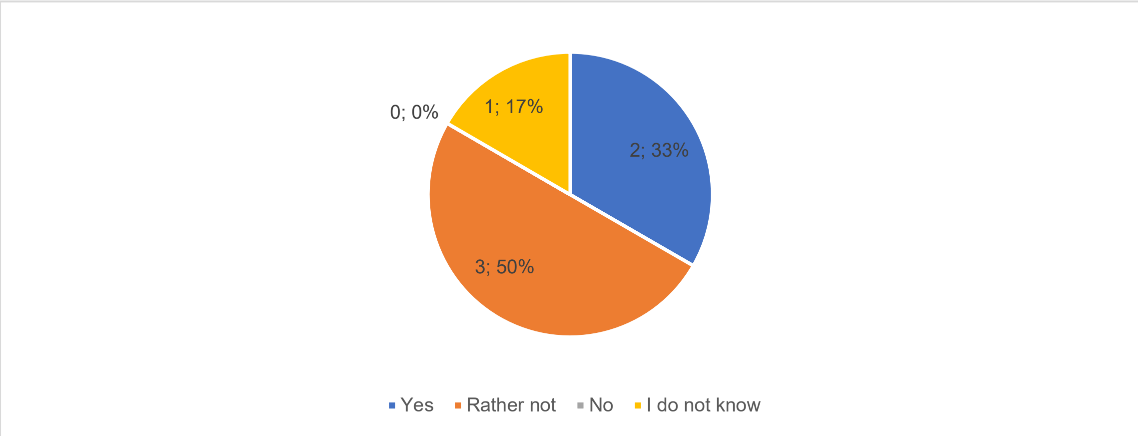


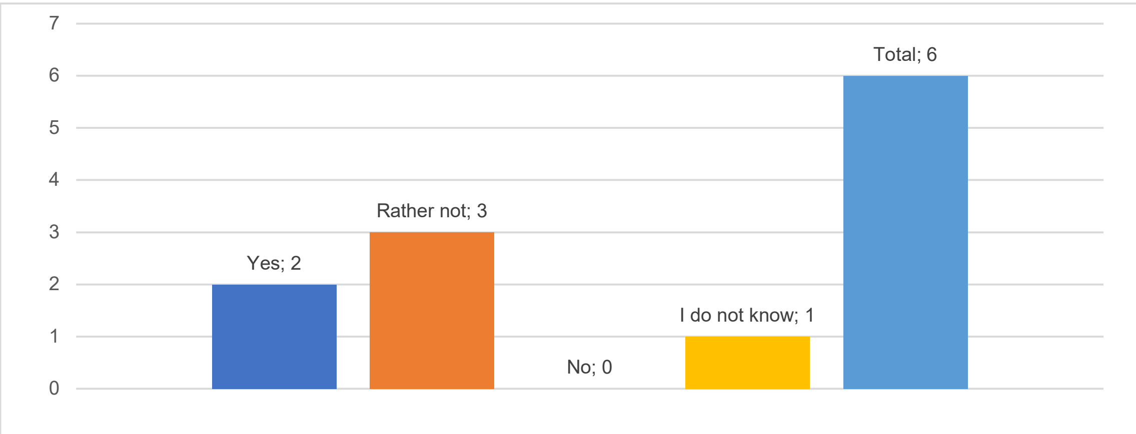
Question #11.	**For expertise (daylighting, construction physics, and similar), I use the BIM digital information model:**
Yes	0
Rather not	1
No	2
I do not know	3
Total	**6**



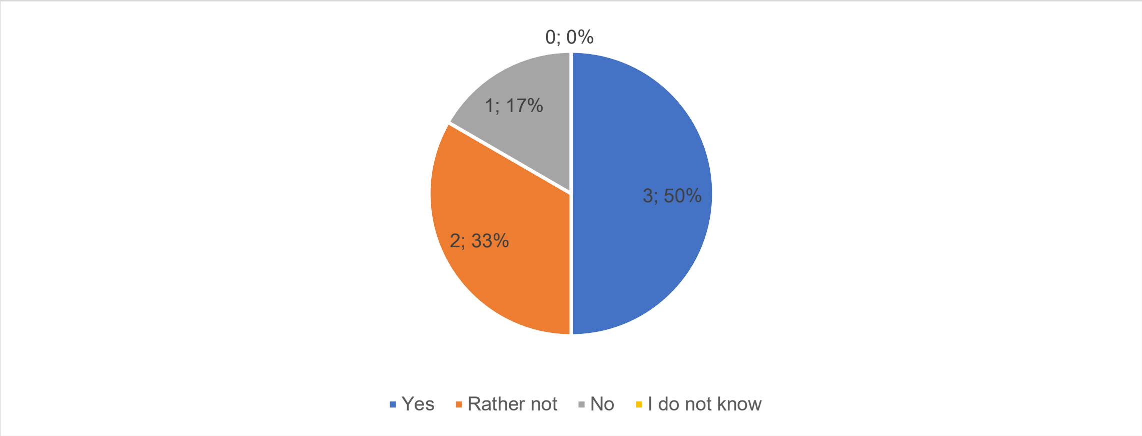


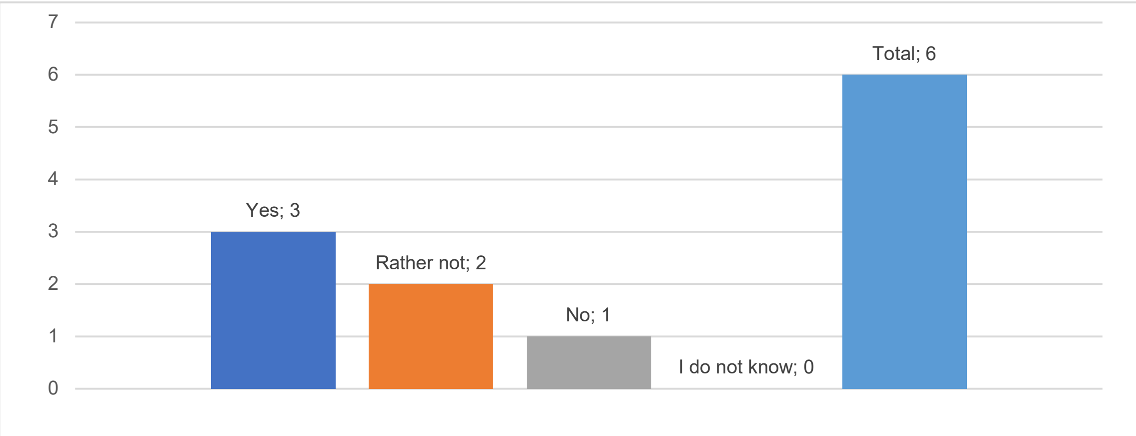
Question #12.	**I use the BIM information model as a source document for BOQ:**
Yes	2
Rather not	3
No	0
I do not know	1
Total	**6**



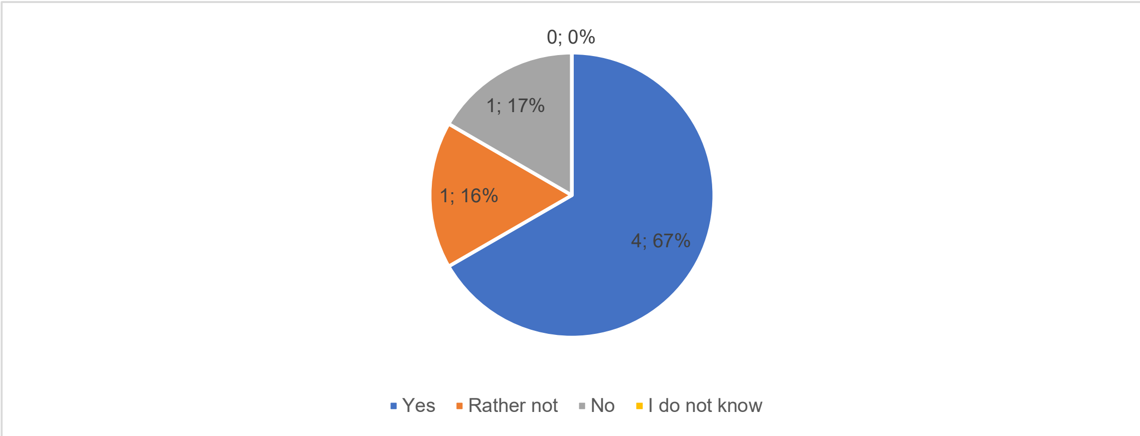


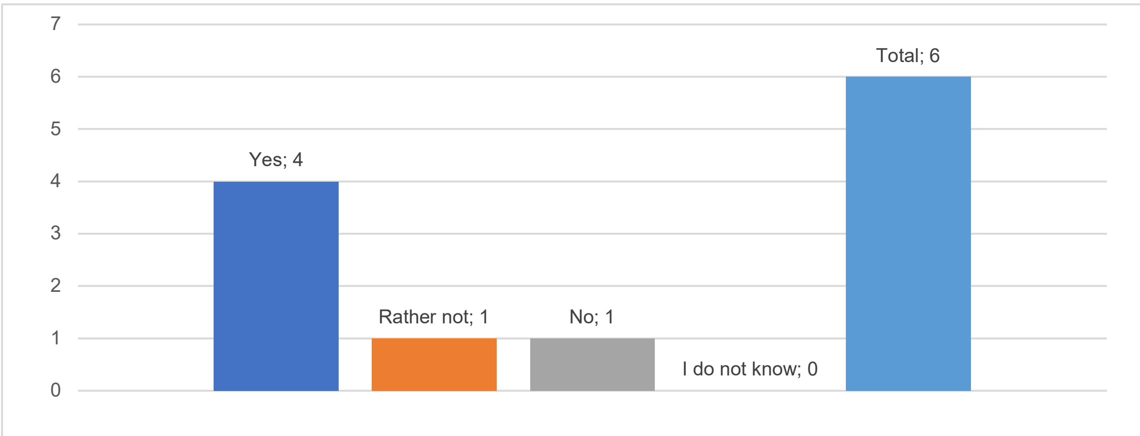
Question #13.	**Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?**
Yes	3
Rather not	2
No	1
I do not know	0
Total	**6**



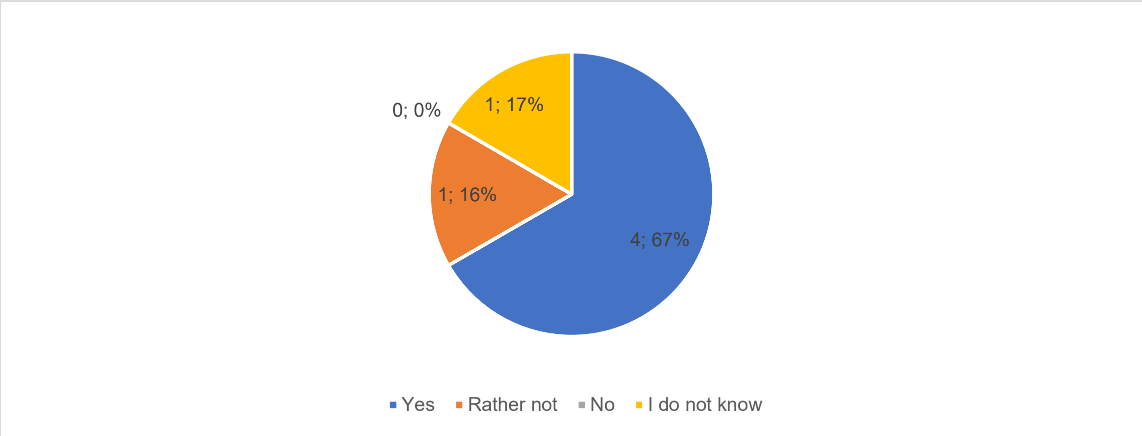


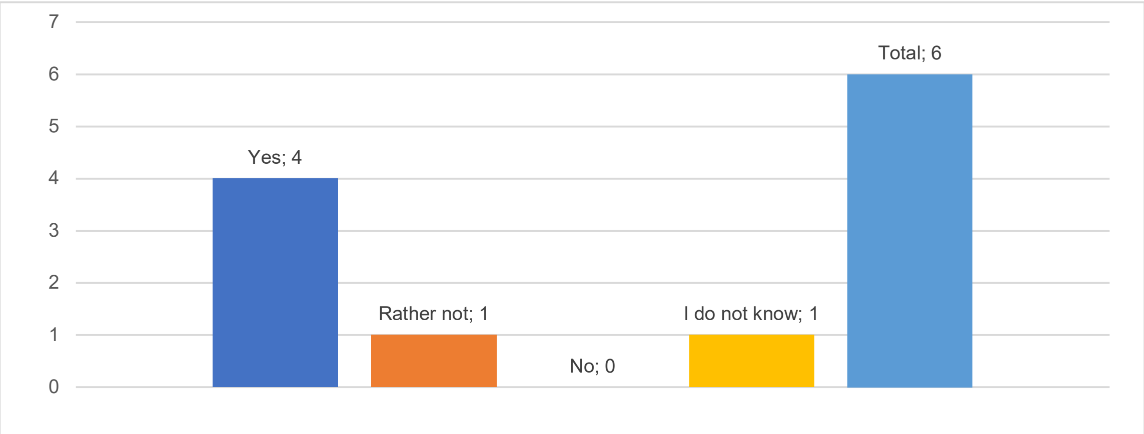
Question #17.	If BIM is used, architects must employ this method too:
Yes	4
Rather not	1
No	1
I do not know	0
Total	**6**



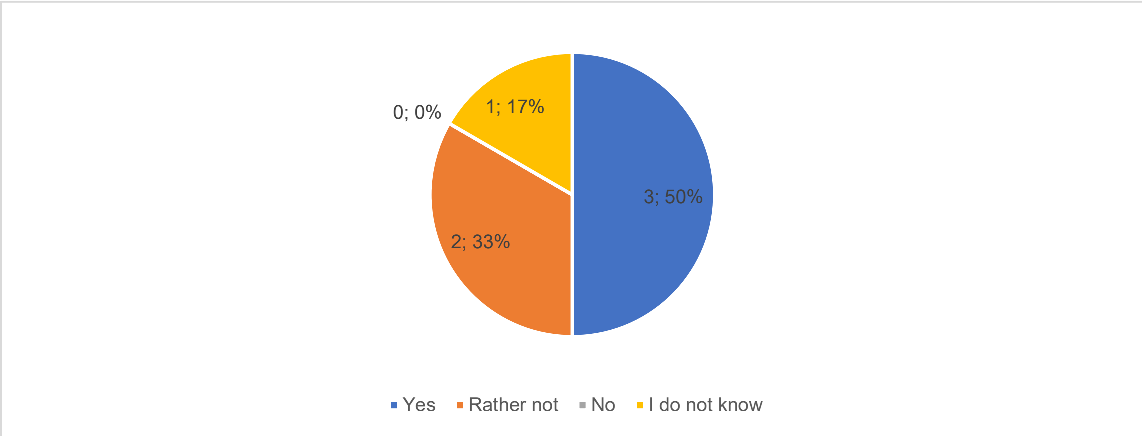


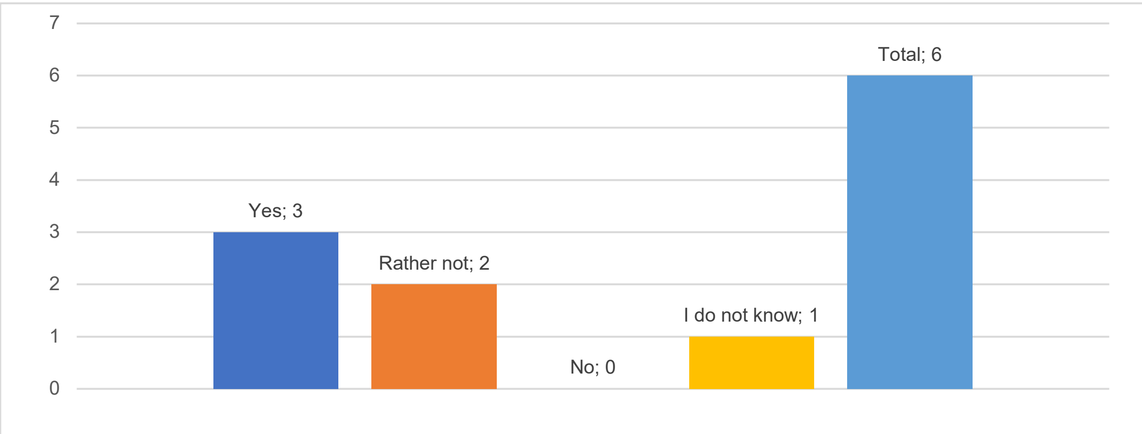
Question #18.	**If BIM is used, architects must also employ the BIM information model:**
Yes	4
Rather not	1
No	0
I do not know	1
Total	**6**



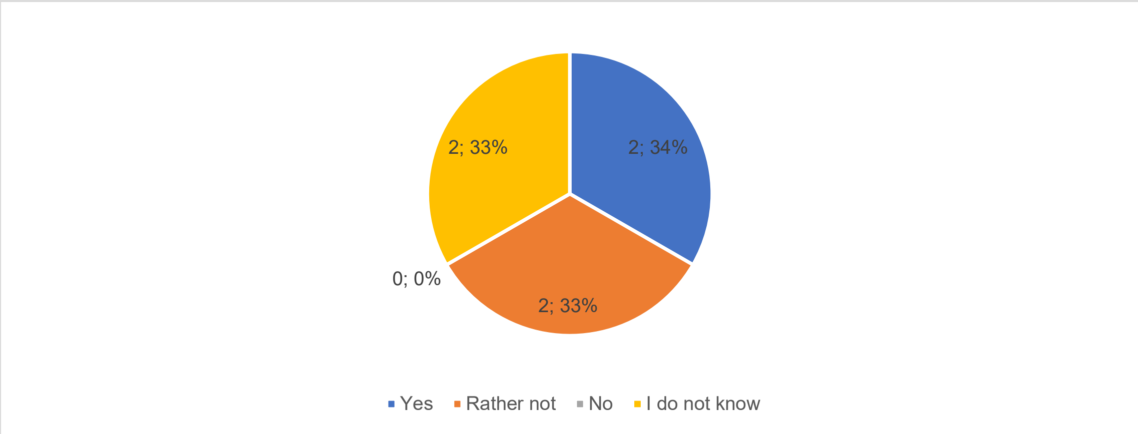


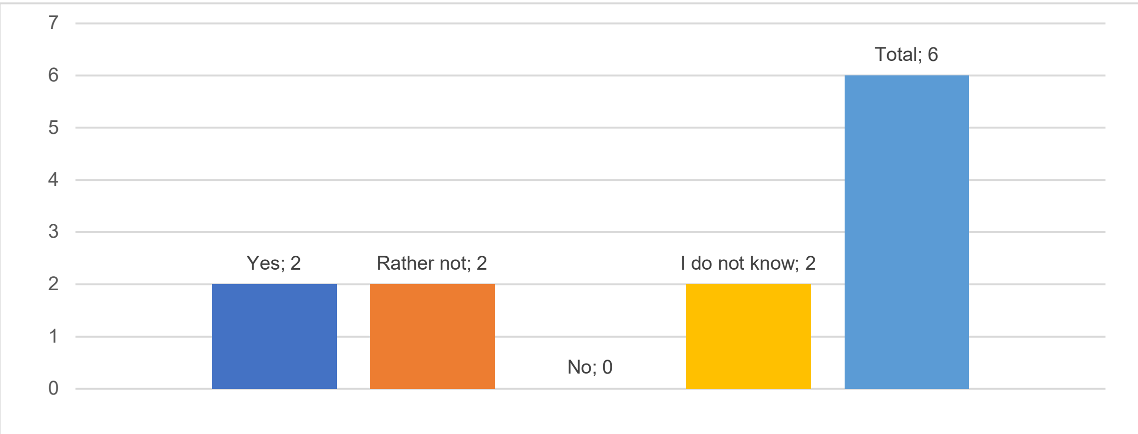
Question #19.	**If BIM is used, architects must also employ the CDE (common data environment):**
Yes	3
Rather not	2
No	0
I do not know	1
Total	**6**



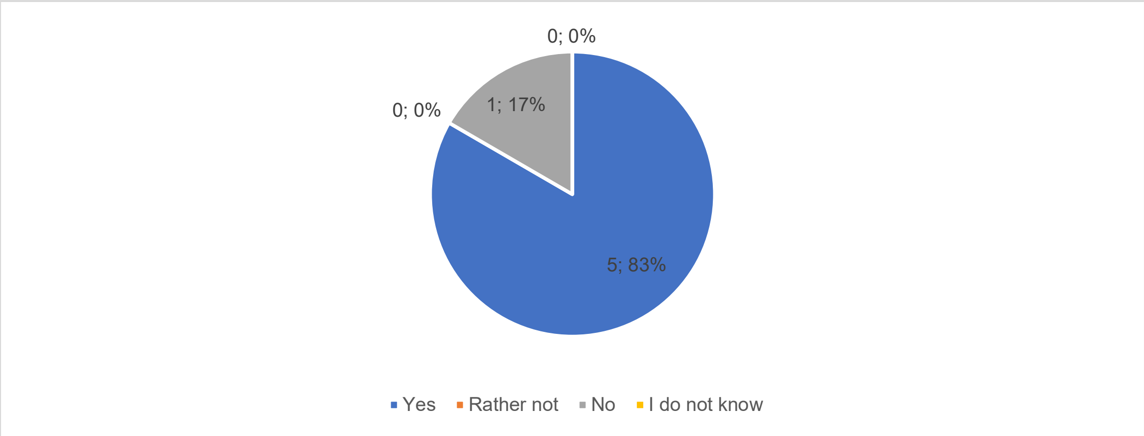


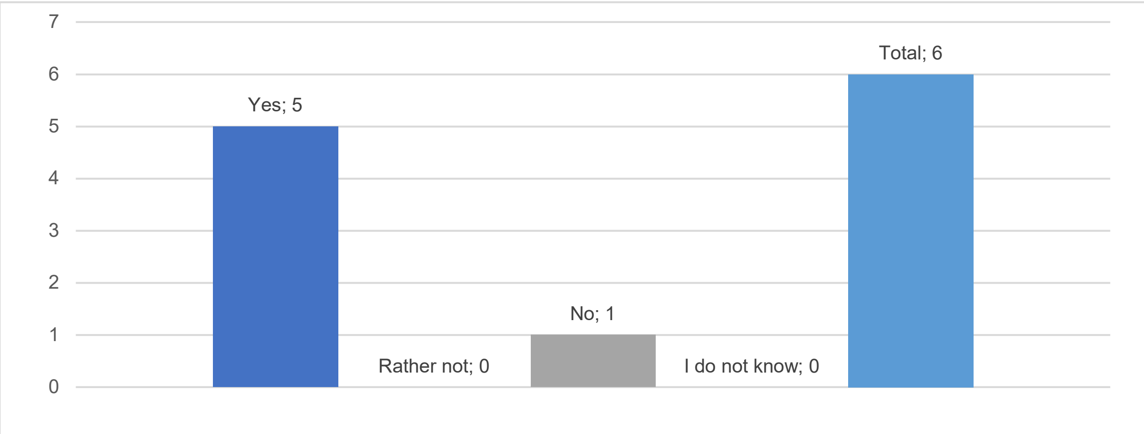
Question #20.	Using BIM, the information details in individual stages differ from those used in the conventional design process:
Yes	2
Rather not	2
No	0
I do not know	2
Total	**6**





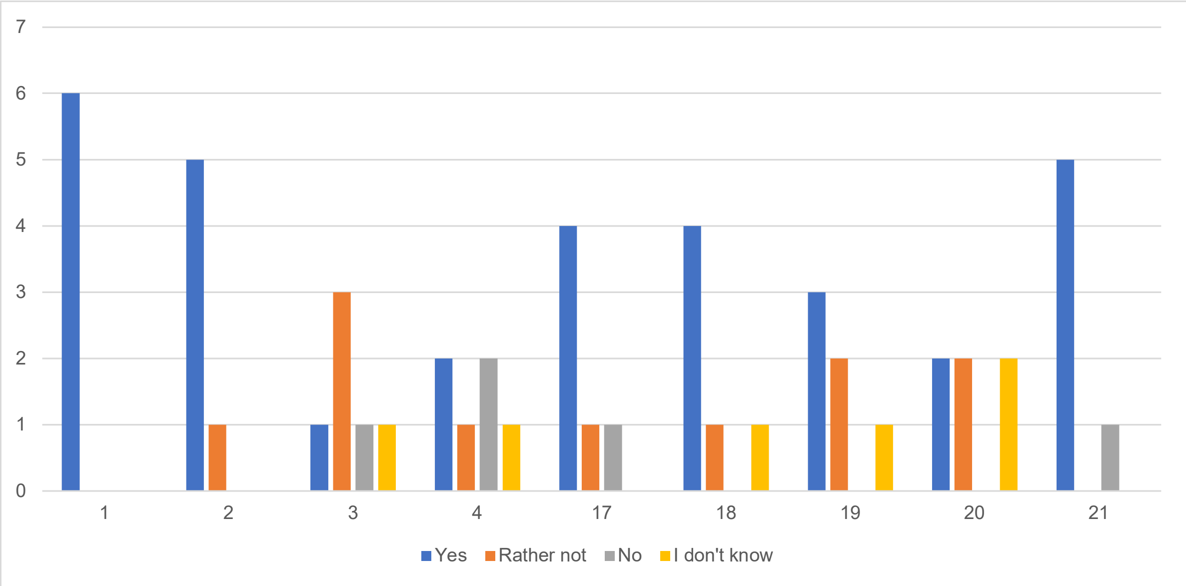
Question #21.	**Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?**
Yes	5
Rather not	0
No	1
I do not know	0
Total	**6**

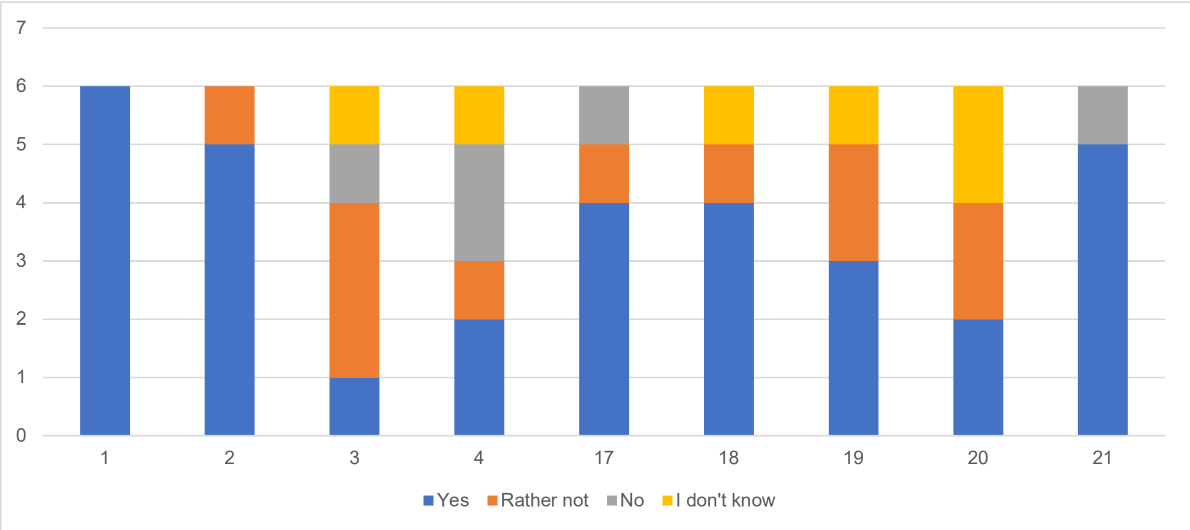




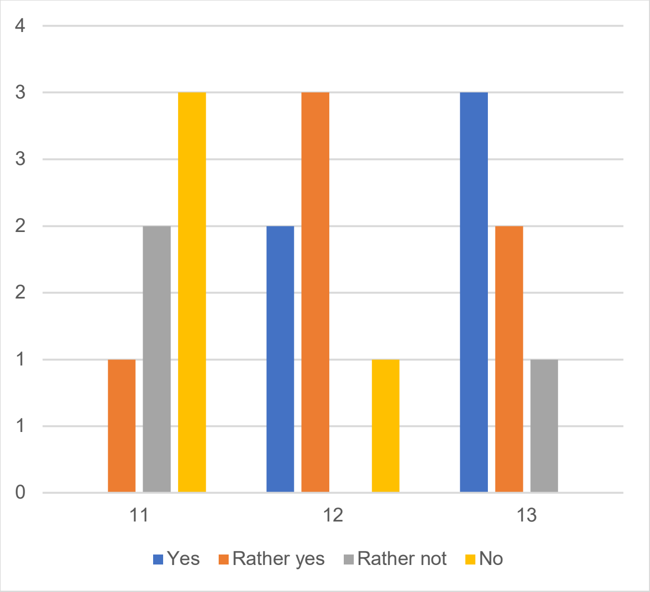
Summary Graphs

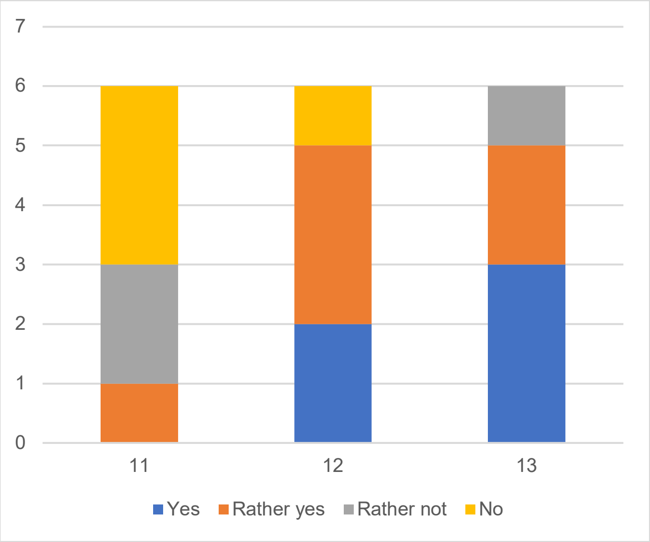
Question	1	2	3	4	17	18	19	20	21
Yes	6	5	1	2	4	4	3	2	5
Rather not	0	1	3	1	1	1	2	2	0
No	0	0	1	2	1	0	0	0	1
I don't know	0	0	1	1	0	1	1	2	0
Total	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**





Question	11	12	13
Yes	0	2	3
Rather yes	1	3	2
Rather not	2	0	1
No	3	1	0
Total	**6**	**6**	**6**





Questionnaire: Clarification Replies

Question #14.

Describe the advantages of using the BIM method in the project development briefly:

- Precision, level of detail, 3D projection as such.
- It makes the entire process simpler and faster.
- A collision can be easily detected: all information is at one place; more mistakes can be discovered – if xrefs are layered in 2D, they cannot be that well checked; alterations in plans immediately project into the sections and similar – three different drawings do not have to be redrawn to correct a mistake in one of them.
- Plans, sections, and elevations can be simply developed + structures simply relocated (does not apply always).
- The project is linked; altering it is simpler (any plan alteration is projected into sections and elevations, and similar). Altering is easier.
- More options can be worked with, better orientation within the project, 3D.

Question #15.

Describe the cons of using the BIM method in the project development briefly:

- I do not know all functions and tricks; I do not see any drawbacks so far.
- For fluent designing, we need a stable Internet and an efficient computer.
- It is time-consuming; it takes a lot of preparation before designing can start — standards, unification by marking the classification, and similar.
- All three dimensions and the structural makeup need to be known; outputs must be detailed (a very laborious process), missing elements must be modelled, it is challenging to draw arches and connections more complex than L.
- The system is complicated; it does not work, sometimes, as it should; it takes a long time to set it up; it is, sometimes, very complicated to set the program up so that it would work for us, not us for it. Incorrect drawing of structures.

Question #16.

Add your brief comment to using the BIM method in the project development:

- See item #15 – I have still been getting to know the method.
- I would use nothing else if possible.
- In my opinion, using BIM for houses and smaller buildings does not make sense.
- It is ideal for simple angular buildings (best for panel houses) – it causes problems if inclining or other way rounded walls are to be used; slanting slabs are a problem. It is difficult to detail drawings to meet Czech standards; several Revits must be open in these SW versions (otherwise, the project must always be closed).
- I think this is the right way, but a lot of work still needs to be done to use the system fully.

Question #23.

Describe the basic requirements on architects' work briefly if employing the BIM design method:

- Precision and possibility to consider all possible layers in structures.
- Make them realize the spatial requirements and draw outlined structures.
- I do not know.

Question #24.

Describe the basic benefits of architects' use of the BIM design method briefly:

- Visibility of loadbearing structures, thicknesses of materials.
- Models can be linked and more simply taken over; it can be immediately recognized what the architect requires.
- Projects are interlinked on the architectural and structural level, better communication with designers.
- The same as regarding the designer.

Question #25.

Describe the fundamental problems of architects' use of the BIM design method briefly:

- I do not know how to answer the last questions.
- The precision of the model.
- The architect has everything drawn in one structure without structuring and, therefore, [thicknesses of] makeups, structural heights, and similar do not match.
- I do not know.
- It can be a problem when the architect is not well familiar with BIM.

Annex B
Research Data and their Evaluation

2. Questionnaires
2.3. Project Managers

Questionnaire

Question #1

I consider BIM a helpful design tool:

a. Yes
b. Rather not
c. No
d. I do not know

Question #2

I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):

a. Yes
b. Rather not
c. No
d. I do not know

Question #3

The scope of a project does not matter if BIM is used:

a. Yes
b. Rather not
c. No
d. I do not know

Question #4

If the BIM method is used, the project typology does not matter:

a. Yes
b. Rather not
c. No
d. I do not know

Question #5

The BIM method suits the following project types:

a. residential
b. office
c. hotels
d. the type does not matter

Question #6

Indicate the project stages in which developing a digital building information model makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect's Supervision

Question #7

Indicate the project stages in which using the common data environment (CDE) makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect's Supervision

Question #8

Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #9

Indicate who must use the common data environment (CDE) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #10

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

a. project development
b. project development and construction
c. project development and construction, building operation
d. I do not know

Question #11

For expertise (daylighting, construction physics, and similar), I use the BIM digital information model:

a. Yes
b. Rather not
c. No
d. I do not know

Question #12

I use the BIM information model as a source document for BOQ:

a. Yes
b. Rather not
c. No
d. I do not know

Question #13

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

a. Yes
b. Rather not
c. No
d. I do not know

Question #14

Describe the advantages of using the BIM method in the project development briefly:

Question #15

Describe the cons of using the BIM method in the project development briefly:

Question #16

Add your brief comment to using the BIM method in the project development:

Question #17

If BIM is used, architects must employ this method too:

a. Yes
b. Rather not
c. No
d. I do not know

Question #18

If BIM is used, architects must also employ the BIM information model:

a. Yes
b. Rather not
c. No
d. I do not know

Question #19

If BIM is used, architects must also employ the CDE (common data environment):

a. Yes
b. Rather not
c. No
d. I do not know

Question #20

Using BIM, the information details in individual stages differ from those used in the conventional design process:

a. Yes
b. Rather not
c. No
d. I do not know

Question #21

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

a. Yes
b. Rather not
c. No
d. I do not know

Question #22

Describe briefly what fundamental data architects should provide in different design stages if using the BIM method:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

Question #23

Describe the basic requirements on architects' work briefly if employing the BIM design method:

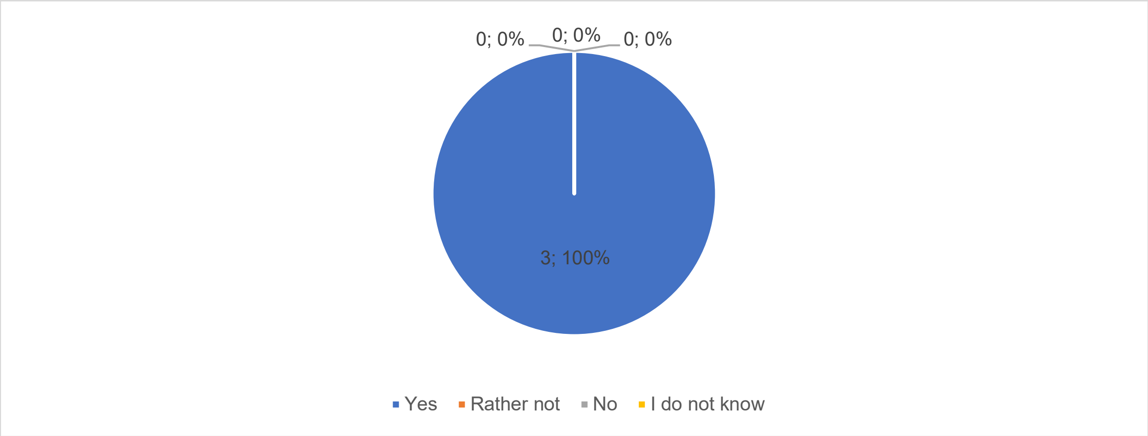
Question #24

Describe the basic benefits of architects' use of the BIM design method briefly:

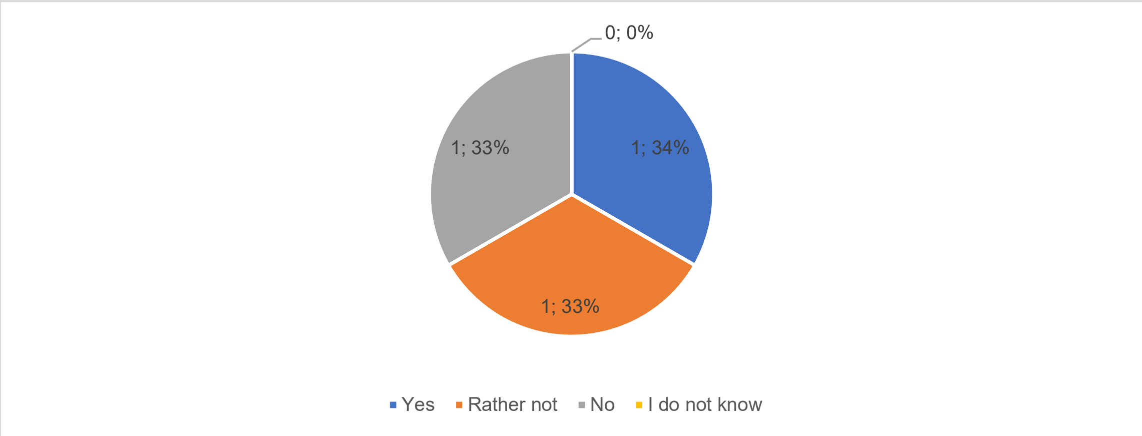
Question #25

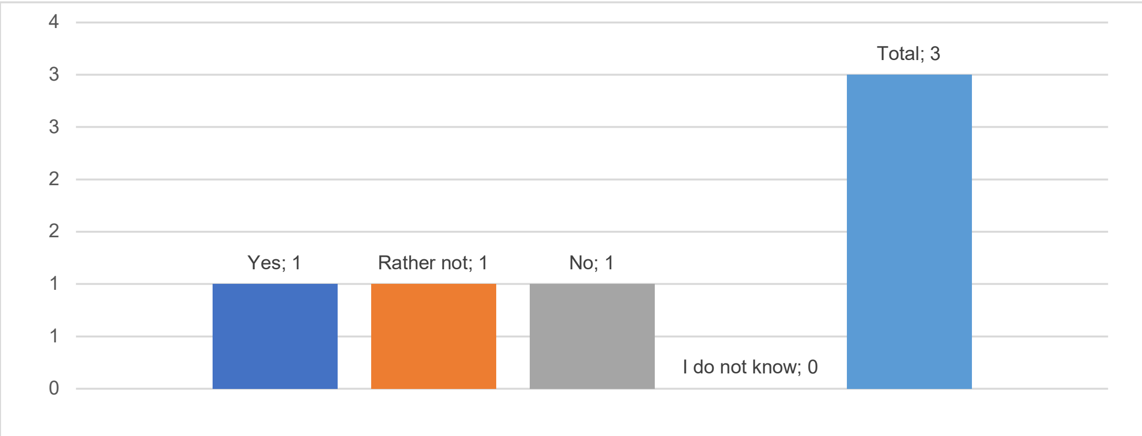
Describe the fundamental problems of architects' use of the BIM design method briefly:

Question #1.	**I consider BIM a helpful design tool:**
Yes	3
Rather not	0
No	0
I do not know	0
Total	**3**

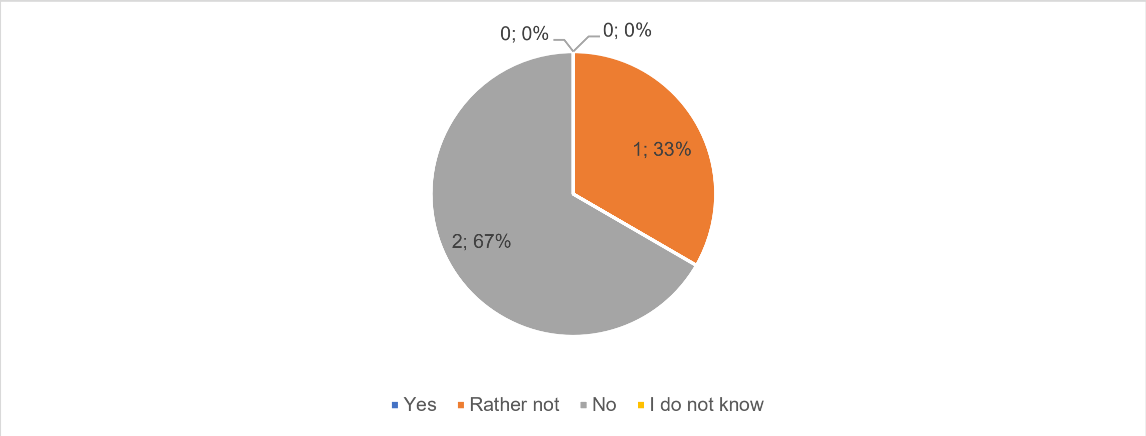


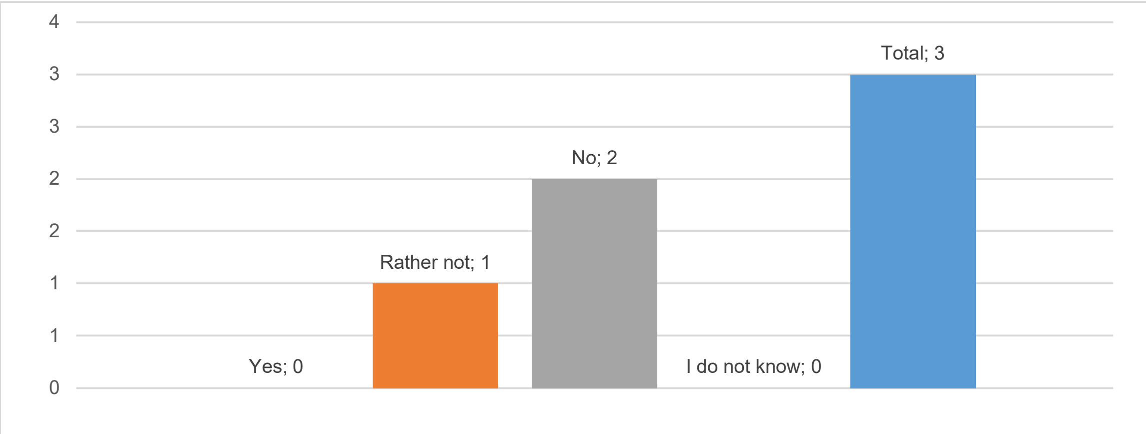
Question #2.	**I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):**
Yes	1
Rather not	1
No	1
I do not know	0
Total	**3**



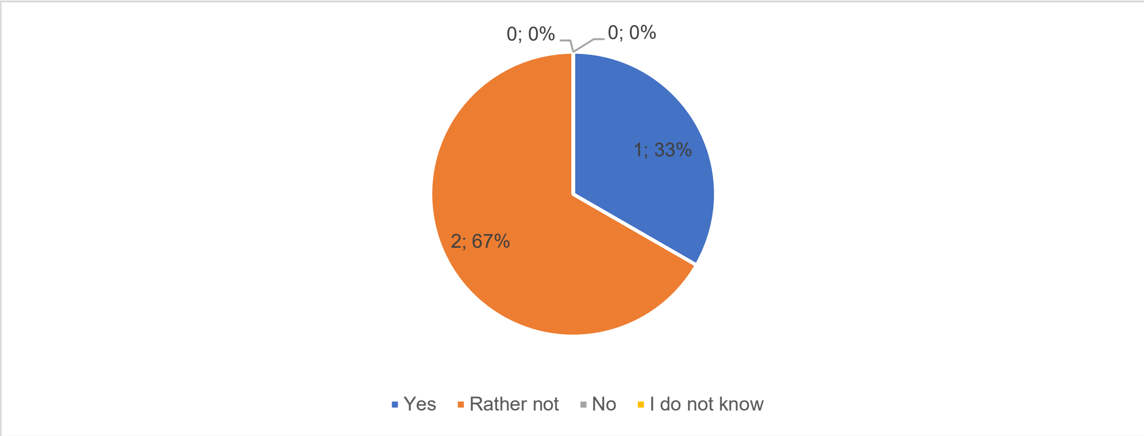


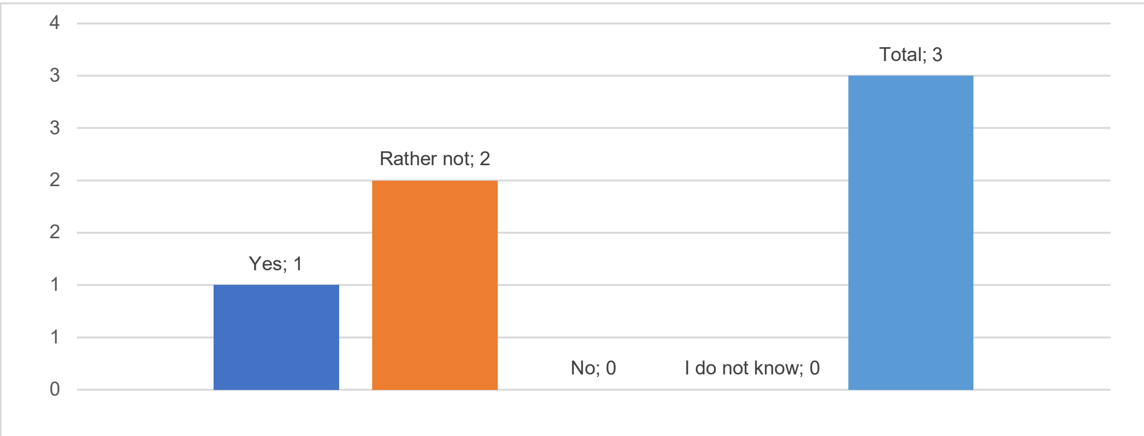
Question #3.	The scope of a project does not matter if BIM is used:
Yes	0
Rather not	1
No	2
I do not know	0
Total	**3**



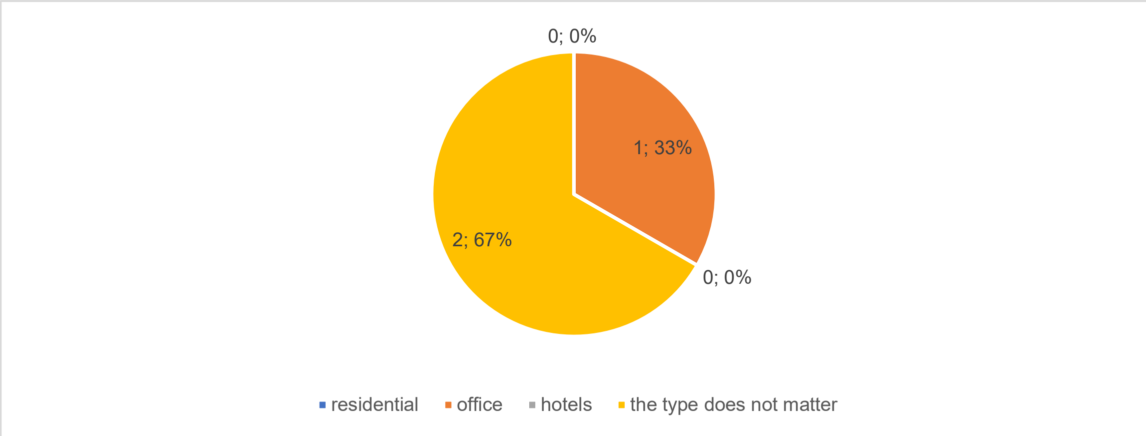


Question #4.	**If the BIM method is used, the project typology does not matter:**
Yes	1
Rather not	2
No	0
I do not know	0
Total	**3**

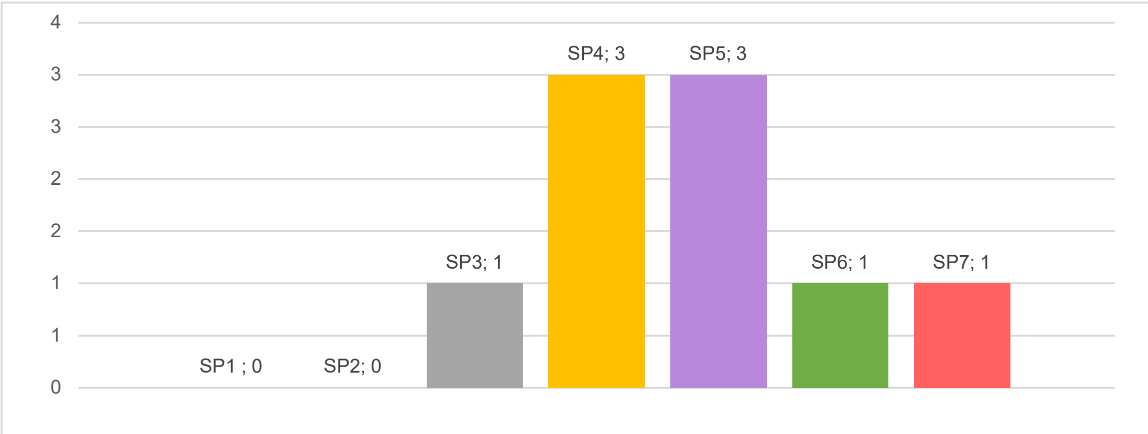




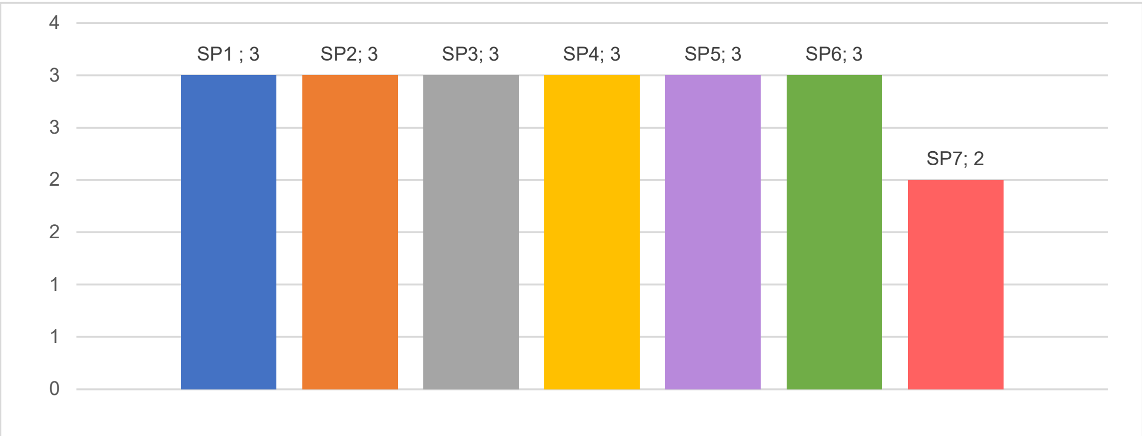
Question #5.	**The BIM method suits the following project types:**
residential	0
office	1
hotels	0
the type does not matter	2
Total	**3**



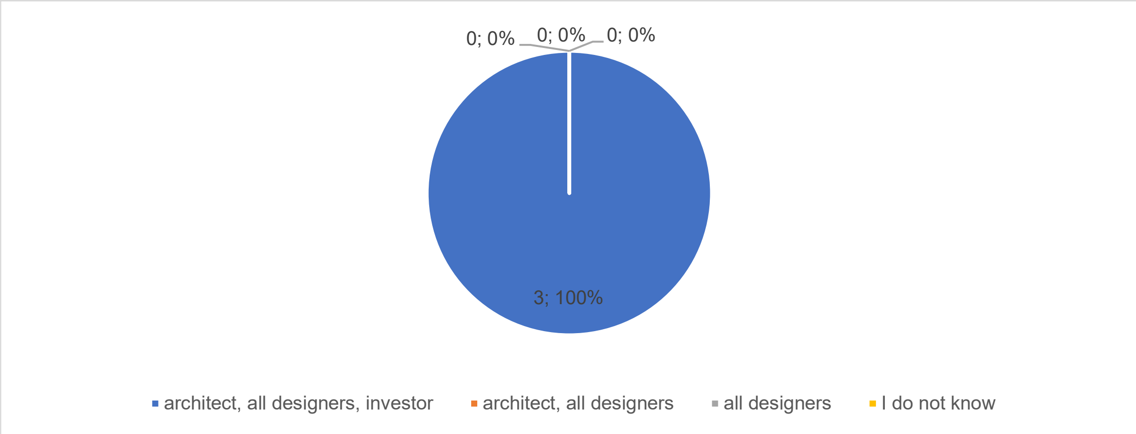
Question #6.	**Indicate the project stages in which developing a digital building information model makes sense:**	
SP1	Project Initiation	0
SP2	Preliminary – Concept Design	0
SP3	Land Zone Permit Design	1
SP4	Building Permit Developed Design	3
SP5	Detailed Design	3
SP6	List of Works and Deliverables	1
SP7	Architect's Supervision	1
Total		**9**



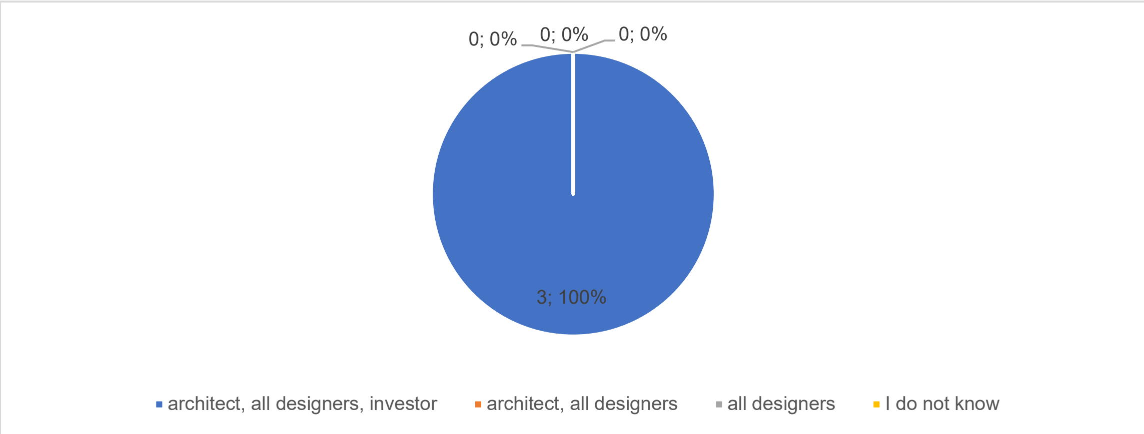
Question #7.	**Indicate the project stages in which using the common data environment (CDE) makes sense:**	
SP1	Project Initiation	3
SP2	Preliminary – Concept Design	3
SP3	Land Zone Permit Design	3
SP4	Building Permit Developed Design	3
SP5	Detailed Design	3
SP6	List of Works and Deliverables	3
SP7	Architect's Supervision	2
Total		**20**



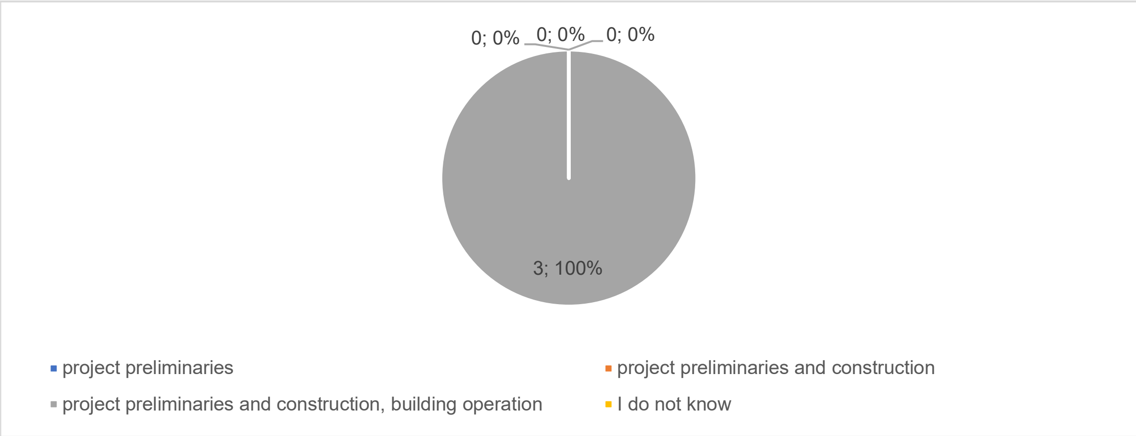
Question #8.	**Indicate who must use the (digital) building information model (IMS) for a meaningful design process:**
architect, all designers, investor	3
architect, all designers	0
all designers	0
I do not know	0
Total	**3**

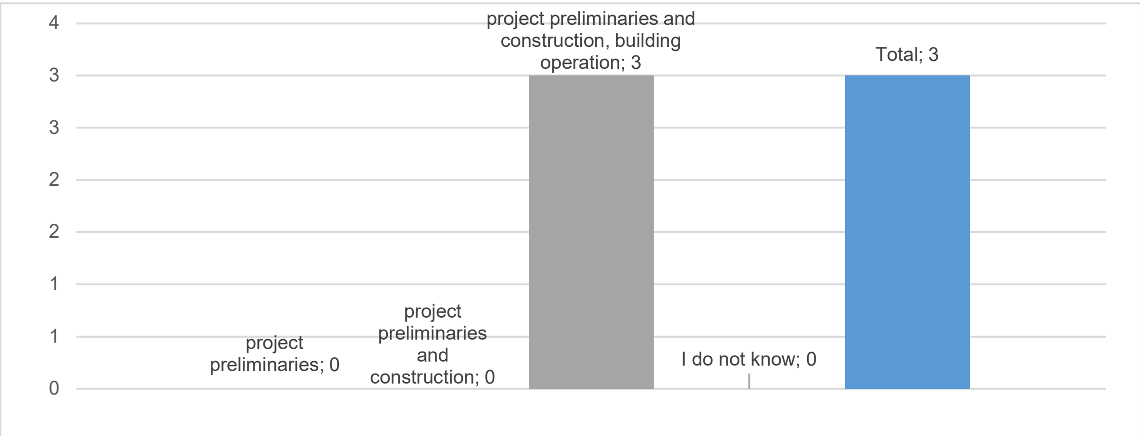


Question #9.	**Indicate who must use the common data environment (CDE) for a meaningful design process:**
architect, all designers, investor	3
architect, all designers	0
all designers	0
I do not know	0
Total	**3**

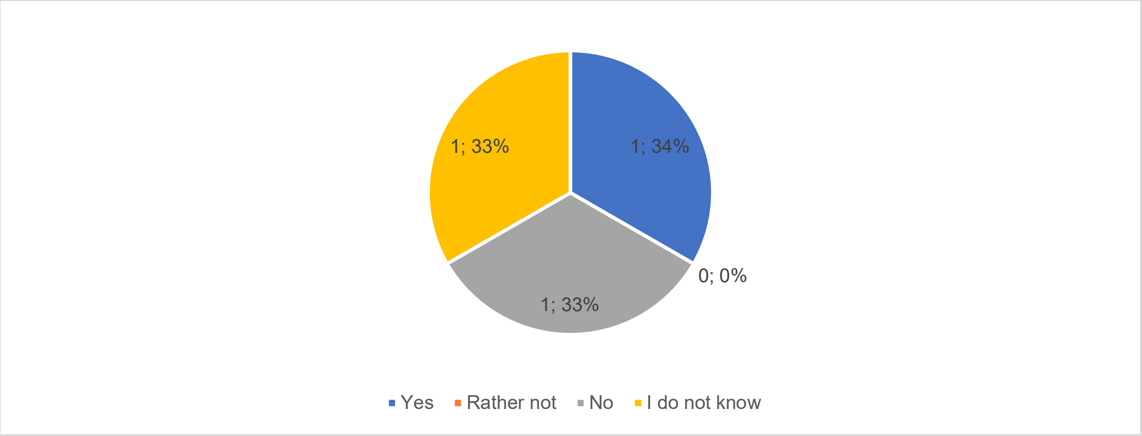


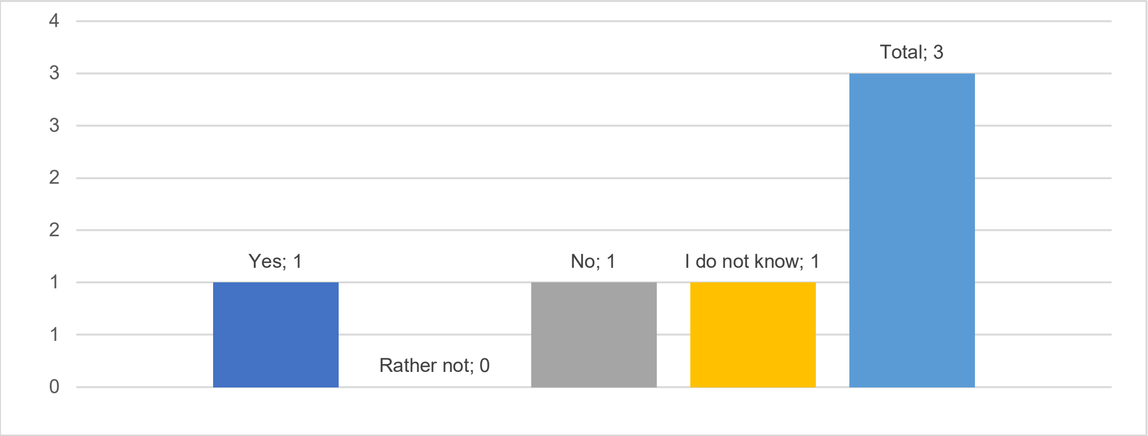
Question #10.	**The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:**
project preliminaries	0
project preliminaries and construction	0
project preliminaries and construction, building operation	3
I do not know	0
Total	**3**



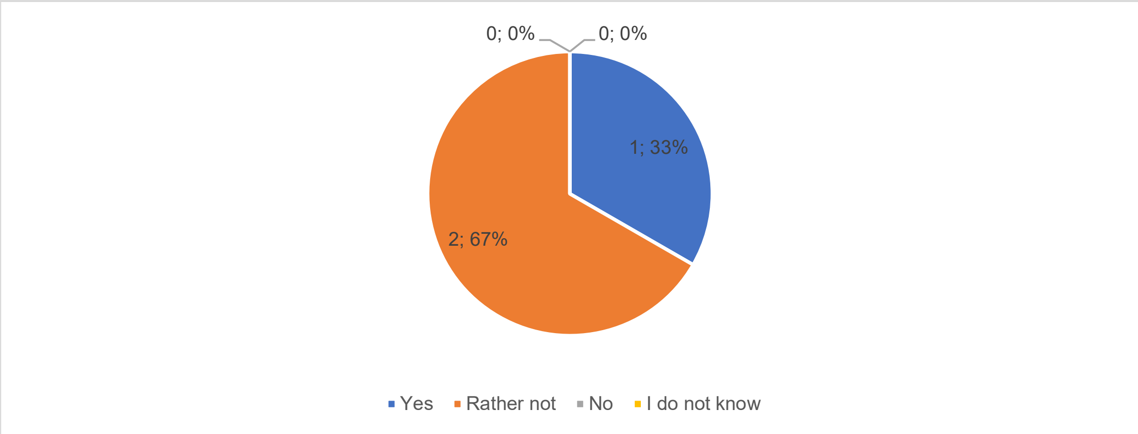


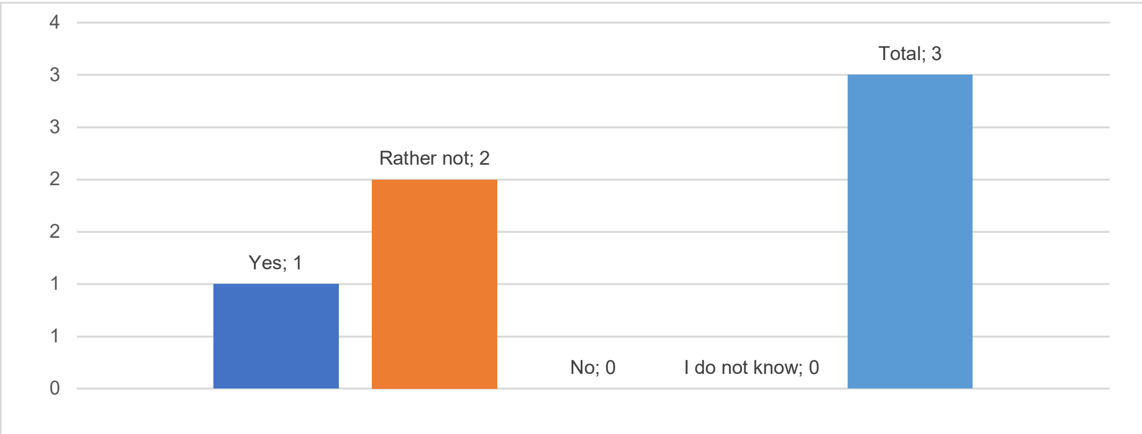
Question #11.	For expertise (daylighting, construction physics, and similar), I use the BIM digital information model:
Yes	1
Rather not	0
No	1
I do not know	1
Total	**3**



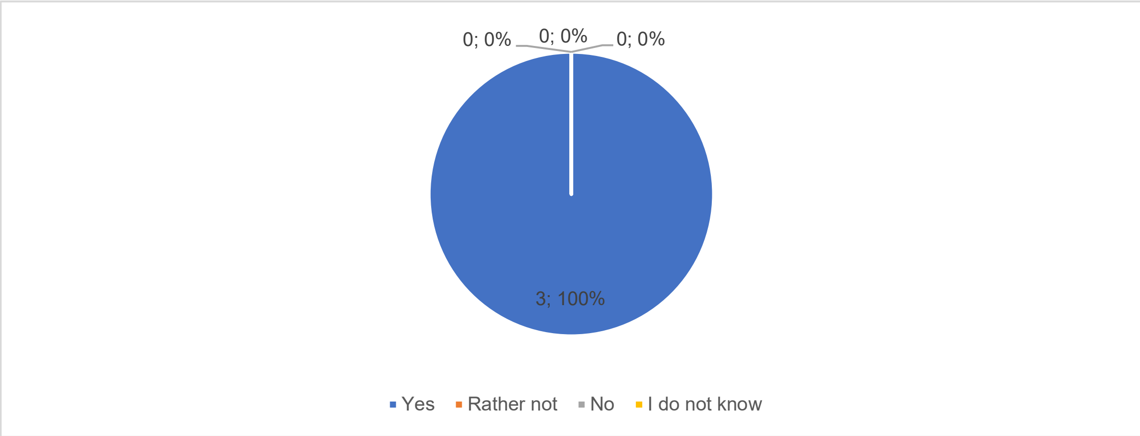


Question #12.	**I use the BIM information model as a source document for BOQ:**
Yes	1
Rather not	2
No	0
I do not know	0
Total	**3**

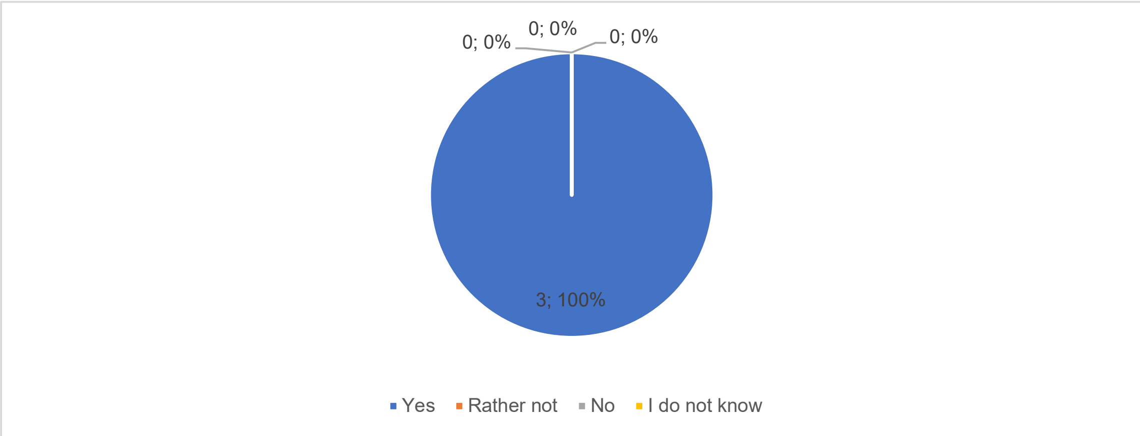




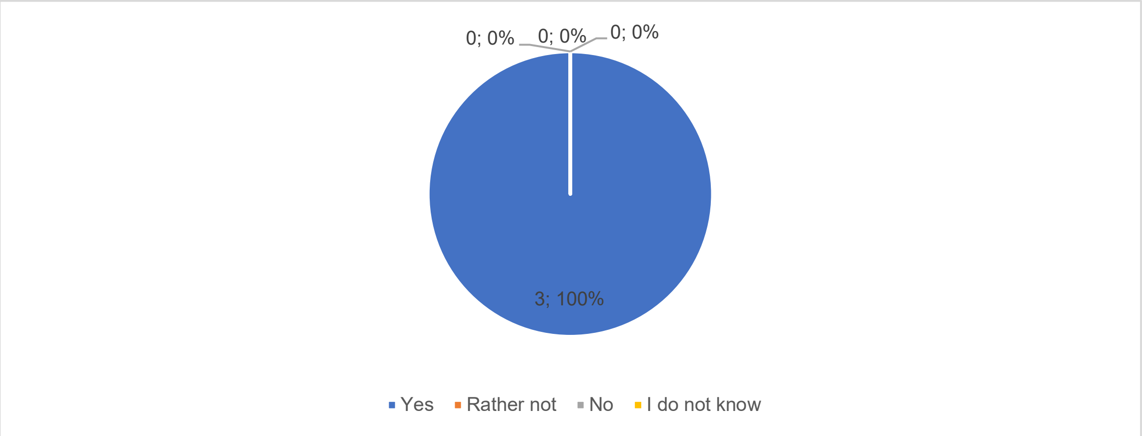
Question #13.	**Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?**
Yes	3
Rather not	0
No	0
I do not know	0
Total	**3**



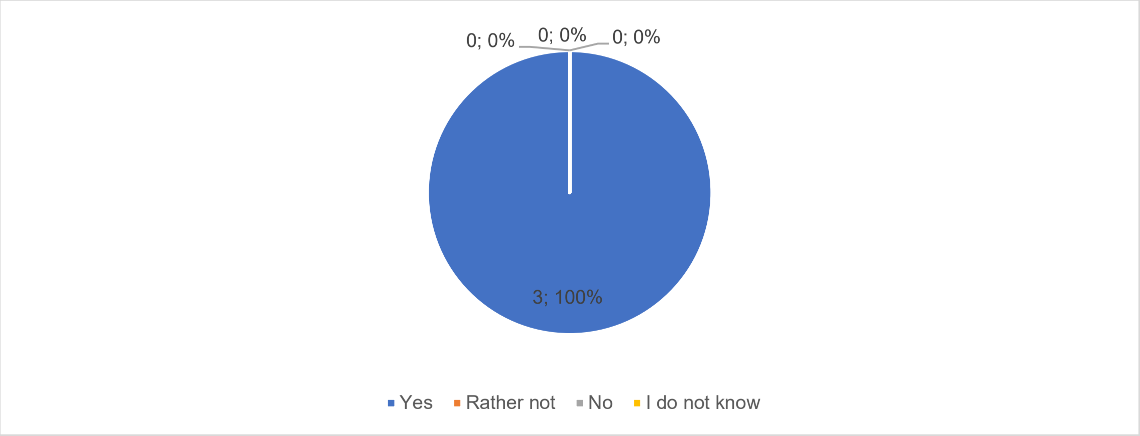
Question #17.	**If BIM is used, architects must employ this method too:**
Yes	3
Rather not	0
No	0
I do not know	0
Total	**3**



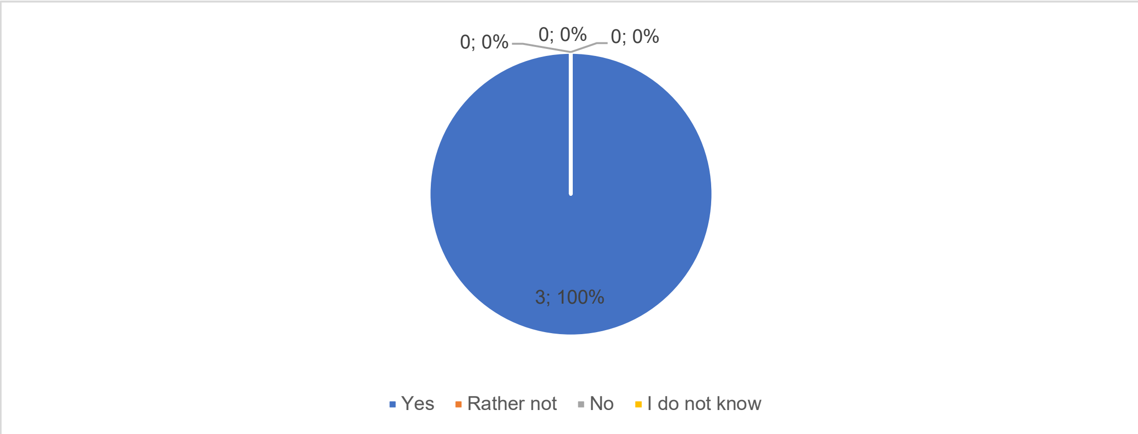
Question #18.	**If BIM is used, architects must also employ the BIM information model:**
Yes	3
Rather not	0
No	0
I do not know	0
Total	**3**



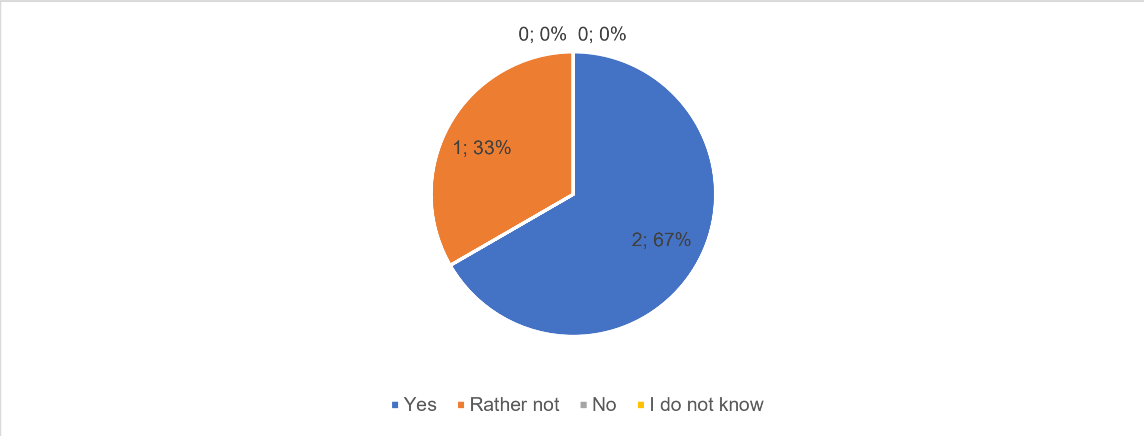
Question #19.	**If BIM is used, architects must also employ the CDE (common data environment):**
Yes	3
Rather not	0
No	0
I do not know	0
Total	**3**

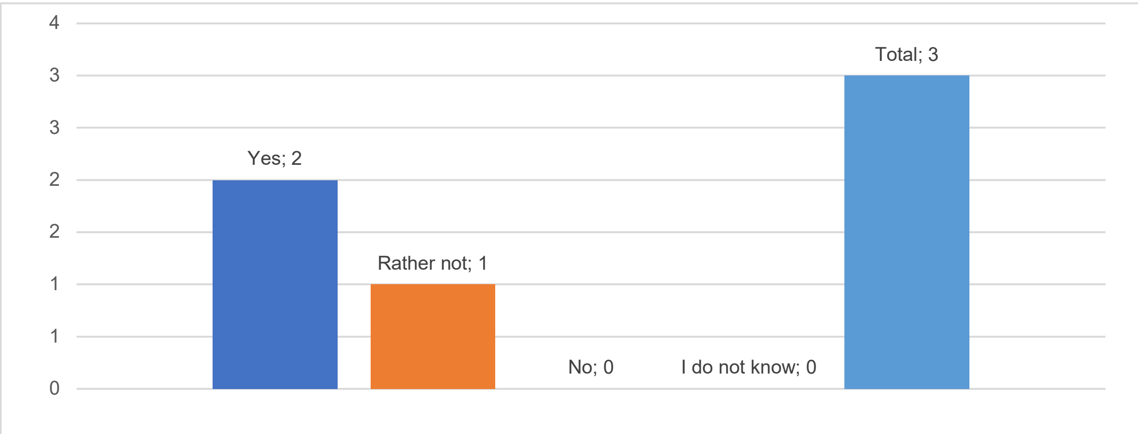


Question #20.	**Using BIM, the information details in individual stages differ from those used in the conventional design process:**
Yes	3
Rather not	0
No	0
I do not know	0
Total	**3**



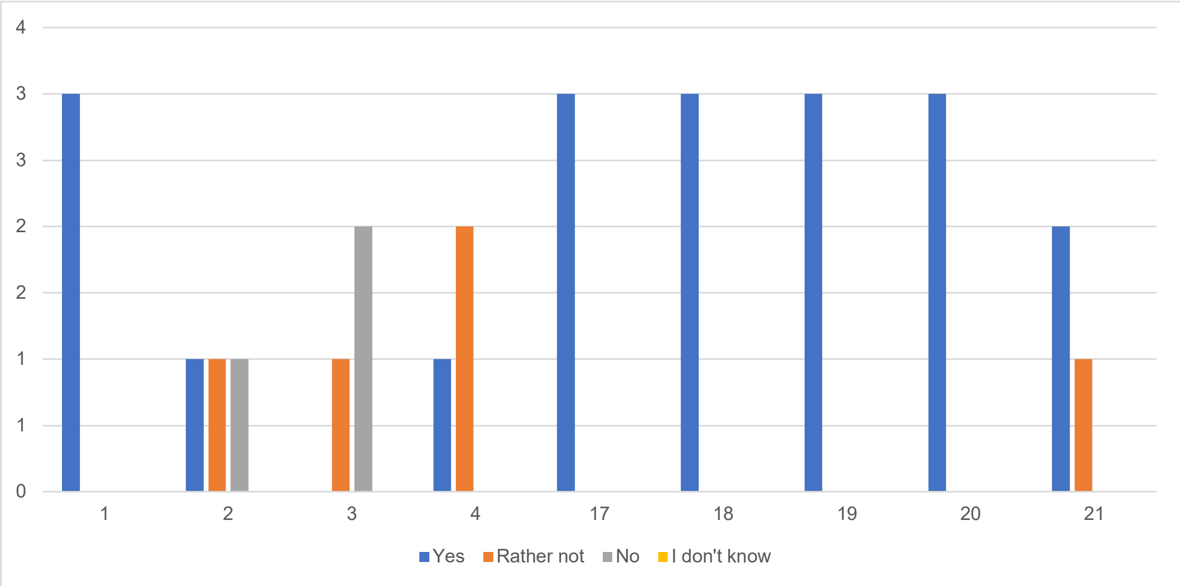
Question #21.	**Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?**
Yes	2
Rather not	1
No	0
I do not know	0
Total	**3**

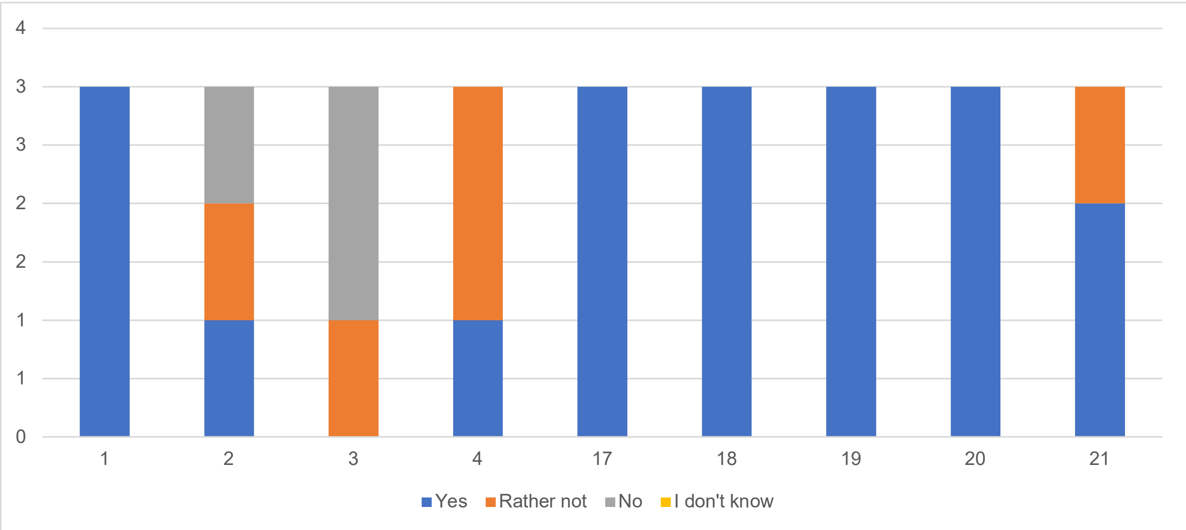




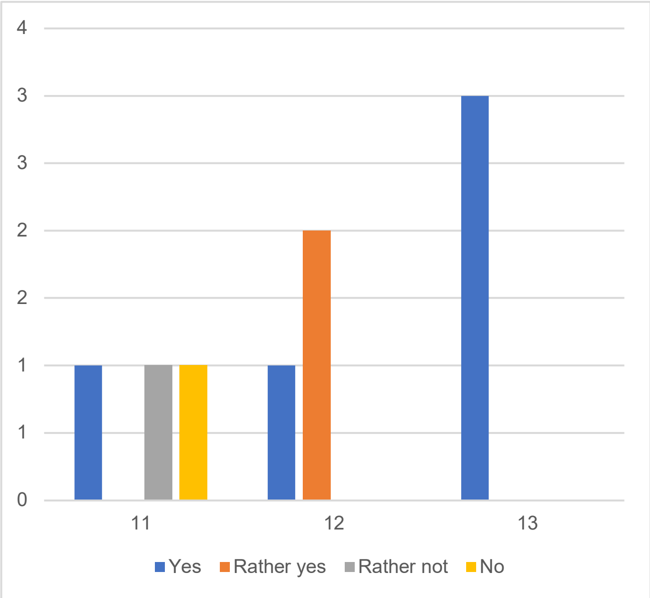
Summary Graphs

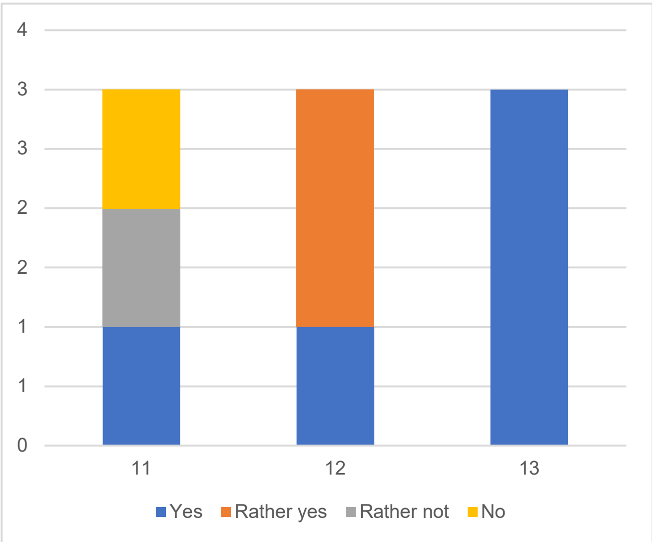
Question	1	2	3	4	17	18	19	20	21
Yes	3	1	0	1	3	3	3	3	2
Rather not	0	1	1	2	0	0	0	0	1
No	0	1	2	0	0	0	0	0	0
I don't know	0	0	0	0	0	0	0	0	0
Total	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**





Question	11	12	13
Yes	1	1	3
Rather yes	0	2	0
Rather not	1	0	0
No	1	0	0
Total	**3**	**3**	**3**





Questionnaire: Clarification Replies

Question #11

For expertise (daylighting, construction physics, and similar), I use the BIM digital information model:

- I do not use it, but I think that it should be so.

Question #12

I use the BIM information model as a source document for BOQ

- I do not use it, but I think that it should be so.

Question #14

Describe the advantages of using the BIM method in the project development briefly:

- Collision control; help during the BOQ development.
- Spatial orientation and coordination of all the involved parties.
- Fast feedback between the architecture design, clients' ideas, and designers modelling; one source of information – information does not disappear, it is uniformly interpreted; it is a groundwork for visualizations, interactive analyses (lighting, insolation, power balance, simulations for state authorities (DOSS) – effect of the design on the surroundings, and similar) including the chance to perform fast alterations.

Question #15

Describe the cons of using the BIM method in the project development briefly:

- Parameters of the brief are not specified straightforwardly – costs increase during the stages due to clients' growing demands.
- Many collisions occur.
- Not all the participants use it; models are taken over from other subjects (compatibility); modelling bespoke structures takes a long time; the quality of graphic output (particularly engineer projects).

Question #16

Add your brief comment to using the BIM method in the project development:

- The idea is good; requirements and modelling must be finalized – otherwise, most people will get frustrated and leave to work on a site or into another field.
- I see BIM as a good tool, but the circumstances of its use must be further refined.
- BIM documents must always be set up at the beginning of project development; all participants in the project should actively use BIM tools and the CDE; effective information exchange processes must be well set up; sufficient HW and SW equipment is needed.

Question #22

Describe briefly what fundamental data architects should provide in different design stages if using the BIM method:

- SP1:
  - The brief + project requirements
  - Cooperation in the process of compiling/updating contract and BIM documents (responsibility for sections of BIM + CDE, licensing, and similar).
- SP2:
  - The definition of the building, possibility to furnish it; areas and volumes
- SP3:
  - LOD according to regulations
  - Updating SP2 + material design + façades concept
- SP4:
  - LOD according to regulations
  - Updated groundwork documents for designer's model
- SP5:
  - LOD according to regulations
  - Updated groundwork documents for designer's model, positions of end elements, architecture details
- SP6:
  - LOD according to regulations
  - Product and material specs
- SP7:
  - Details + refining of material specs
  - Support of the designer/building model's update
- I do not know.

Question # 23.

Describe the basic requirements on architects' work briefly if employing the BIM design method:

- They should process their project in BIM.
- I do not know.
- Active use of the CDE, continuous updating of the groundwork for the model (it can be 2D), ability to actively browse through and comment on the model.

Question # 24.

Describe the basic benefits of architects' use of the BIM design method briefly:

- Linking of models.
- I do not know.
- Fast feedback between the architecture design, clients' ideas, and designers modelling; one source of information – information does not disappear, it is uniformly interpreted; it is a groundwork for visualizations, interactive analyses (lighting, insolation, power balance,

simulations for state authorities (DOSS) – effect of the design on the surroundings, and similar) including the chance to perform fast alterations.

Question # 25.

Describe the fundamental problems of architects' use of the BIM design method briefly:

- They emphasize different elements and details than designers.
- I do not know.
- The problem is that the CDE and the designer model are not used (browsing, comments).

Annex B
Research Data and their Evaluation

2. Questionnaires
2.4. BIM Managers

Questionnaire

Question #1

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

a. Yes
b. Rather yes
c. Rather not
d. No

Question #2

I consider BIM a helpful design tool:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #3

I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):

a. Yes
b. Rather yes
c. Rather not
d. No

Question #4

If BIM is used, architects must employ the BIM information model:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #5

If BIM is used, architects must also employ the CDE (common data environment):

a. Yes
b. Rather yes
c. Rather not
d. No

Question #6

The scope of a project does not matter if BIM is used:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #7

If the BIM method is used, the project typology does not matter:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #8

The BIM method suits the following project types:

a. residential
b. office
c. hotels
d. the type does not matter

Question #9

Indicate the project stages in which developing a digital building information model makes sense (tick according to your location):

SP1 Project Initiation

SP2 Preliminary – Concept Design

SP3 Land Zone Permit Design

SP4 Building Permit Developed Design

SP5 Detailed Design

SP6 List of Works and Deliverables

SP7 Architect's Supervision

Question #10

Indicate the project stages in which using the common data environment (CDE) makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect's Supervision

Question #11

Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #12

Indicate who must use the common data environment (CDE) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #13

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

a. project development
b. project development and construction
c. project development and construction, building operation
d. I do not know

Question #14

Using BIM, the information details in individual stages differ from those used in the conventional design process:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #15

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

a. Yes
b. Rather yes
c. Rather not
d. No

Question #16

Describe briefly, if you can, what fundamental data architects should provide in different design stages if using the BIM method:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

Question #17

I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).

a. Yes
b. Rather yes
c. Rather not
d. No

Question #18

Describe, if you can, the basic requirements on architects' work briefly if employing the BIM design method:

Question #19

Describe the basic benefits of architects' use of the BIM design method briefly if you can:

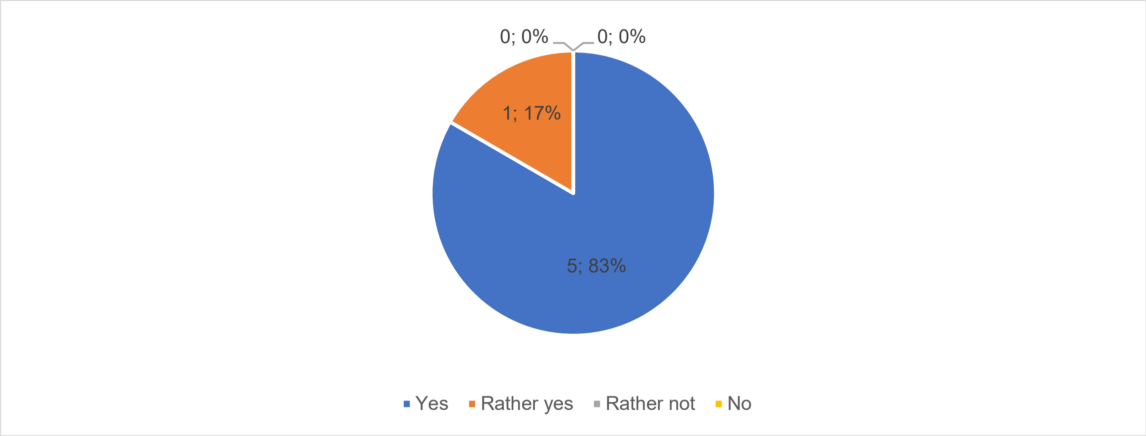
Question #20

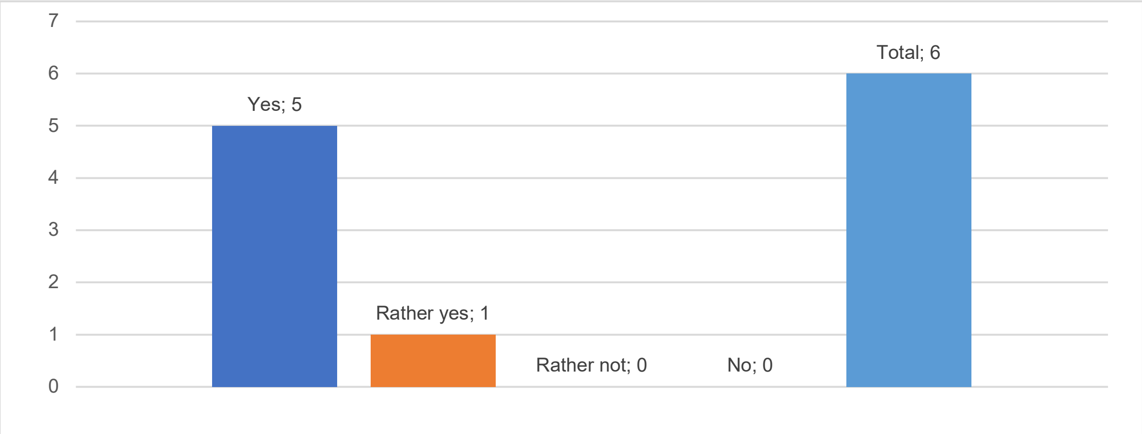
Describe the fundamental problems of architects' use of the BIM design method briefly if you can:

Question #21

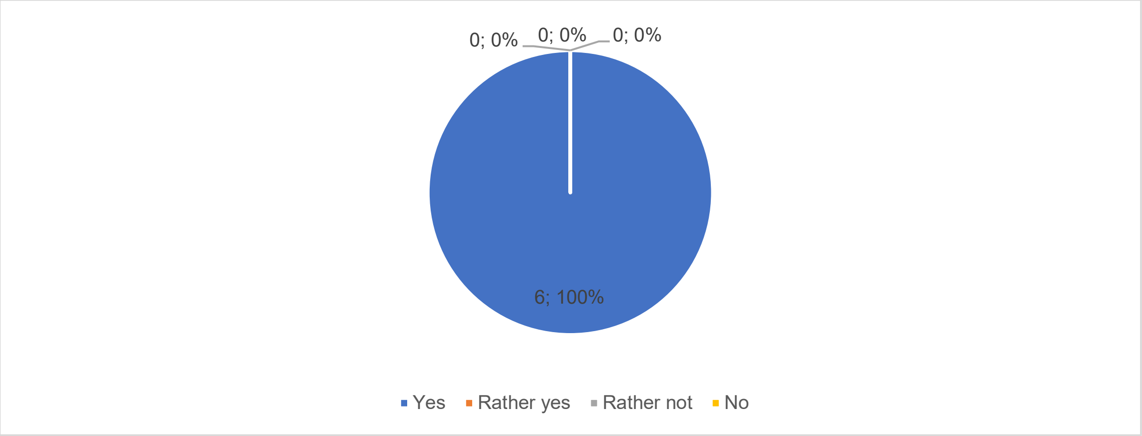
Briefly comment on the use of the BIM method for the project development if you can:

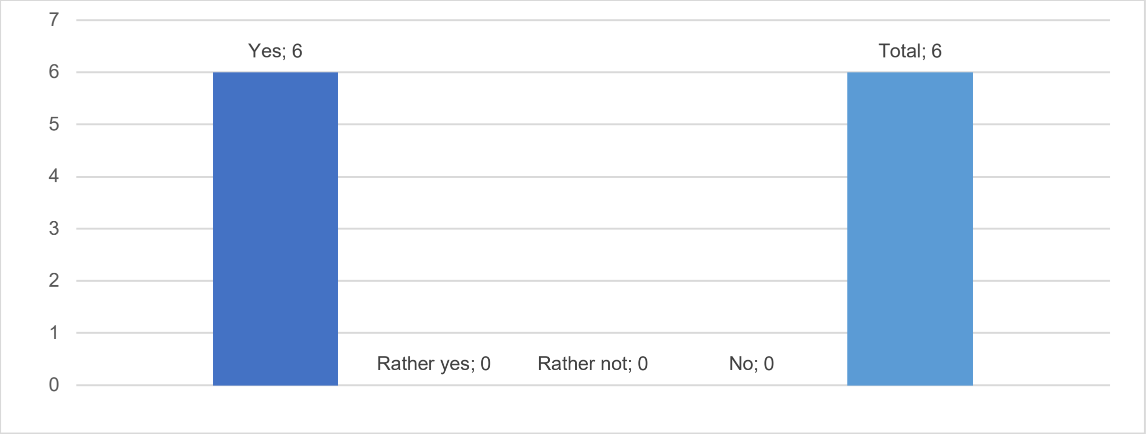
Question #1.	**Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?**
Yes	5
Rather yes	1
Rather not	0
No	0
Total	**6**



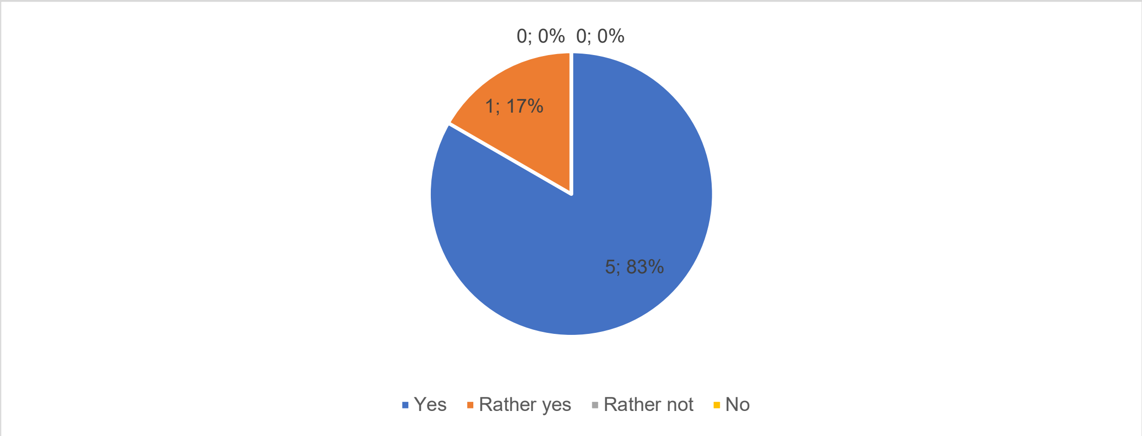


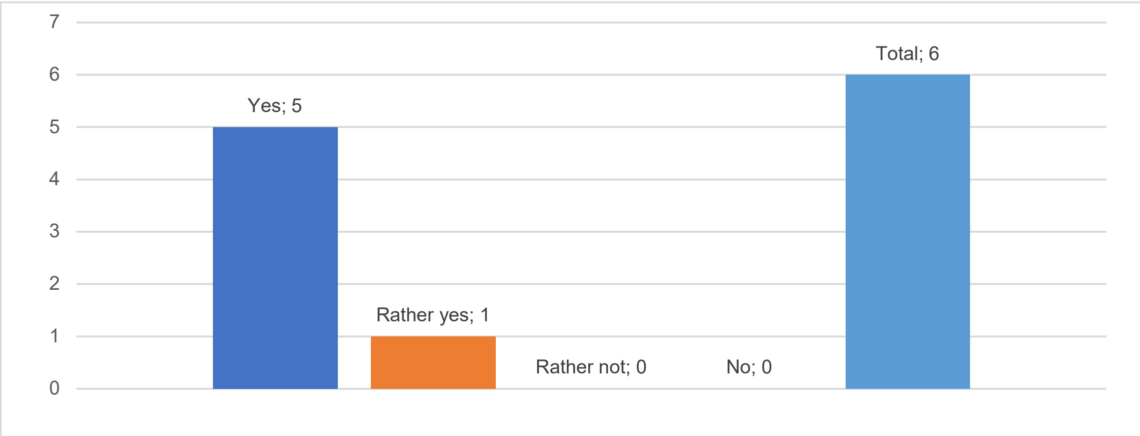
Question #2.	**I consider BIM a helpful design tool:**
Yes	6
Rather yes	0
Rather not	0
No	0
Total	**6**



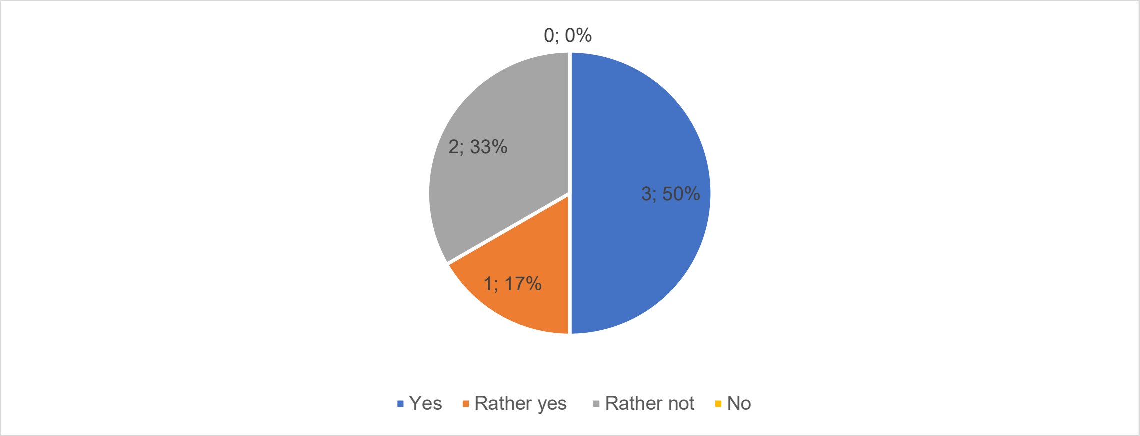


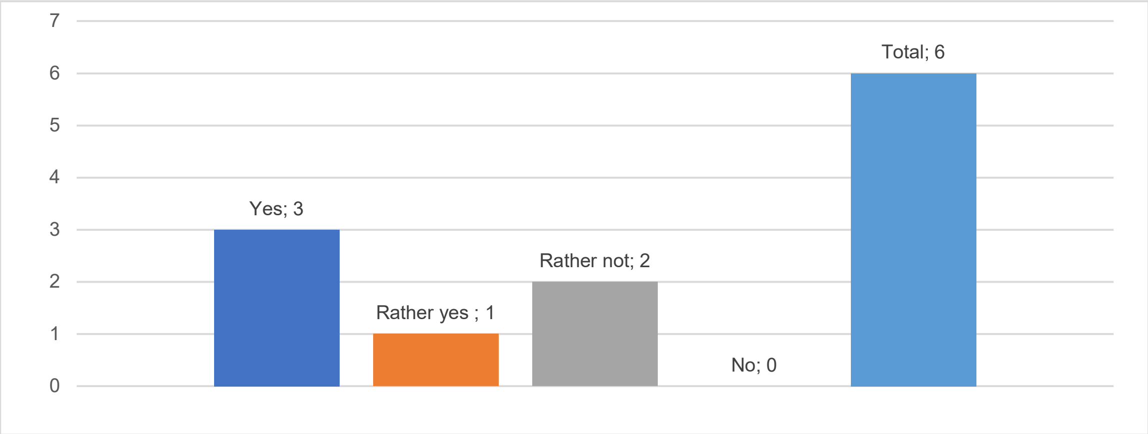
Question #3.	**I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):**
Yes	5
Rather yes	1
Rather not	0
No	0
Total	**6**



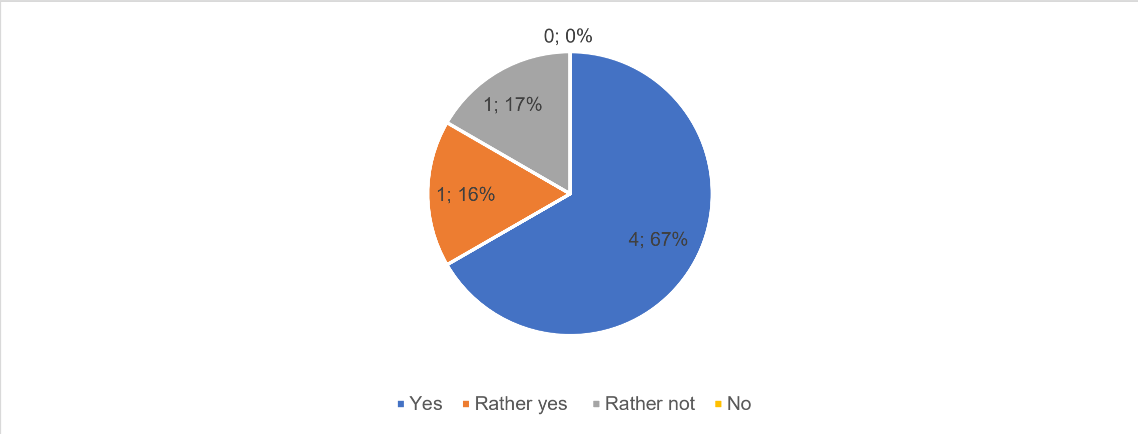


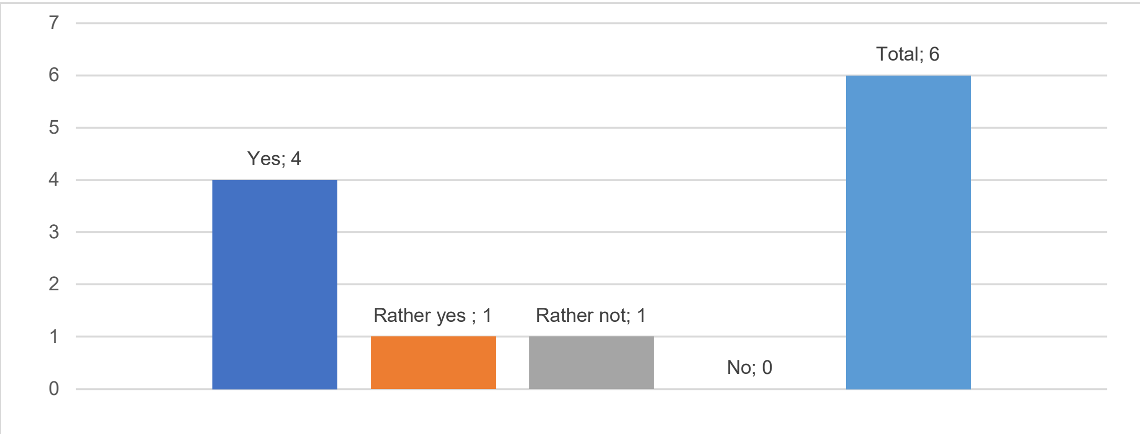
Question #4.	If BIM is used, architects must also employ the BIM information model:
Yes	3
Rather yes	1
Rather not	2
No	0
Total	**6**



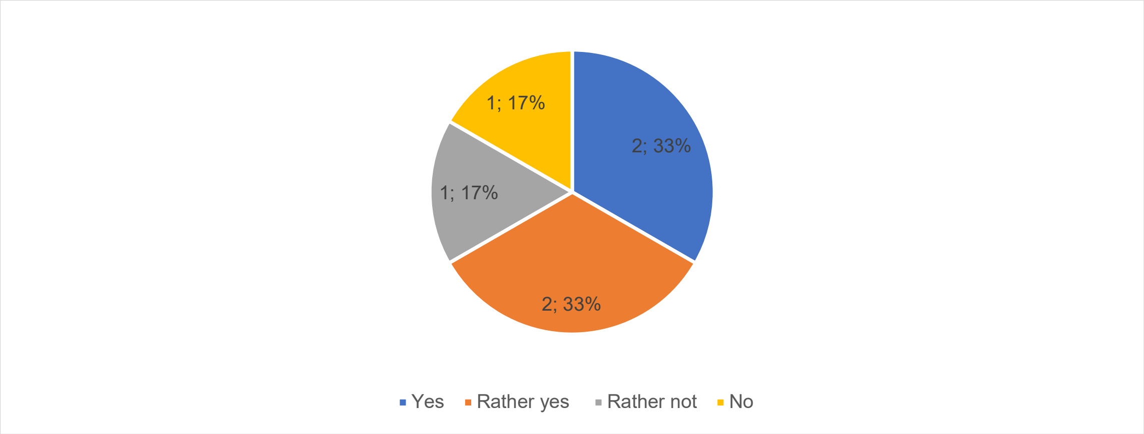


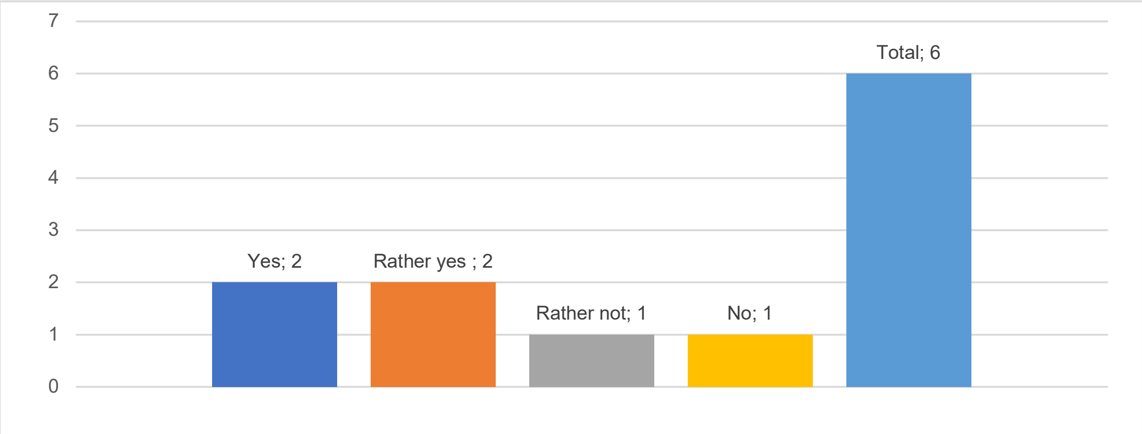
Question #5.	**If BIM is used, architects must also employ the CDE (common data environment):**
Yes	4
Rather yes	1
Rather not	1
No	0
Total	**6**



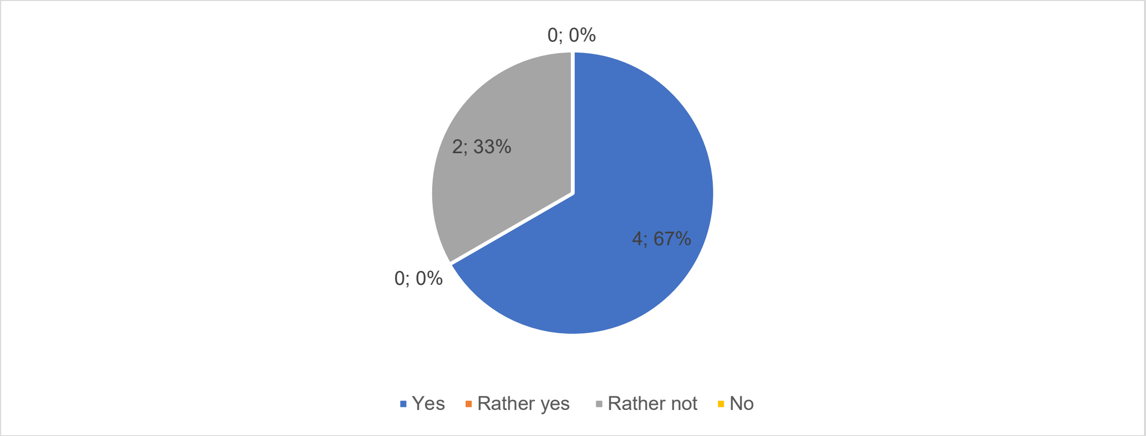


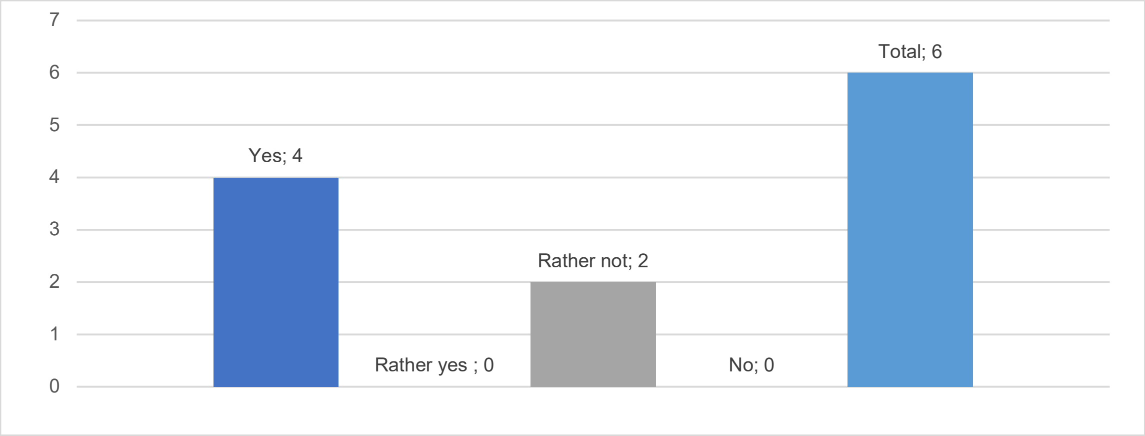
Question #6.	**The scope of a project does not matter if BIM is used:**
Yes	2
Rather yes	2
Rather not	1
No	1
Total	**6**



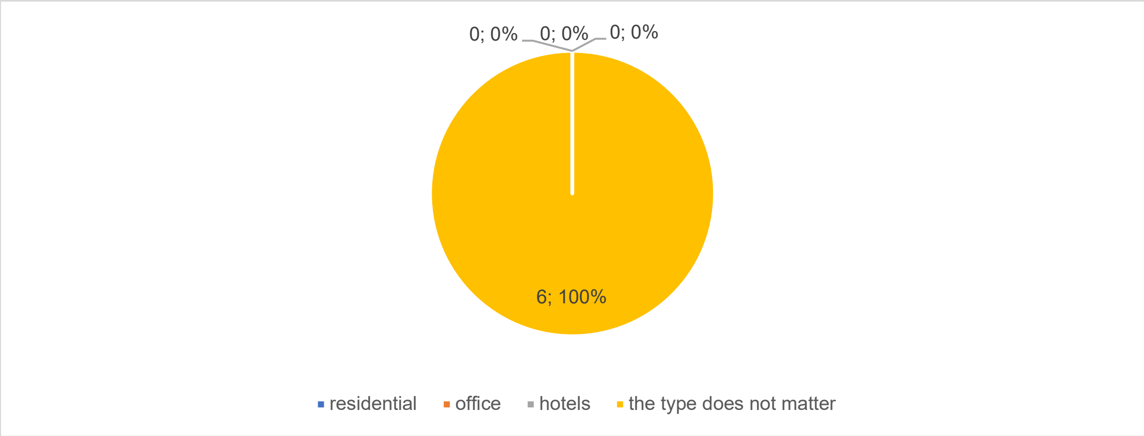


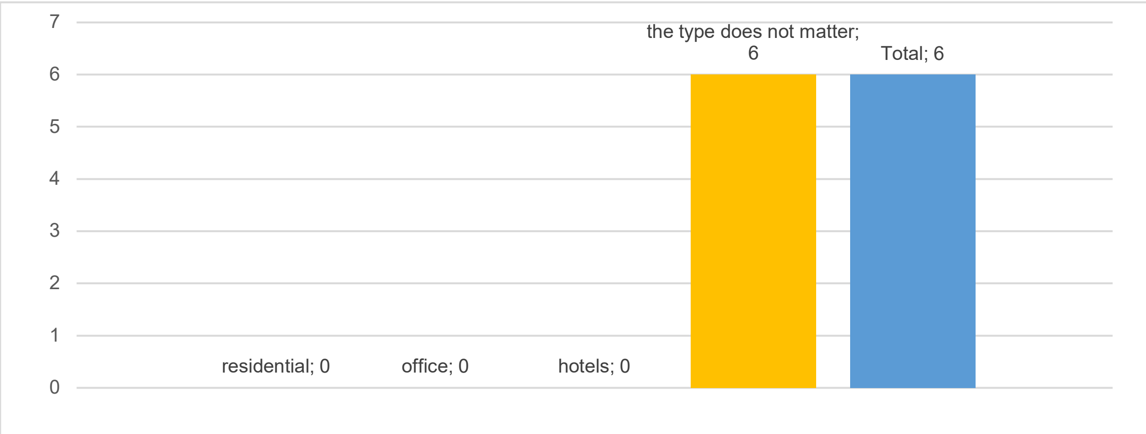
Question #7.	**If the BIM method is used, the project typology does not matter:**
Yes	4
Rather yes	0
Rather not	2
No	0
Total	**6**



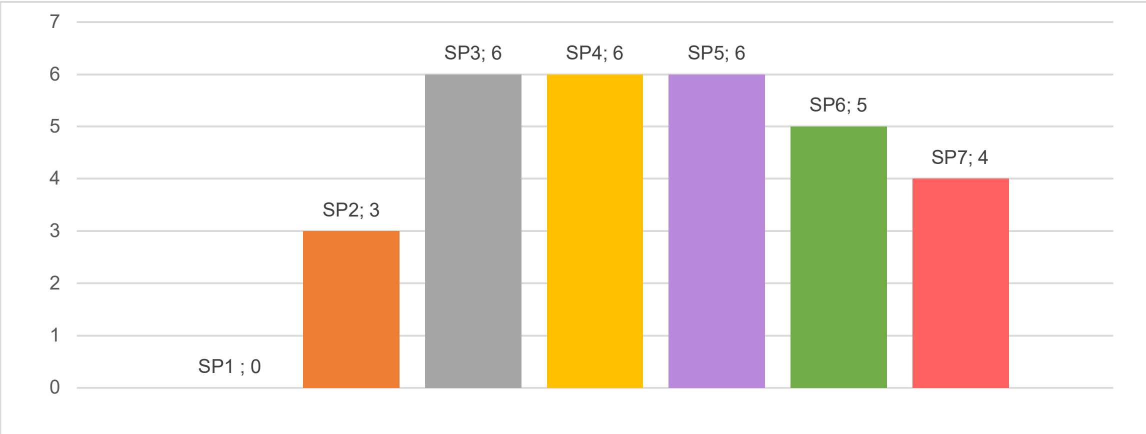


Question #8.	**The BIM method suits the following project types:**
residential	0
office	0
hotels	0
the type does not matter	6
Total	**6**

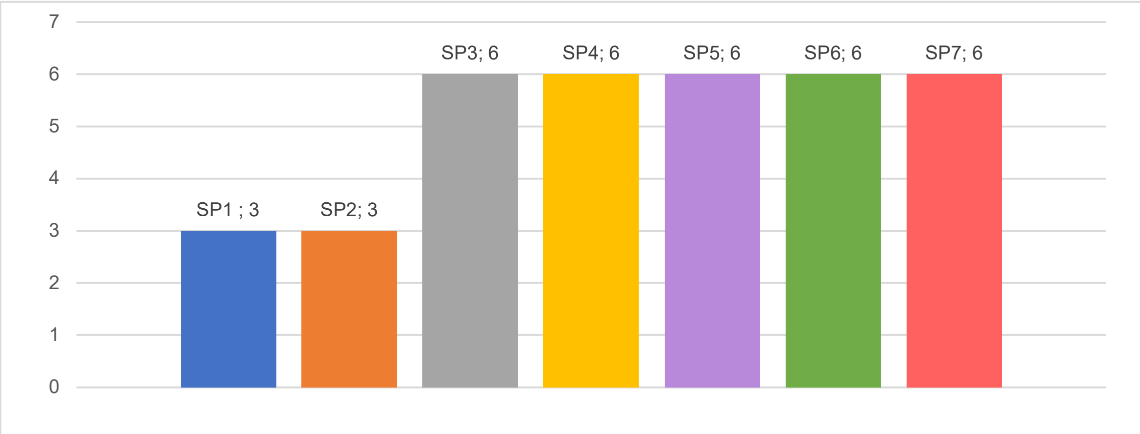




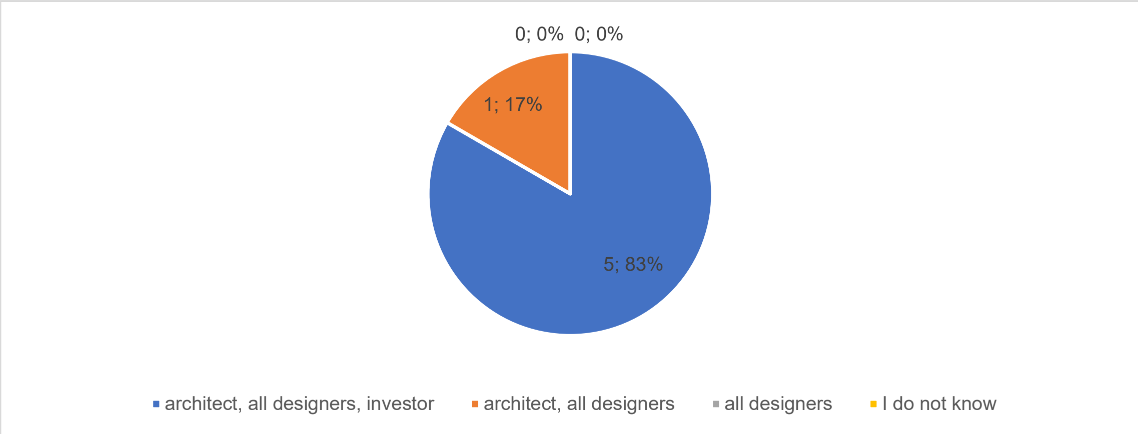
Question #9.	**Indicate the project stages in which developing a digital building information model makes sense:**	
SP1	Project Initiation	0
SP2	Preliminary – Concept Design	3
SP3	Land Zone Permit Design	6
SP4	Building Permit Developed Design	6
SP5	Detailed Design	6
SP6	List of Works and Deliverables	5
SP7	Architect's Supervision	4
Total		**30**

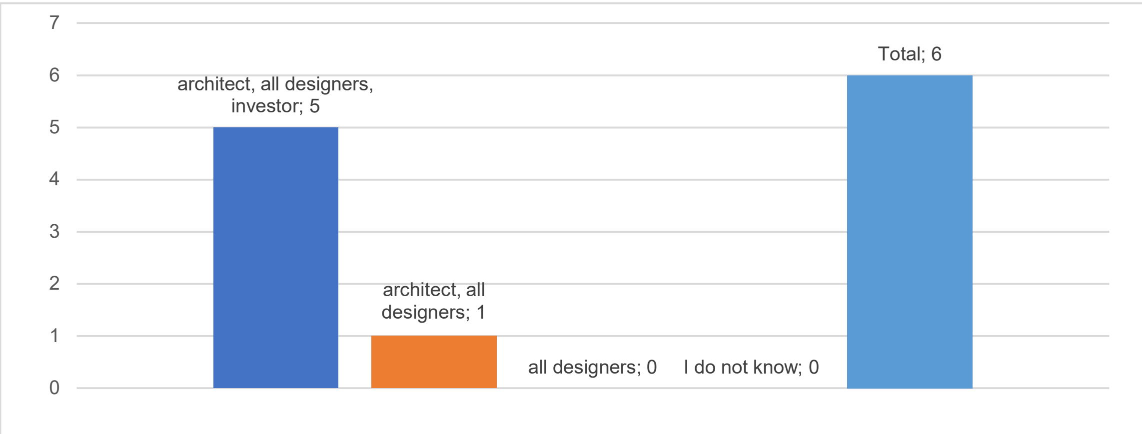


Question #10.	**Indicate the project stages in which using the common data environment (CDE) makes sense:**	
SP1	Project Initiation	3
SP2	Preliminary – Concept Design	3
SP3	Land Zone Permit Design	6
SP4	Building Permit Developed Design	6
SP5	Detailed Design	6
SP6	List of Works and Deliverables	6
SP7	Architect’s Supervision	6
Total		**36**

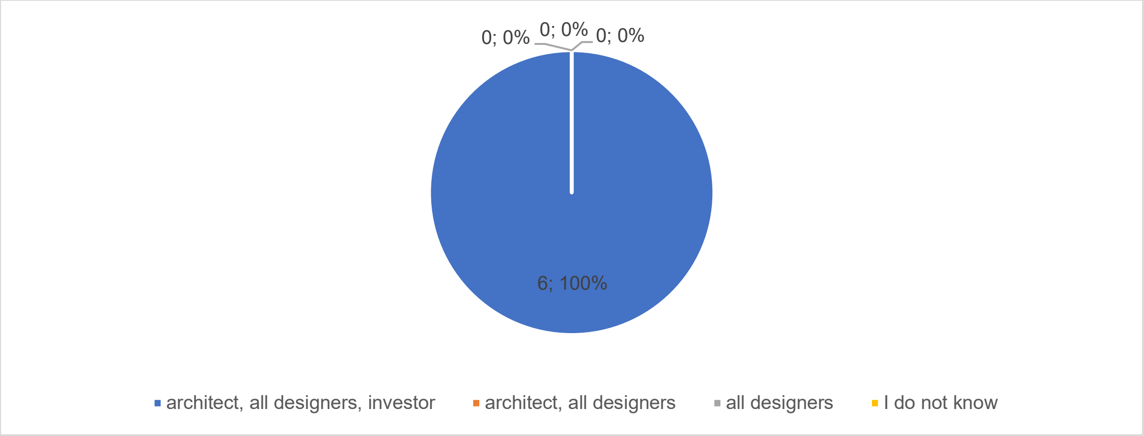


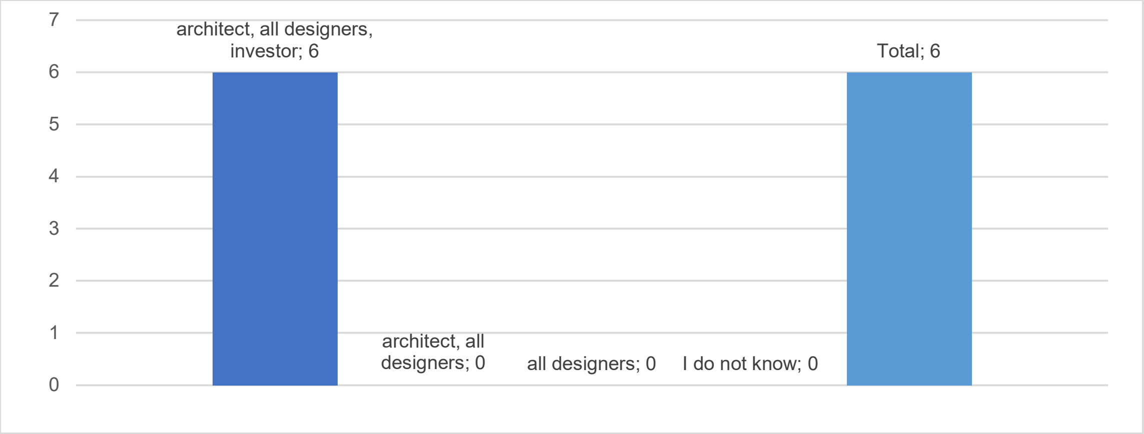
Question #11.	**Indicate who must use the (digital) building information model (IMS) for a meaningful design process:**
architect, all designers, investor	5
architect, all designers	1
all designers	0
I do not know	0
Total	**6**



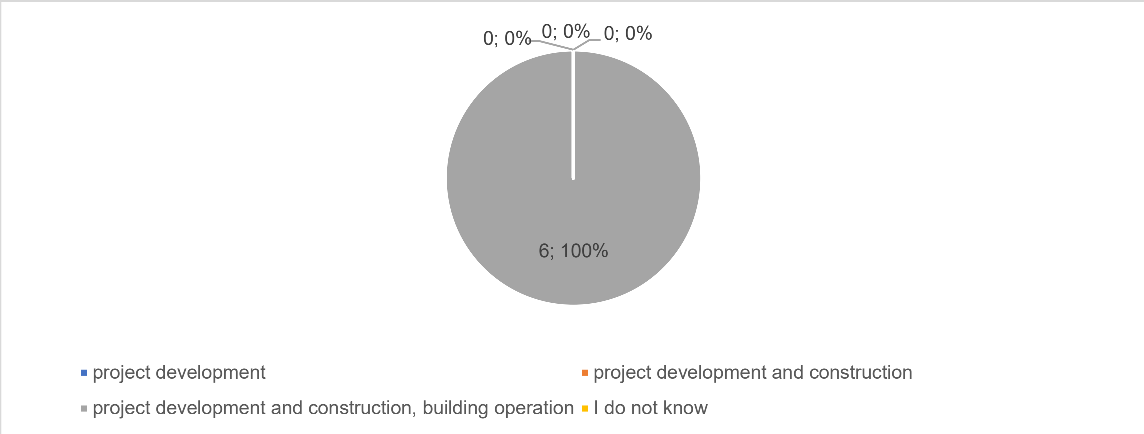


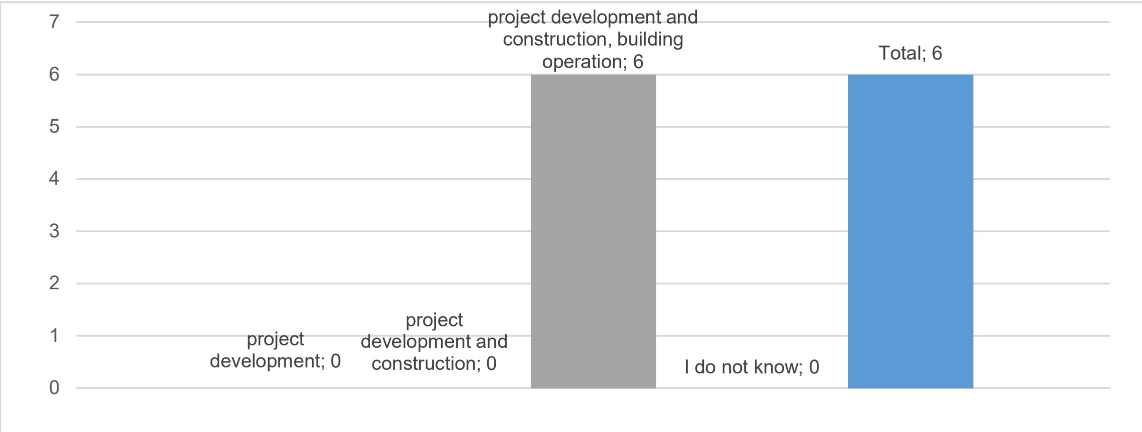
Question #12.	**Indicate who must use the common data environment (CDE) for a meaningful design process:**
architect, all designers, investor	6
architect, all designers	0
all designers	0
I do not know	0
Total	**6**



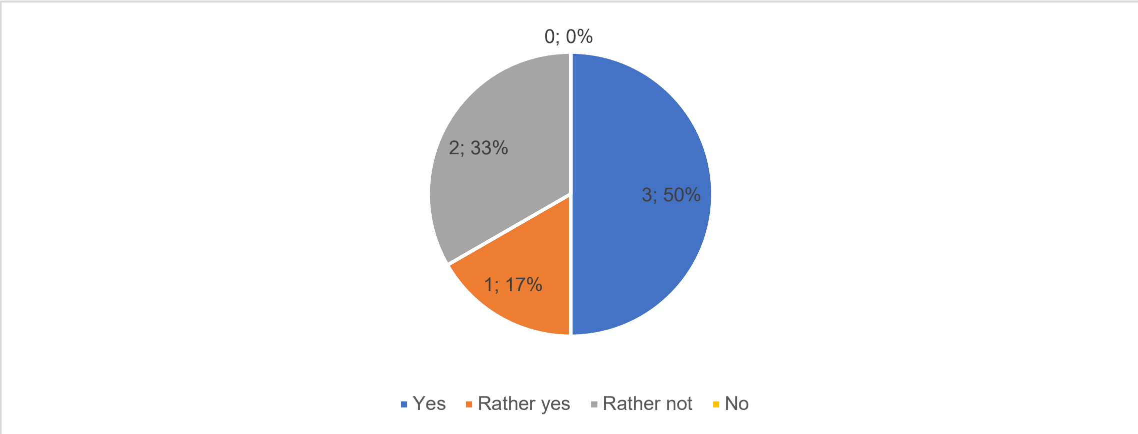


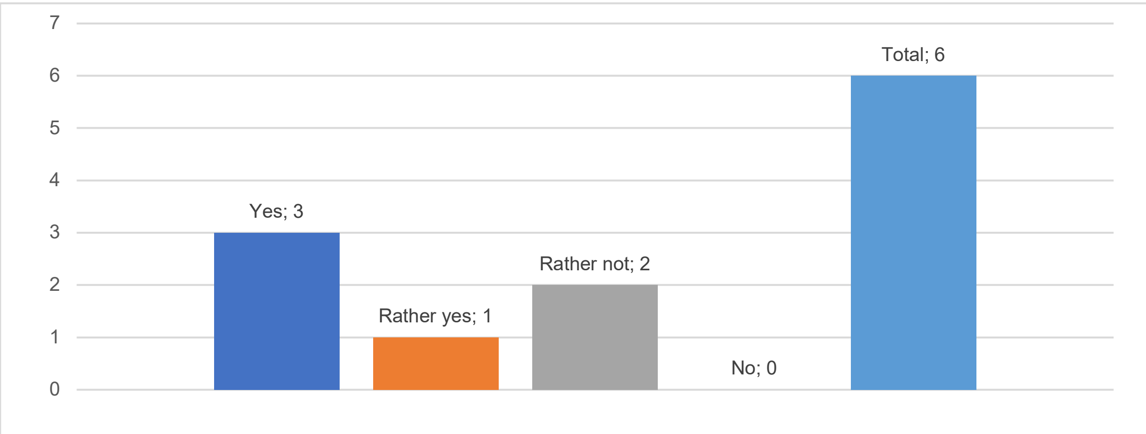
Question #13.	**The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:**
project development	0
project development and construction	0
project development and construction, building operation	6
I do not know	0
Total	**6**



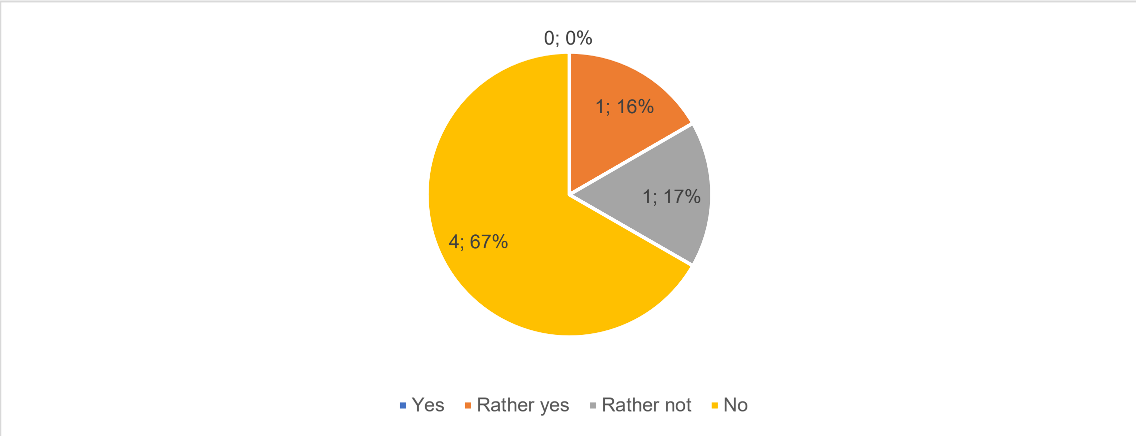


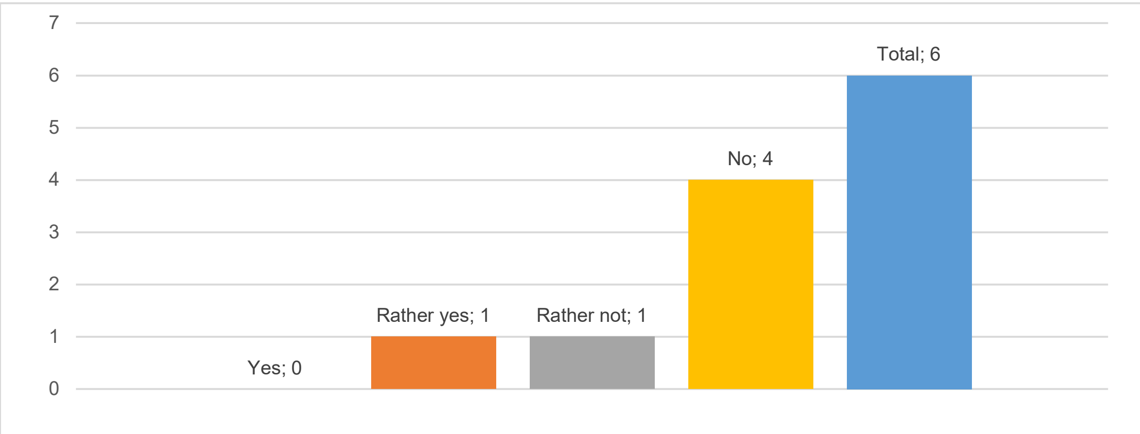
Question #14.	**Using BIM, the information details in individual stages differ from those used in the conventional design process:**
Yes	3
Rather yes	1
Rather not	2
No	0
Total	**6**



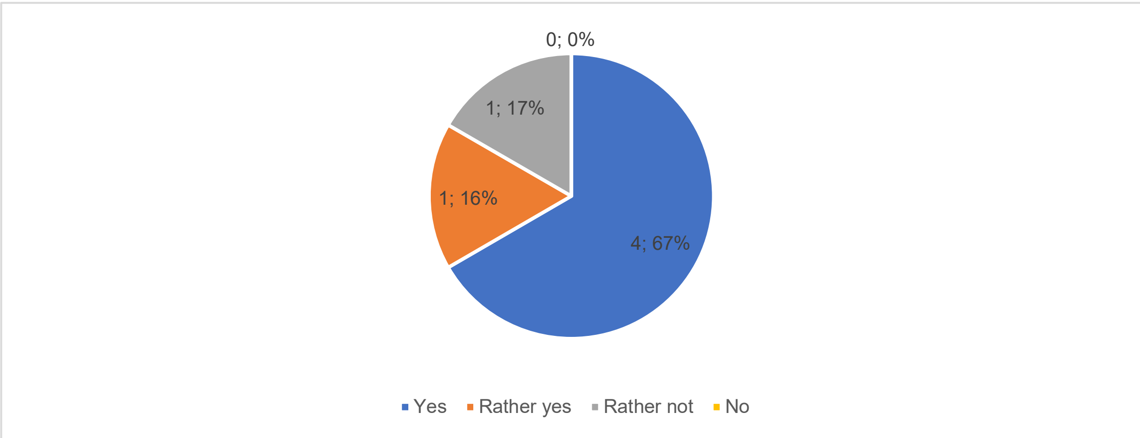


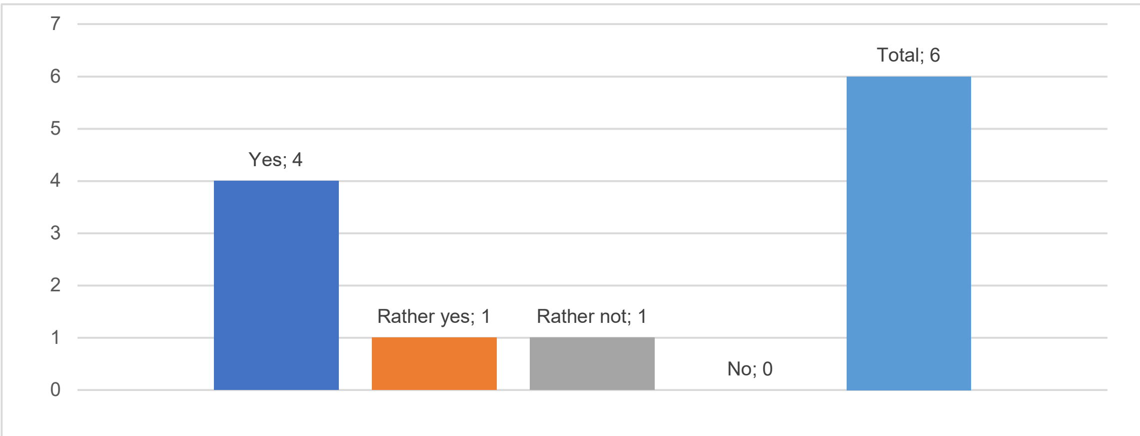
Question #15.	**Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?**
Yes	0
Rather yes	1
Rather not	1
No	4
Total	**6**





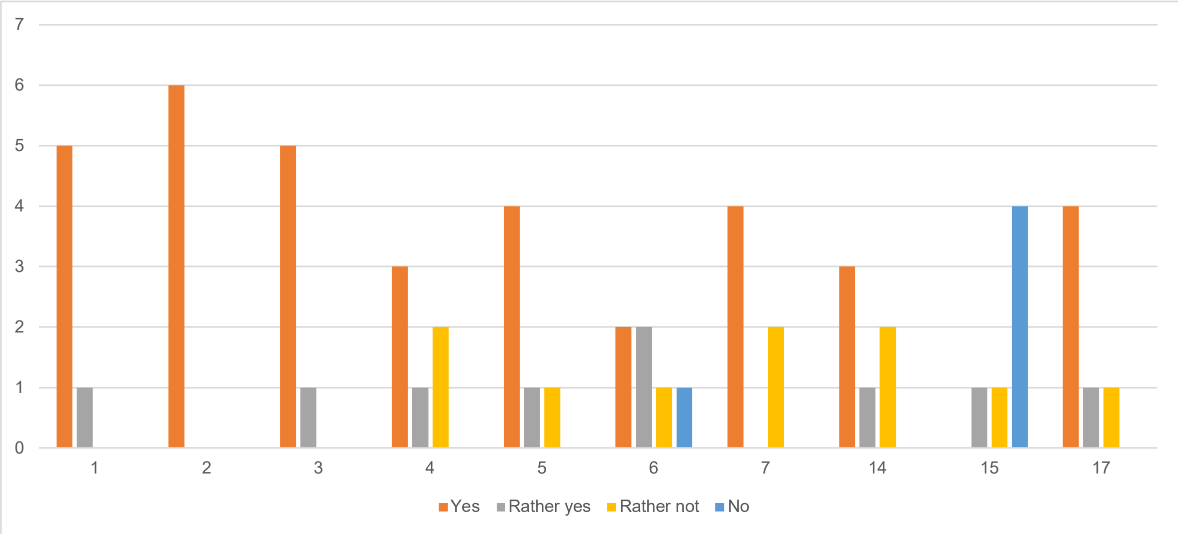
Question #17.	**I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).**
Yes	4
Rather yes	1
Rather not	1
No	0
Total	**6**

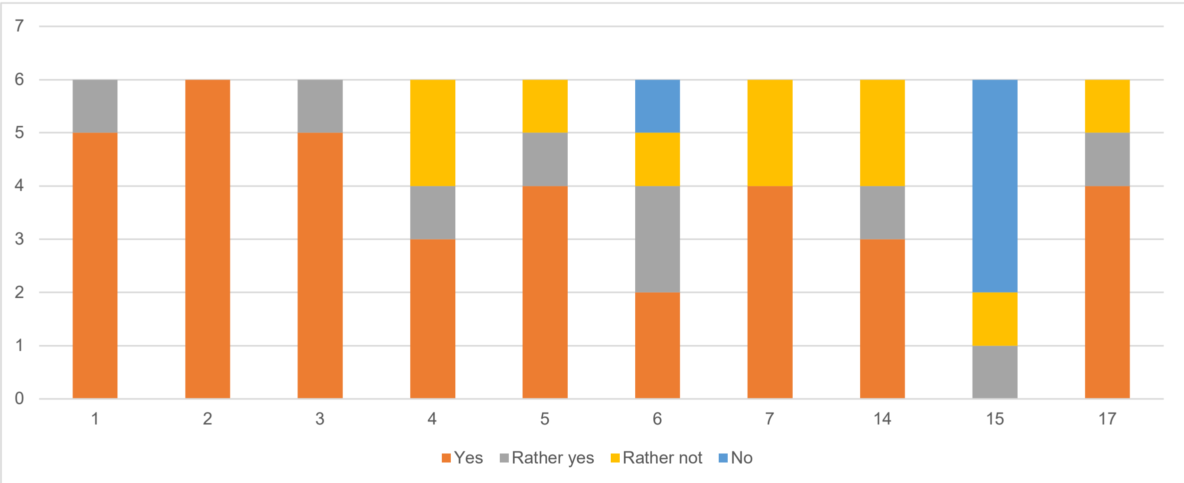




Summary Graphs

Question	1	2	3	4	5	6	7	14	15	17
Yes	5	6	5	3	4	2	4	3	0	4
Rather yes	1	0	1	1	1	2	0	1	1	1
Rather not	0	0	0	2	1	1	2	2	1	1
No	0	0	0	0	0	1	0	0	4	0
Total	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**





Questionnaire: Clarification Replies

Question #1

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

- The question is too general, this is a broad topic, it is necessary to specify. If it is a principle, then of course yes, it is necessary.
- Assuming that a digital model is required on behalf of the Customer, the DiMS and CDE requirements should be annexed to the Contract - but in particular, they should be dealt outside the Contract.
- it is sufficient to mention that it is required and that it will be regulated by other documents. If there is no requirement on the part of the investor, the question is unnecessary.

Question #2

I consider BIM a helpful design tool:

- It is not a tool, it is a method. If the question is really about whether BIM is a useful tool, then the right answer is no.

Question #3

I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):

- I understand BIM as a series of requirements for the model, contained information (graphical, non-graphical), CDE, design process in 3D, coordination, it is a complex topic inseparable from the project itself.

Question #4

If BIM is used, architects must employ the BIM information model:

- I don't think it's absolutely necessary, but it can definitely be an advantage - depending on the stage the project is at, but if it is used, I see that as a big plus.

Question #5

If BIM is used, architects must also employ the CDE (common data environment):

- Yes, the CDE should come from the investor and be kept consistent throughout the project development and implementation process. but if it is used, I see that as a big plus.

Question #6

The scope of a project does not matter if BIM is used:

- Yes, it doesn’t matter.
- Problems can arise with linear structures and extremely large objects, the project must then be divided into individual parts. It is important to stick to smaller sizes of working models.

Question #7

If the BIM method is used, the project typology does not matter:

- Yes, it doesn't matter.

Question #8

The BIM method suits the following project types:

- Depending on the expectations of the investor and what the BIM is to be used for (FM, coordination, other uses, Asset Management), it is applicable to all buildings.
- I would have done a single family home in Revit by now if it came to that. Just everything.

Question #9

Indicate the project stages in which developing a digital building information model makes sense (tick according to your location):

- There is lack of explanation of the terms what is digital, what is information, what is digital information, etc.
- It is necessary to separate the Digital and Information models, the specific digital model is of higher importance only in later stages (part of the Land Zone Permit Design, Building Permit Developed Design and beyond). The Information Model, which includes the specifications and other information and is essentially a complete project, is needed from the beginning.
- SP2:
    - Conceptual design in a digital model - parametric designs.
- SP3:
    - Building envelope within the digital model - basic balance.
- SP4:
    - Basic conceptual spatial coordination, publication of drawings via digital model.
- SP5:
    - Spatial coordination, publication of drawings via digital model.
- SP6:
    - The digital and information model is used as a basis for the specifications (works and deliverables).
- SP7:
    - the digital and information model must be used and updated during construction - a basic necessity for downstream processes and building management.

Question #10

Indicate the project stages in which using the common data environment (CDE) makes sense:

- CDE works best if it is implemented from the beginning to the end of each phase of the project (preparation to realization, documentation of the actual construction, etc); an integral part of CDE is the Construction Information Model.

Question #11

Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

- Again, these are two different concepts - The Building Information Model should be used by all participants. Digital building models can also be used by everyone, it is not strictly necessary, here, it is primarily about the designers, sub-designers of the professions and the investor.
- No one has to use it, but it would be great.

Question #12

Indicate who must use the common data environment (CDE) for a meaningful design process:

- Everyone.
- No one has to use it, but it would be great.

Question #13

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

- When used correctly by all parties, there is an advantage at all stages, with more efficient information transfer and greater project coordination.

Question #14

Using BIM, the information details in individual stages differ from those used in the conventional design process:

- In practice, they differ, but this is mainly due to the client's ignorance - nonsensical requirements are given in the requirements; they differ in the degree of input required for the geometry of the modelled elements.
- There are certain specifics or limits of modelling programs in general, which are for example written into the graphical processing of the model. The materiality of the information depends rather on the use of the software tools of the project developers.

Question #15

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

- The information corresponds to the phase, as in standard design. It depends on the approach of the architect.
- Not likely, so I hope I'm not mistaken.

Question #16

Describe briefly, if you can, what fundamental data architects should provide in different design stages if using the BIM method:

- The architect should provide all the information required for the project and the project phase (not only in the case of the use of the BIM method) within the agreed deadlines; at the same time, he should not block the process.

- It depends on the recipient of the information, but I think it is generally similar to the type of information that has been common in the construction process so far.
- I don't know to whom.
- I'm not that adept at it, but that's how I imagine it.
- Regardless of the use of the BIM method, the architect should provide the necessary information for a given phase, it is not possible to clearly specify - it depends on the type of project, but the level of information should correspond to the needs of the level of the project phase and its processing detail in that phase
- SP1:
    - Information about the project, the programme.
    - I don't know.
- SP2:
    - House concept, visualization, basic schematic plans (floor plans, views, sections), clear building program (tuned with the investor), if a model, then without non-graphic information.
    - Material solution, floor plan, basic outline of the structural system and material solution, location on the plot, +- defining the operational units, idea of what to do with the parterre, possible limitations.
- SP3:
    - GFA, building envelope, environmental influences, floor plan.
    - All above in more detailed design + layout with the idea of the device.
- SP4:
    - verification of compliance with the requirements of the Land Zone Permit Design, elaboration according to the Decree 499/2006 Coll., settlement of the concerned relevant state authorities.
    - synergy with emerging problems of fundamental visual character, conceptual material solutions, thought-out layout with almost final room dimensions and structural heights, solved operations, counted parking lots both inside and outside
- SP5:
    - List of Works and Deliverables, details,...
    - All above + model of interiors and end elements with precise positions responding to the gradual coordination of professions, precise specification of materials and surfaces (or compositions in cooperation with designers).
- SP6:
    - It's already coming out of the Detailed Design, so the architect probably doesn't have much to say in it to budget preparer.
- SP7:
    - Agenda, control days, information management, information transfer.
    - I don't know.

Question #17

I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).

- There is no explanation of the terms what is digital, what is informational, what is digital informational, etc; if the question focuses on the digital model of the building (model created with tools for the information modelling method) then if the project is prepared using the BIM method it is clearly used where possible

Question #18

Describe, if you can, the basic requirements on architects' work briefly if employing the BIM design method:

- Basic understanding of the BIM method; basic knowledge of using BIM software tools; basic knowledge of CDE.
- Again, it depends on case by case, assuming that the Architect is a direct BIM supplier (which he does not necessarily have to be), the requirements for him are the same as for the designer in BIM - knowledge of the software, it’s effective use, the principles of reporting from the model, if the software allows it, the requirements for the formats to be submitted.
- If the architect works in BIM, he needs to follow the conventions of creating an information model, in short, we model as if we are building. If the architect does not follow these conventions, the model becomes unusable for subsequent design work and often has to be modelled again.
- Awareness of the importance of the BIM method, knowledge of the use of software that enables to work by the BIM method, using of the CDE.

Question #19

Describe the basic benefits of architects' use of the BIM design method briefly if you can:

- \- Possibility of using parametric design; possibility of using digital model for basic analysis; possibility of using digital model for basic balance of the building.
- \- Sustainability of information, less duplication of information in the project, less information errors, coordination, spatial coordination.
- \- If the architect uses BIM, he is able to detect design and technical inconsistencies in the model in the early stages of design. At the same time, by using BIM software, it eliminates human error, for example - inconsistency in drawings, etc.
- First - easier communication at the level of submittal if the architect works in a certified BIM tool. If it is the same tool that the designer is using, it is even better. Second - if BIM is used on both sides, usually CDE is used which in itself is a great advantage both in data centralization and future usability. Third - easier understanding of the design concept if it is in 3D (should be standard nowadays) for both the designer and the investor.
- \- Use of parametric modelling in design, use of digital model for analysis, use for calculation of basic building balances.

Question #20

Describe the fundamental problems of architects' use of the BIM design method briefly if you can:

- If the architect uses the BIM method and creates a digital model already in the early stages (Preliminary - Concept Design, Land Zone Permit Design) there is a great risk that the level of information (geometric and non-geometric) exceeds the efficiency of this method and BIM becomes a source of multiple works and loses efficiency in these stages.
- Ignorance of the capabilities of the software and its advantages/disadvantages. Higher level of detail in some phases - "paper can take everything, 3D can't" (impact on price or timeframe in certain phases).
- If an architect is working in BIM software, they are often forced to go into more detail than necessary in the initiation phase of the design. The software often limits him in the "freedom" of design.
- I can only think of potential in expertise in using the software. e.g. due to the transition to BIM and inexperience, otherwise there are no disadvantages for the designer. For the architect himself it can be an inconvenience, because creating studies e.g. in Revit is more difficult in my opinion.
- An architectural model that is created from the earliest stages of a project may contain redundant or even outdated information that will remain in the model throughout its multiple changes. The model may be unnecessarily burdened with a lot of unnecessary information, which sometimes causes the project to collapse. In addition, it may be appropriate for subsequent phases to use different components or modelling approaches to the early phases. Remodelling also removes any inaccuracies caused by multiple modifications to the original model.

Question #21

Briefly comment on the use of the BIM method for the project development if you can:

- The BIM method is the future in design, but it should be used to increase the efficiency of work, especially in the "cost/performance" mode, and should not become an obstacle or burden in the design of buildings in the project preparation or in the process of negotiation and permitting of construction, etc.
- The most important thing nowadays is the correct alignment of the Client's requirements and expectations from this method.
- Elimination of errors; Unified data environment; Coordination; Consistency of drawings; Economy.
- It's great. I'm extremely glad I haven't been designing in CAD for years, it's significantly more labour intensive in the early stages of a project, but that difference is erased in the later stages of a project by the efficiency of the information in the model, so it's ideal for “from the beginning to the end” mode.

Annex B
Research Data and their Evaluation

2. Questionnaires
2.5. Builders

Annex B
Research Data and their Evaluation

2. Questionnaires

2.5. Builders

2.5.1. Private Builders

Questionnaire

Question #1

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

a. Yes
b. Rather yes
c. Rather not
d. No

Question #2

I consider BIM a helpful design tool:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #3

I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):

a. Yes
b. Rather yes
c. Rather not
d. No

Question #4

If BIM is used, architects must employ the BIM information model:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #5

If BIM is used, architects must also employ the CDE (common data environment):

a. Yes
b. Rather yes
c. Rather not
d. No

Question #6

The scope of a project does not matter if BIM is used:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #7

If the BIM method is used, the project typology does not matter:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #8

The BIM method suits the following project types:

a. residential
b. office
c. hotels
d. the type does not matter

Question #9

Indicate the project stages in which developing a digital building information model makes sense (tick according to your location):

SP1 Project Initiation
SP2 Preliminary – Concept Design
SP3 Land Zone Permit Design
SP4 Building Permit Developed Design
SP5 Detailed Design
SP6 List of Works and Deliverables
SP7 Architect’s Supervision

Question #10

Indicate the project stages in which using the common data environment (CDE) makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect's Supervision

Question #11

Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #12

Indicate who must use the common data environment (CDE) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #13

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

a. project development
b. project development and construction
c. project development and construction, building operation
d. I do not know

Question #14

Using BIM, the information details in individual stages differ from those used in the conventional design process:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #15

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

a. Yes
b. Rather yes
c. Rather not
d. No

Question #16

Describe briefly, if you can, what fundamental data architects should provide in different design stages if using the BIM method:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

Question #17

I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).

a. Yes
b. Rather yes
c. Rather not
d. No

Question #18

Describe, if you can, the basic requirements on architects' work briefly if employing the BIM design method:

Question #19

Describe the basic benefits of architects' use of the BIM design method briefly if you can:

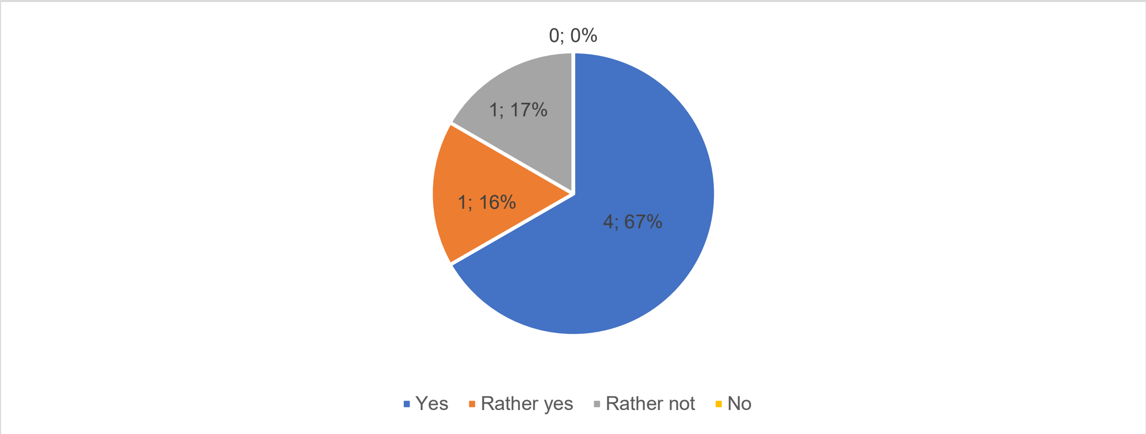
Question #20

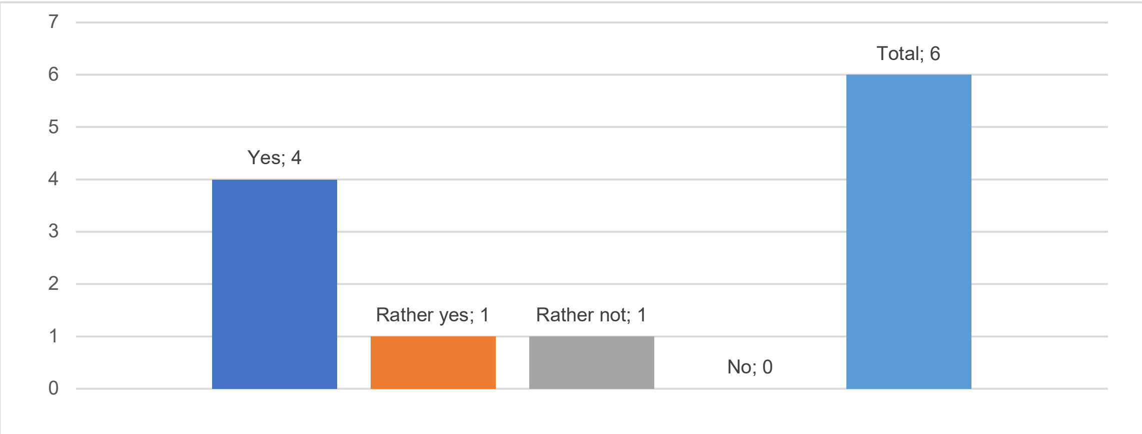
Describe the fundamental problems of architects' use of the BIM design method briefly if you can:

Question #21

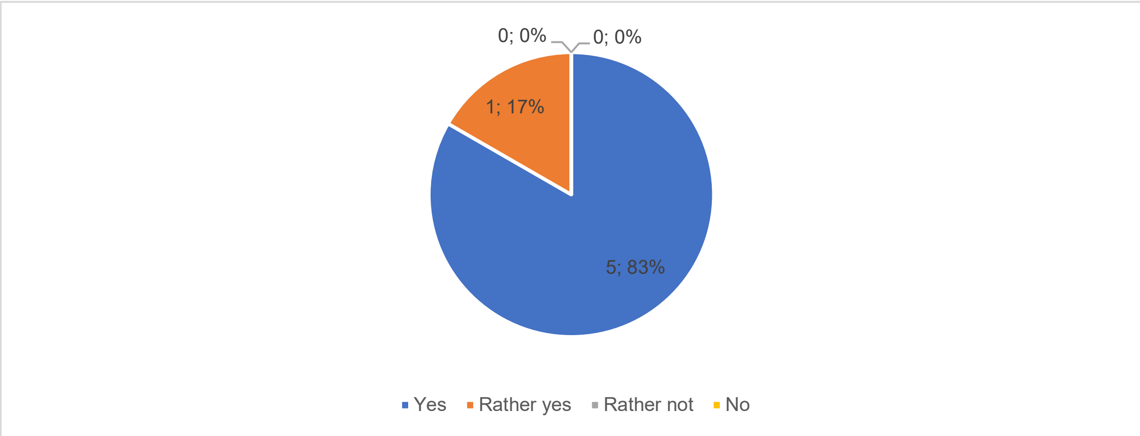
Briefly comment on the use of the BIM method for the project development if you can:

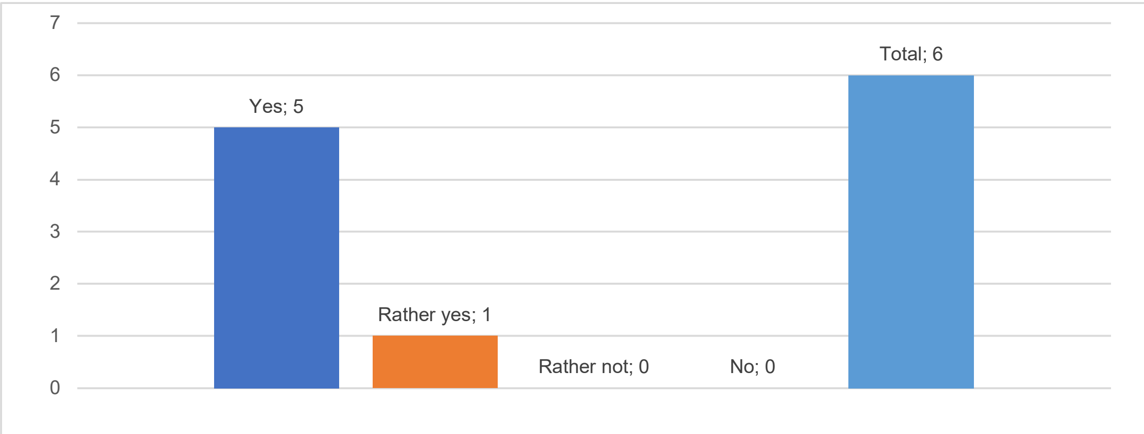
Question #1.	**Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?**
Yes	4
Rather yes	1
Rather not	1
No	0
Total	**6**



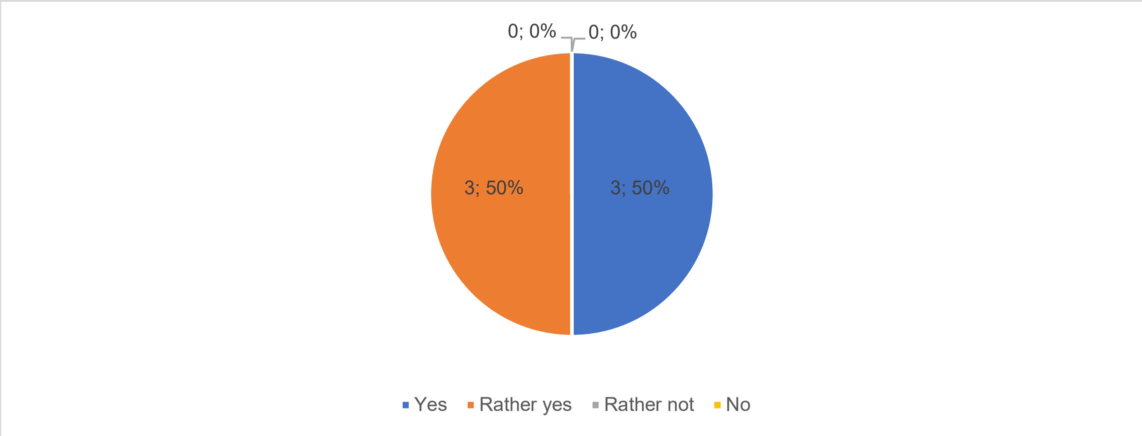


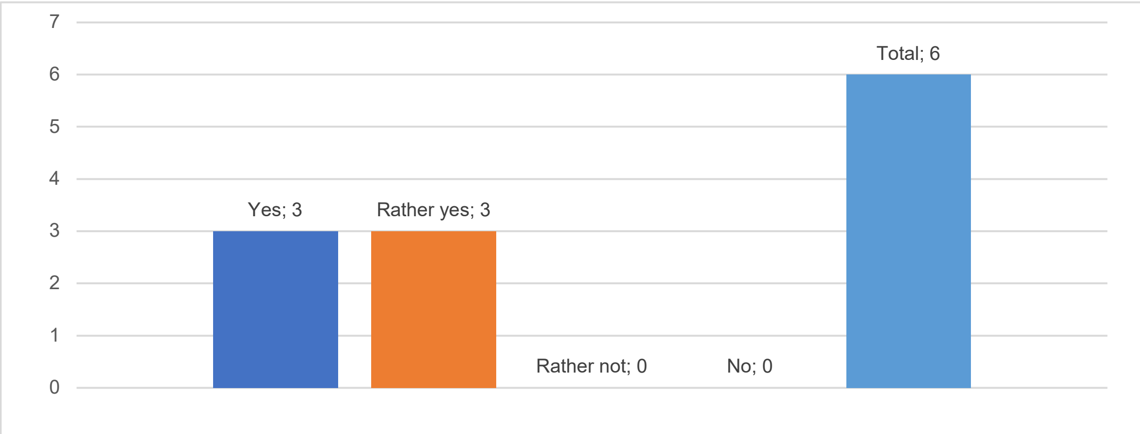
Question #2.	**I consider BIM a helpful design tool:**
Yes	5
Rather yes	1
Rather not	0
No	0
Total	**6**



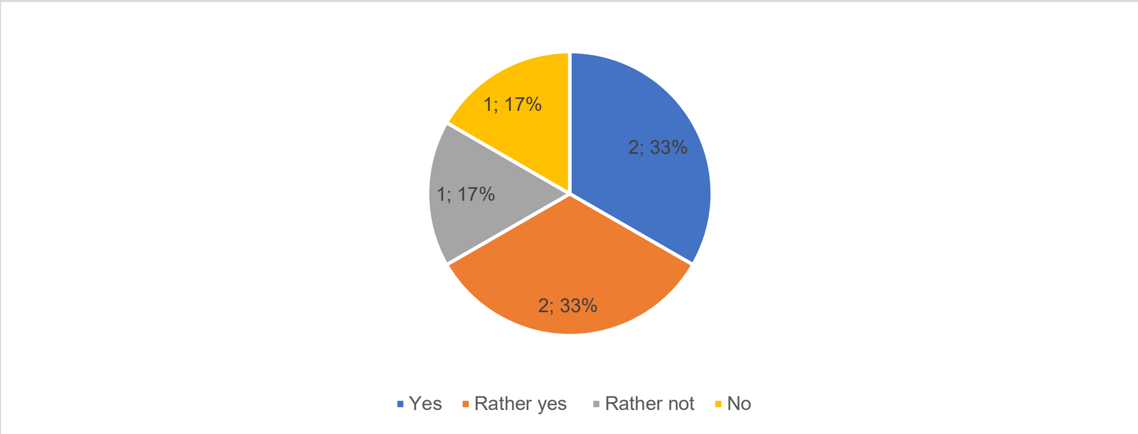


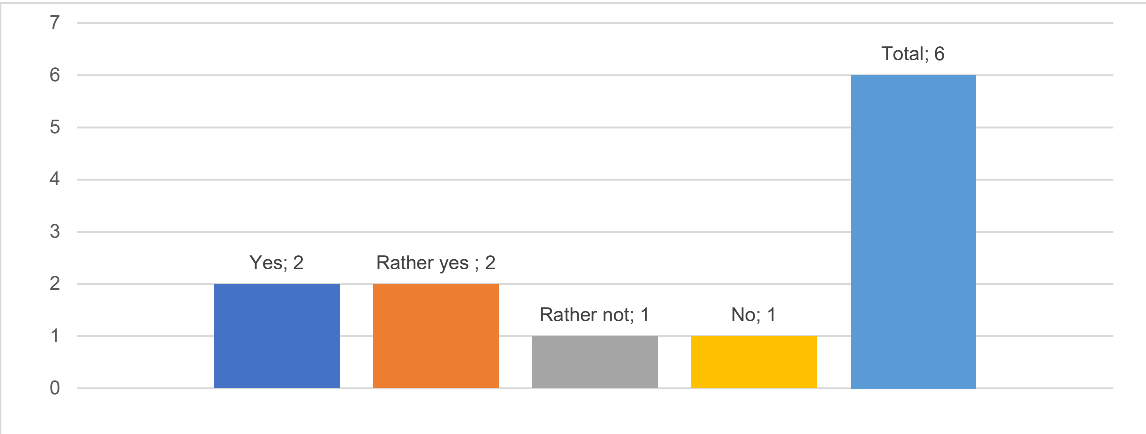
Question #3.	**I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):**
Yes	3
Rather yes	3
Rather not	0
No	0
Total	**6**



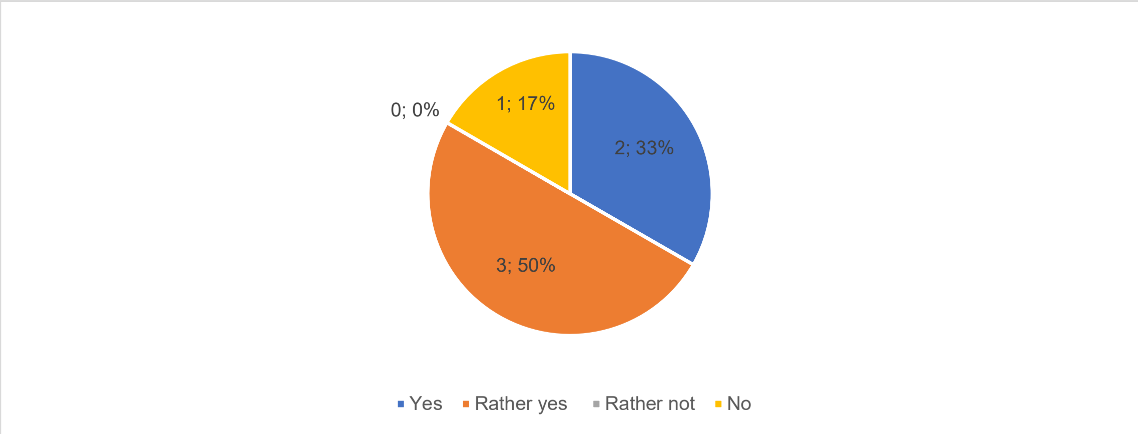


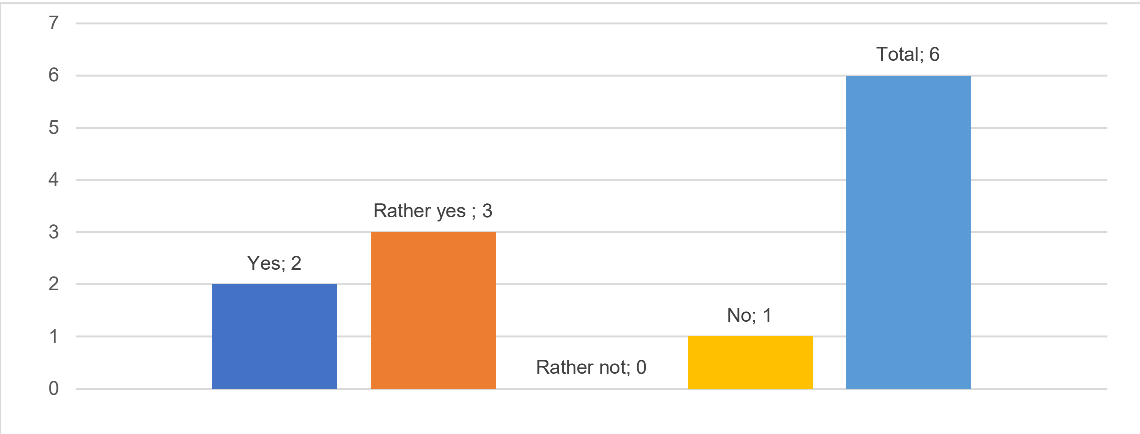
Question #4.	**If BIM is used, architects must also employ the BIM information model:**
Yes	2
Rather yes	2
Rather not	1
No	1
Total	**6**



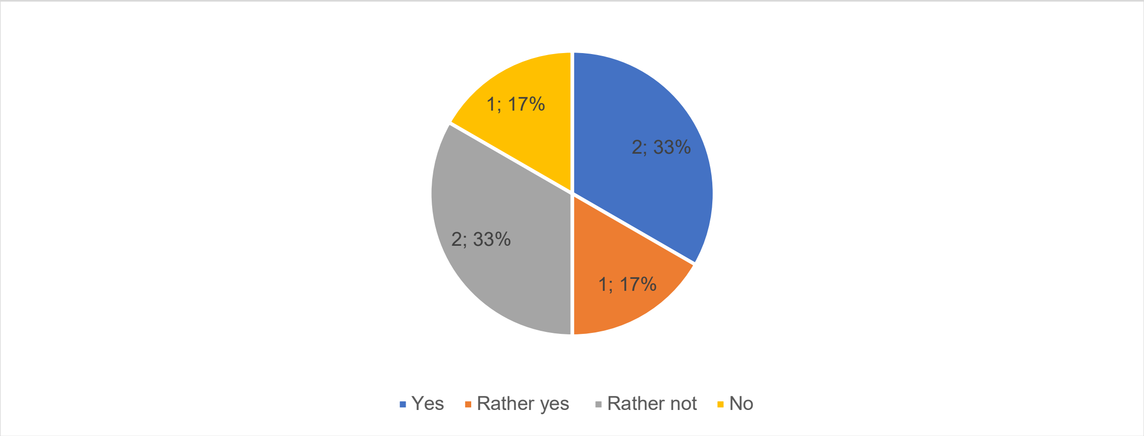


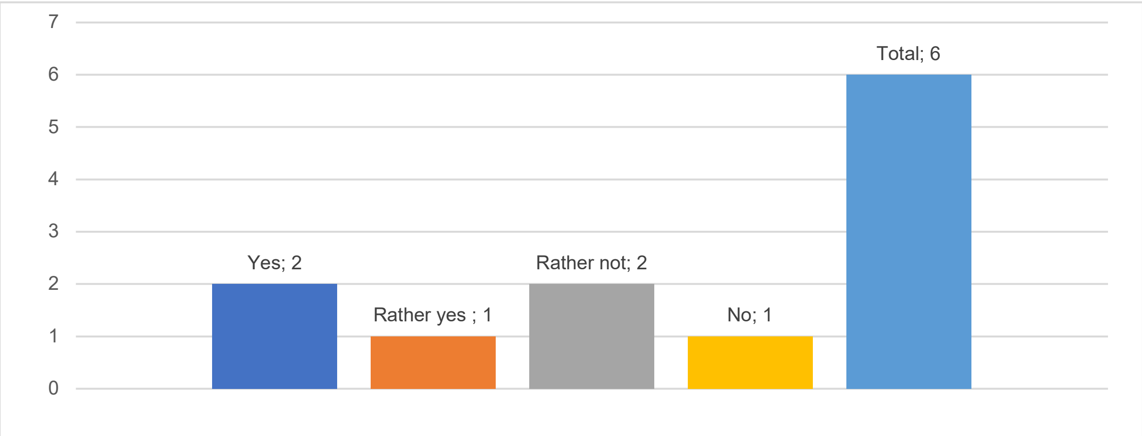
Question #5.	**If BIM is used, architects must also employ the CDE (common data environment):**
Yes	2
Rather yes	3
Rather not	0
No	1
Total	**6**



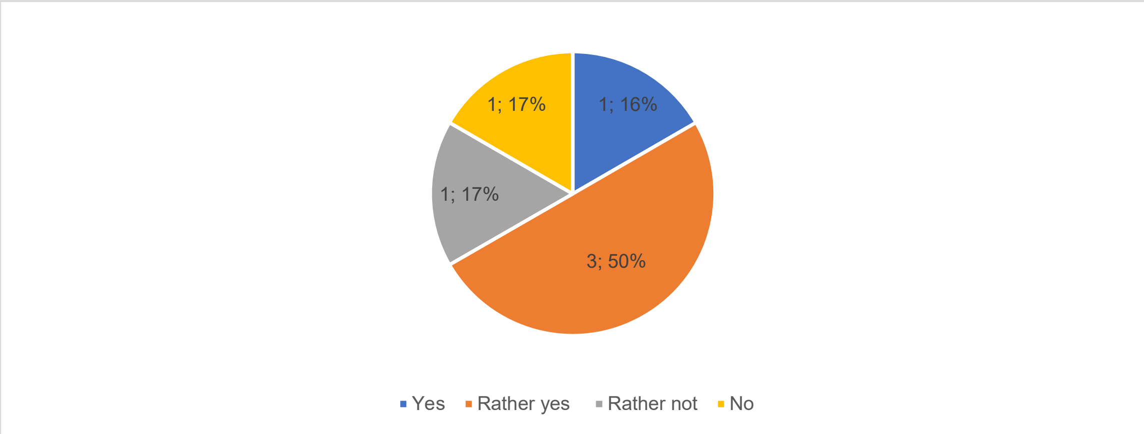


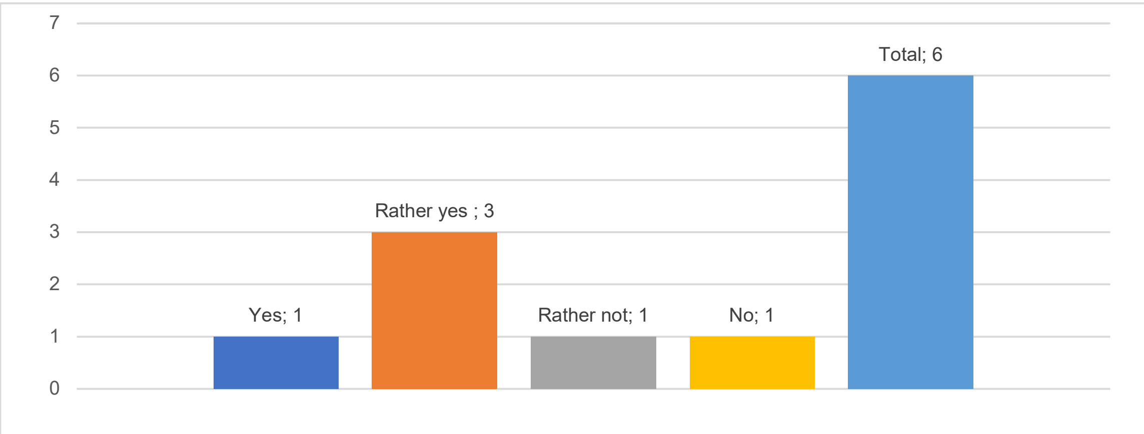
Question #6.	**The scope of a project does not matter if BIM is used:**
Yes	2
Rather yes	1
Rather not	2
No	1
Total	**6**



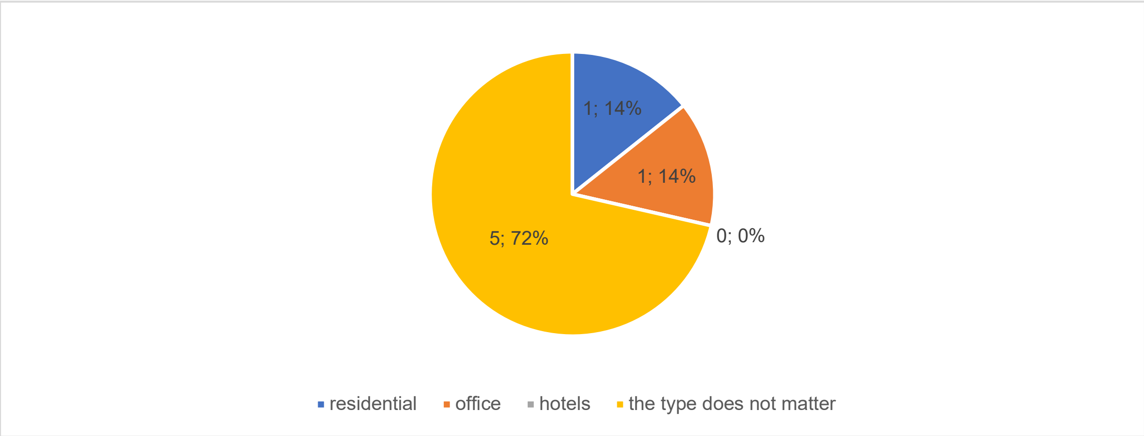


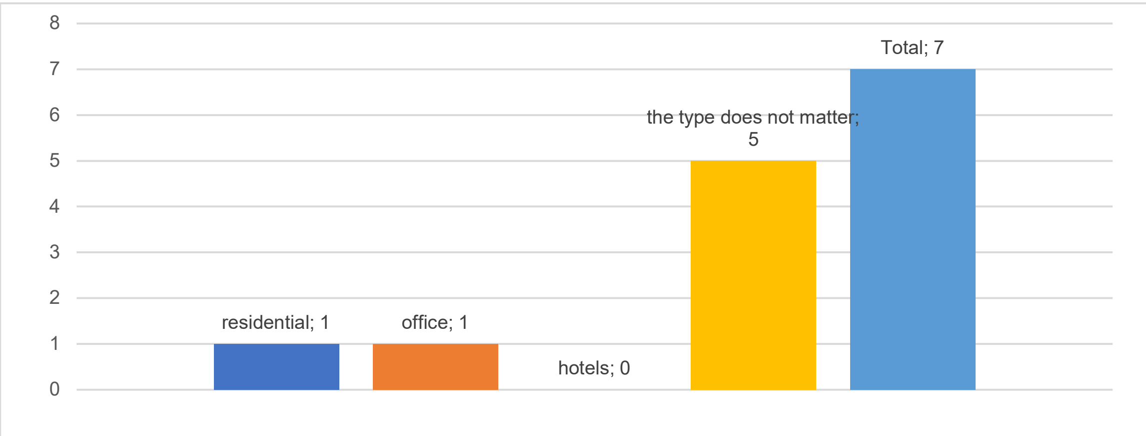
Question #7.	**If the BIM method is used, the project typology does not matter:**
Yes	1
Rather yes	3
Rather not	1
No	1
Total	**6**



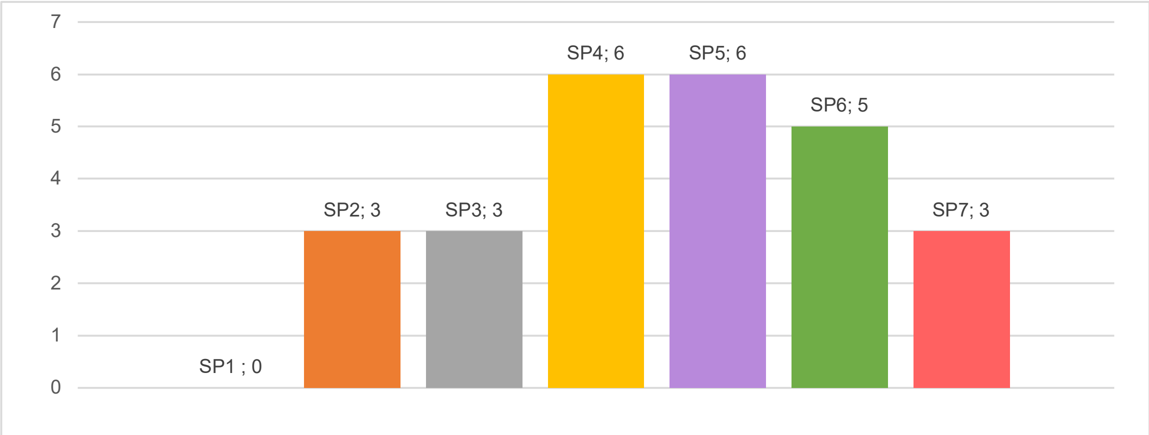


Question #8.	**The BIM method suits the following project types:**
residential	1
office	1
hotels	0
the type does not matter	5
Total	**7**

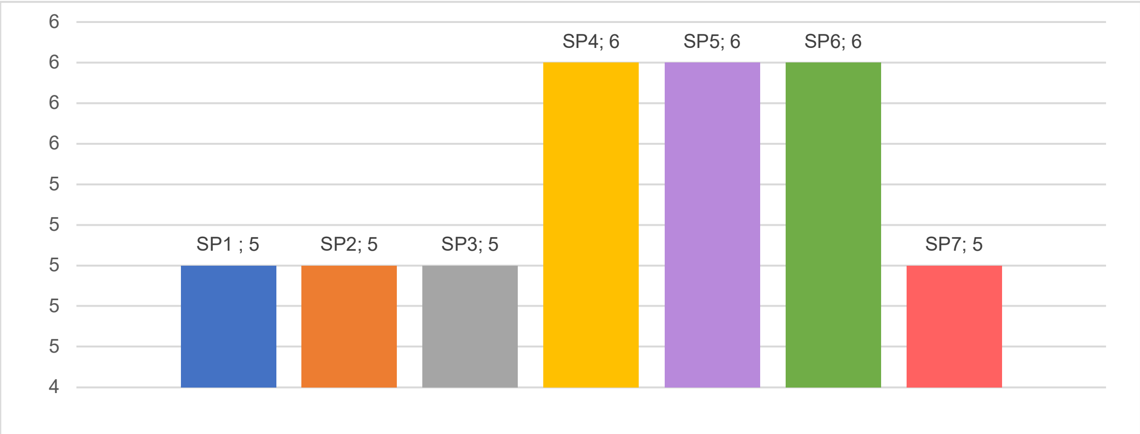




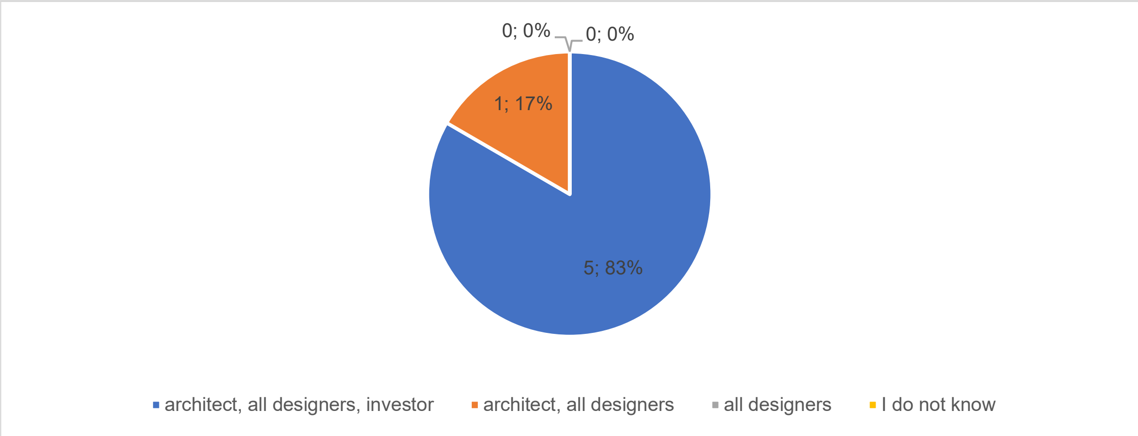
Question #9.	**Indicate the project stages in which developing a digital building information model makes sense:**	
SP1	Project Initiation	0
SP2	Preliminary – Concept Design	3
SP3	Land Zone Permit Design	3
SP4	Building Permit Developed Design	6
SP5	Detailed Design	6
SP6	List of Works and Deliverables	5
SP7	Architect’s Supervision	3
Total		**26**

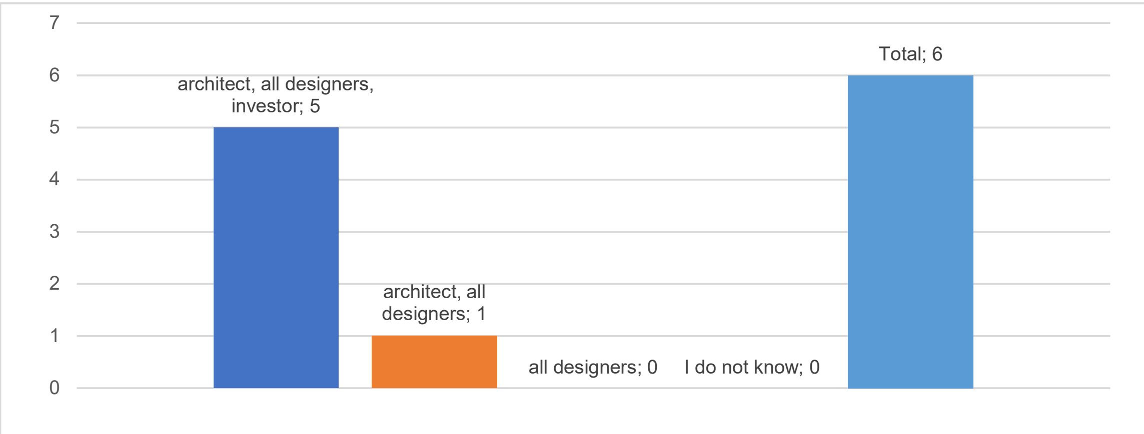


Question #10.	**Indicate the project stages in which using the common data environment (CDE) makes sense:**	
SP1	Project Initiation	5
SP2	Preliminary – Concept Design	5
SP3	Land Zone Permit Design	5
SP4	Building Permit Developed Design	6
SP5	Detailed Design	6
SP6	List of Works and Deliverables	6
SP7	Architect’s Supervision	5
Total		**38**

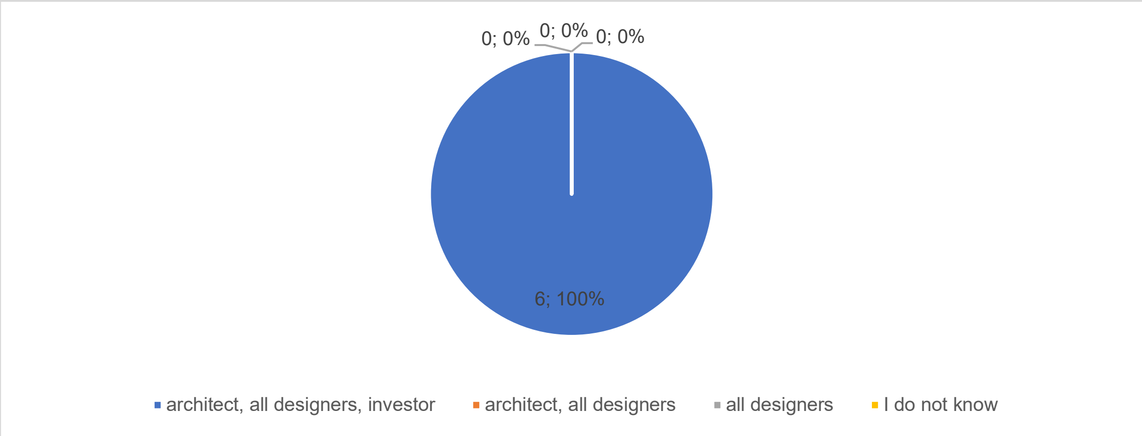


Question #11.	Indicate who must use the (digital) building information model (IMS) for a meaningful design process:
architect, all designers, investor	5
architect, all designers	1
all designers	0
I do not know	0
Total	**6**

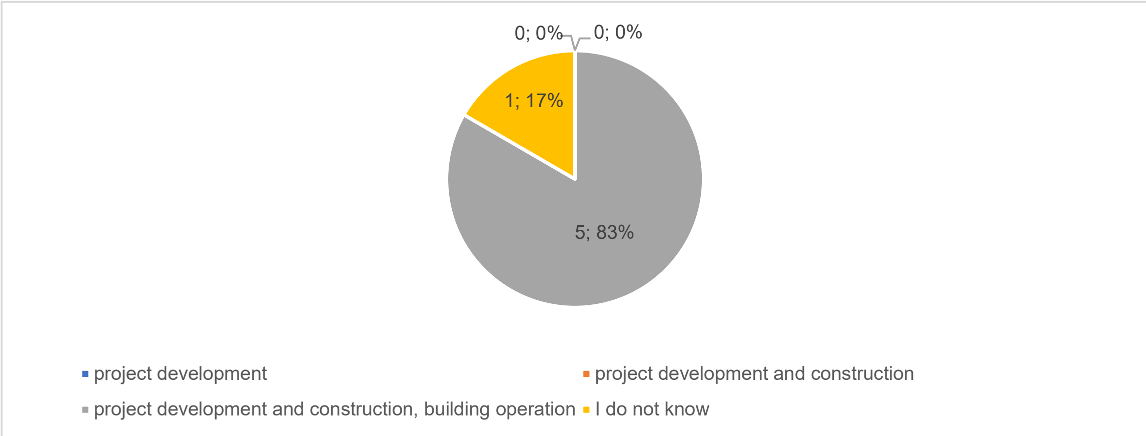


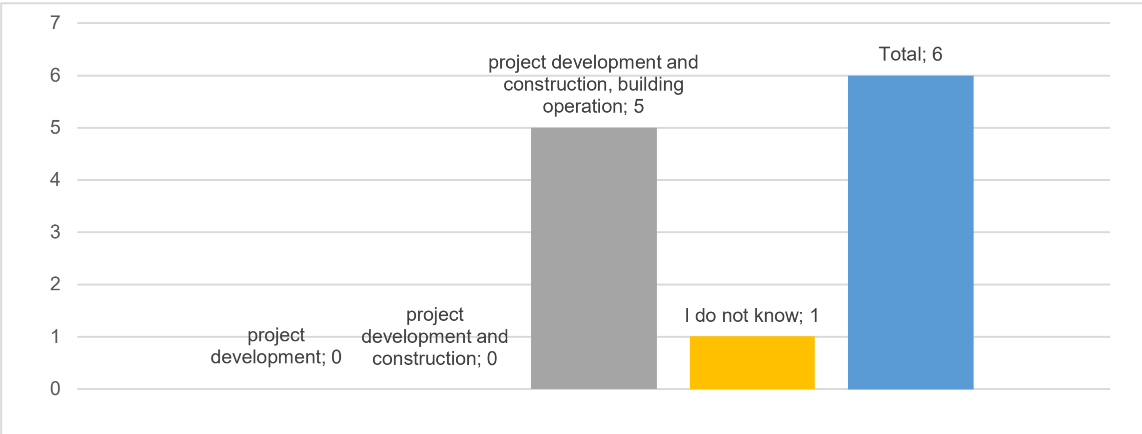


Question #12.	**Indicate who must use the common data environment (CDE) for a meaningful design process:**
architect, all designers, investor	6
architect, all designers	0
all designers	0
I do not know	0
Total	**6**

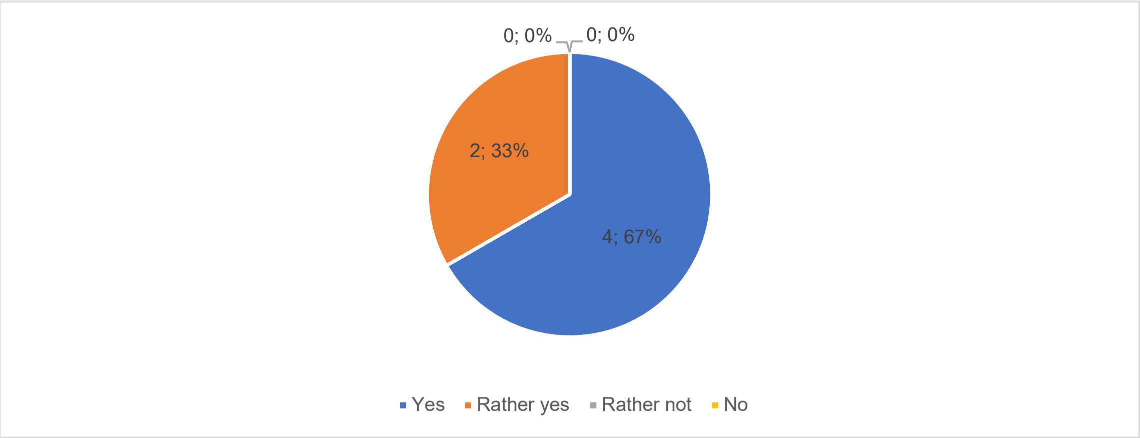


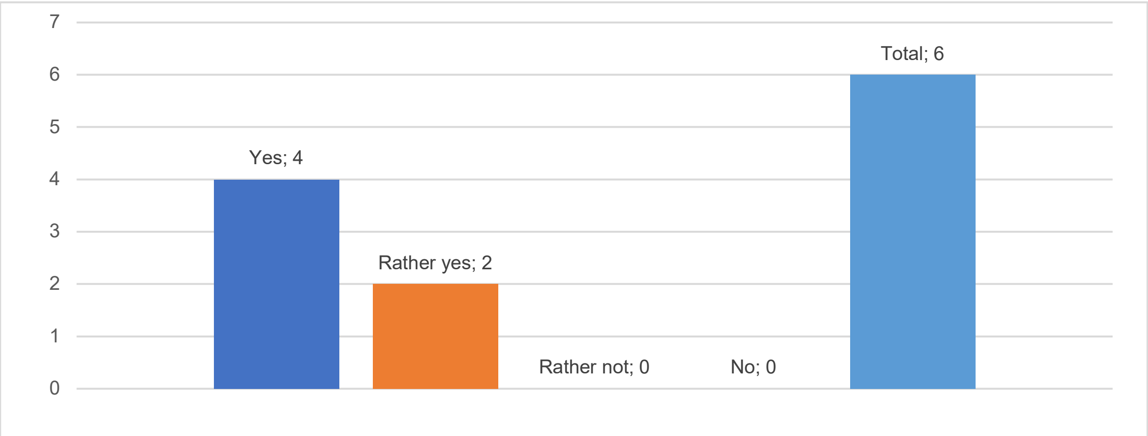
Question #13.	The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:
project development	0
project development and construction	0
project development and construction, building operation	5
I do not know	1
Total	**6**



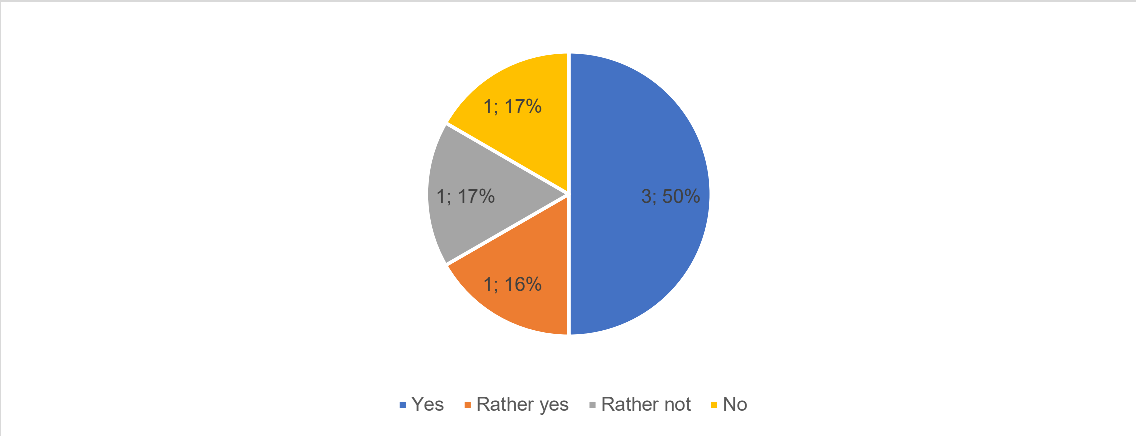


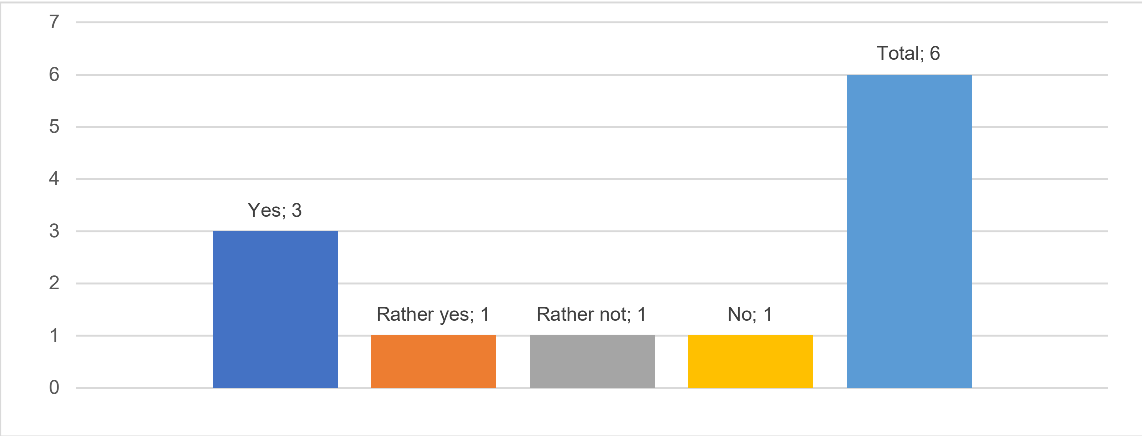
Question #14.	**Using BIM, the information details in individual stages differ from those used in the conventional design process:**
Yes	4
Rather yes	2
Rather not	0
No	0
Total	**6**



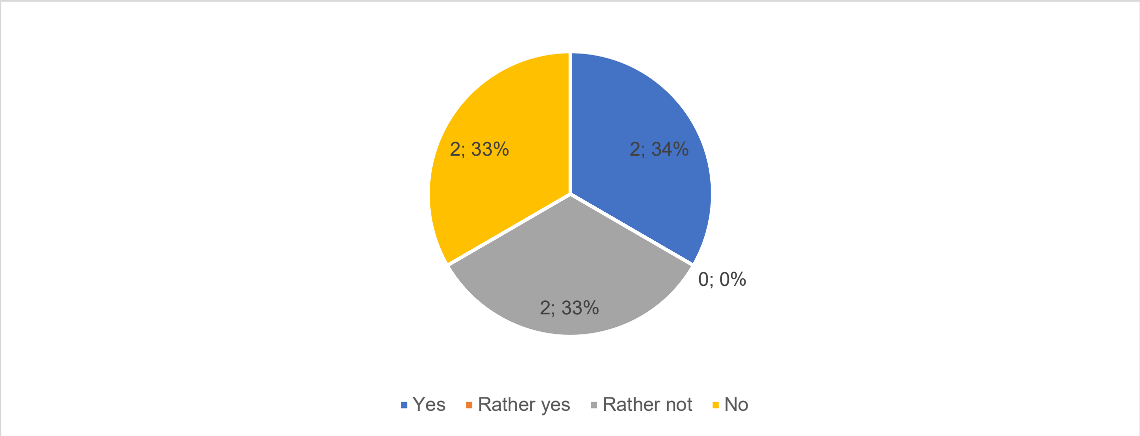


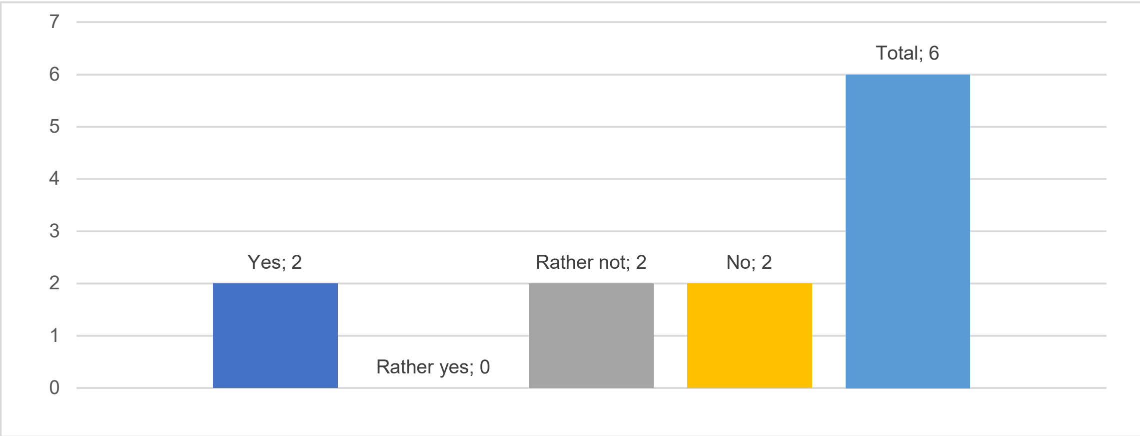
Question #15.	**Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?**
Yes	3
Rather yes	1
Rather not	1
No	1
Total	**6**





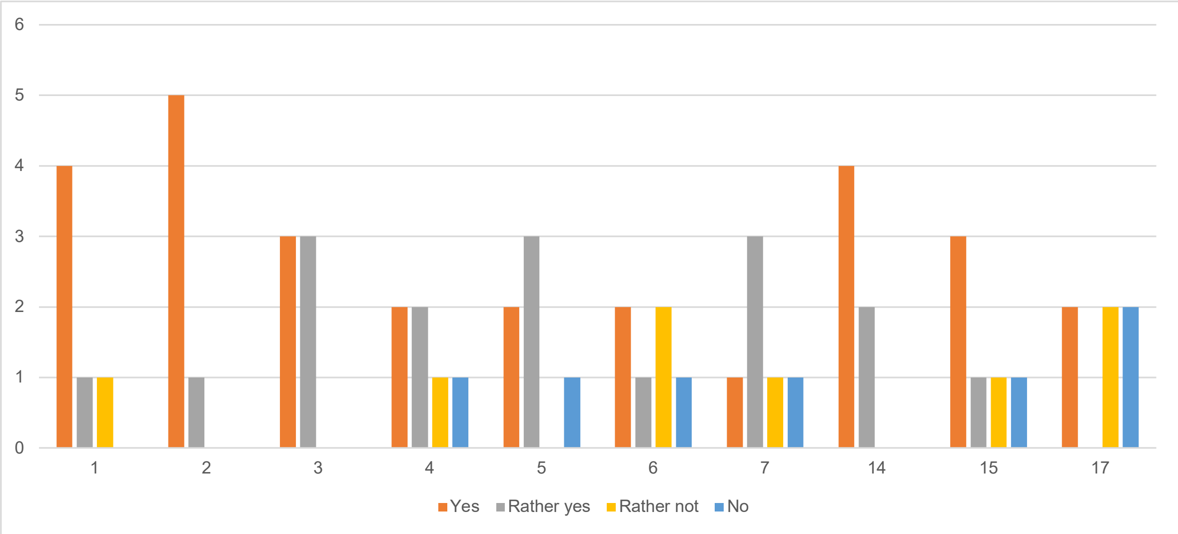
Question #17.	I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).
Yes	2
Rather yes	0
Rather not	2
No	2
Total	**6**

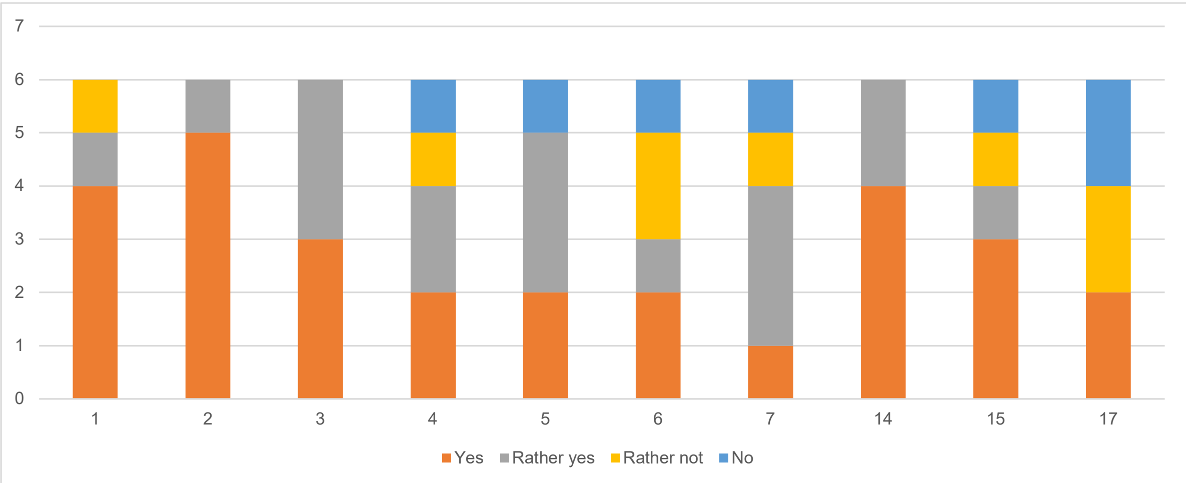




Summary Graphs

Question	1	2	3	4	5	6	7	14	15	17
Yes	4	5	3	2	2	2	1	4	3	2
Rather yes	1	1	3	2	3	1	3	2	1	0
Rather not	1	0	0	1	0	2	1	0	1	2
No	0	0	0	1	1	1	1	0	1	2
Total	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**





Questionnaire: Clarification Replies

Question #1

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

- Yes, if a BIM model or use of a CDE is required.

Question #4

If BIM is used, architects must employ the BIM information model:

- No, the existence of a BIM model can also be the benefit for the designer.

Question #5

If BIM is used, architects must also employ the CDE (common data environment):

- No, the BIM model can be shared and viewed in other ways. However, CDE makes it easier.

Question #6

The scope of a project does not matter if BIM is used:

- It doesn't matter if we are talking about development projects.

Question #7

If the BIM method is used, the project typology does not matter:

- Yes, it doesn’t matter.

Question #9

Indicate the project stages in which developing a digital building information model makes sense (tick according to your location):

- SP7:
  - It is not about model processing, but e.g. BIM 360 Field etc.

Question #13

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

- It is far from being the standard so far.

Question #15

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

- Generally a BIM designer, not necessarily an architect.

Question #16

Describe briefly, if you can, what fundamental data architects should provide in different design stages if using the BIM method:

- We have extensive manuals for this at Skanska, totalling many hundreds of pages.
- SP1:
  - I'm not an architect.
- SP2:
  - I'm not an architect.
  - Mass (geometry only), capacities, terrain.
- SP3:
  - Materials, colour of facades.
  - I'm not an architect.
  - Building envelope, capacity, terrain.
- SP4:
  - Material specifications.
  - I'm not an architect.
  - Building envelope, capacities, terrain, material specifications, basic parameters of elements (dimensions).
- SP5:
  - I'm not an architect.
  - Building envelope, capacities, terrain, material specifications, detailed element parameters (parameters in the tender details).
- SP6:
  - I'm not an architect.
  - Building envelope, capacities, terrain, material specifications, detailed element parameters (parameters in the tender details).
- SP7:
  - I'm not an architect.
  - Building envelope, capacities, terrain, material specifications, detailed element parameters (parameters in the tender details).

Question #17

I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).

- We have specialists for that.

Question #18

Describe, if you can, the basic requirements on architects' work briefly if employing the BIM design method:

- Proficiency with design software and CDE in accordance with standard practice so that the architect is able to design and communicate effectively with others. However, BIM tends to bring more benefits (if we are talking about the design itself) to building designers and drafting professions in the stages from planning permission onwards.

- See Skanska manuals.
- I don't know.
- I am not an architect.
- Good knowledge of the software in which the BIM model is processed, knowledge of BIM issues.

Question #19

Describe the basic benefits of architects' use of the BIM design method briefly if you can:

- The architect can more easily realize the continuity of the structures and see the problem areas. At the same time, it is possible to create derivatives of drawings very efficiently and update the design promptly. The model also helps the architect with the selection of materials and allows him to calculate the quantity and therefore the cost of the construction.
- The need for precise design refinement, quality coordination of professions, the possibility to work with data, but it is not primarily about architectural creation.
- Exchange of information, control of the design process.
- I am not an architect.
- Elimination of errors in the project, better presentation of the project to clients, possibilities of using more advanced tools for designing buildings (statics, thermal engineering), more accurate processing of the List of Works and Deliverables, better management tool for communication with the client, contractor and other participants in the construction.

Question #20

Describe the fundamental problems of architects' use of the BIM design method briefly if you can:

- I haven't met many architects with BIM design yet, but I would see the biggest potential disadvantage as the incompatibility/complexity of the initial model from the architect to the next phases (especially building permits). The modelling principles need to be agreed with the general designer so that they don't conflict with each other and then there doesn't need to be re-modelling.
- It is a special skill, conditioned by generation and team of collaborators, the architect alone is not able to create the project without them, the time required depends on the requirements (LOD, data structure), the complete completion of the information model is time consuming and contains many times more information than 2D.
- I don't know.
- I am not an architect.
- Lack of education in BIM (not only architects but also other participants in the project preparation and construction), time consuming.

Question #21

Briefly comment on the use of the BIM method for the project development if you can:

- I see BIM as the future of building design. By making its way into the pricing, preparation and overall management of a construction project, it is making a major contribution to the development of the construction industry. However, certain rules and principles must be followed. Only when used correctly, BIM brings positive benefits to users and greatly streamlines the processes involved in building construction.
- We have been dealing with the BIM issue for over 10 years, it is a question of evolution, now designing in BIM is our standard, but it took years and still the situation in the Czech Republic is not comparable with the developed world, the implementation at the national level, 4D, 5D solutions, etc. is not satisfactorily solved. In terms of design, the focus of work has shifted to the earlier stages of the project, in our case to the Building Permit Developed Design.
- I am looking forward to my first implementation with BIM.
- BIM = more work on model creation = better (more detailed) solution of structural collisions, HVAC management.
- Before starting the project preparation, it is essential to agree on the purpose of using a BIM model to derive the necessary detail. This is the only way to use BIM effectively.

Annex B
Research Data and their Evaluation

2. Questionnaires
2.5. Builders
2.5.2. Public Builders

Questionnaire

Question #1

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

a. Yes
b. Rather yes
c. Rather not
d. No

Question #2

I consider BIM a helpful design tool:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #3

I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):

a. Yes
b. Rather yes
c. Rather not
d. No

Question #4

If BIM is used, architects must employ the BIM information model:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #5

If BIM is used, architects must also employ the CDE (common data environment):

a. Yes
b. Rather yes
c. Rather not
d. No

Question #6

The scope of a project does not matter if BIM is used:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #7

If the BIM method is used, the project typology does not matter:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #8

The BIM method suits the following project types:

a. residential
b. office
c. hotels
d. the type does not matter

Question #9

Indicate the project stages in which developing a digital building information model makes sense (tick according to your location):

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

Question #10

Indicate the project stages in which using the common data environment (CDE) makes sense:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect's Supervision

Question #11

Indicate who must use the (digital) building information model (IMS) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #12

Indicate who must use the common data environment (CDE) for a meaningful design process:

a. architect, all designers, investor
b. architect, all designers
c. all designers
d. I do not know

Question #13

The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:

a. project development
b. project development and construction
c. project development and construction, building operation
d. I do not know

Question #14

Using BIM, the information details in individual stages differ from those used in the conventional design process:

a. Yes
b. Rather yes
c. Rather not
d. No

Question #15

Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?

a. Yes
b. Rather yes
c. Rather not
d. No

Question #16

Describe briefly, if you can, what fundamental data architects should provide in different design stages if using the BIM method:

SP1	Project Initiation
SP2	Preliminary – Concept Design
SP3	Land Zone Permit Design
SP4	Building Permit Developed Design
SP5	Detailed Design
SP6	List of Works and Deliverables
SP7	Architect’s Supervision

Question #17

I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).

a. Yes
b. Rather yes
c. Rather not
d. No

Question #18

Describe, if you can, the basic requirements on architects' work briefly if employing the BIM design method:

Question #19

Describe the basic benefits of architects' use of the BIM design method briefly if you can:

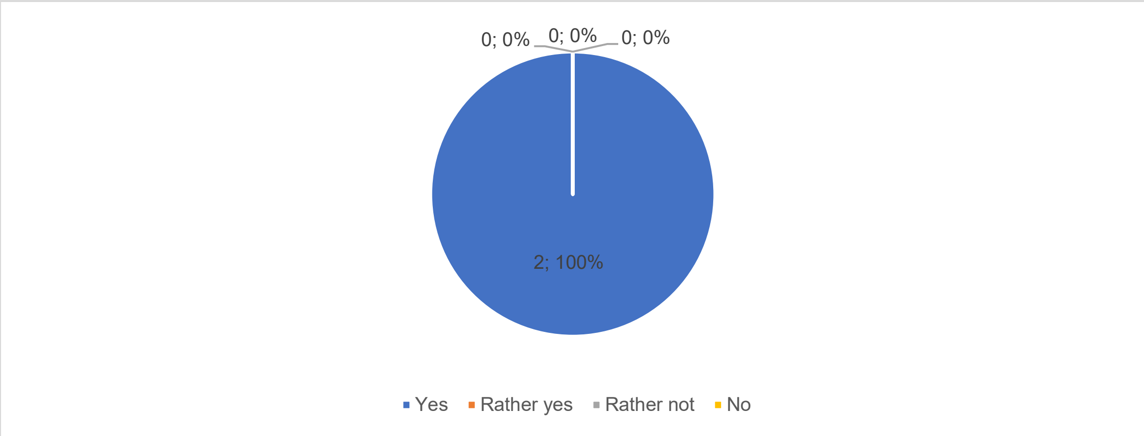
Question #20

Describe the fundamental problems of architects' use of the BIM design method briefly if you can:

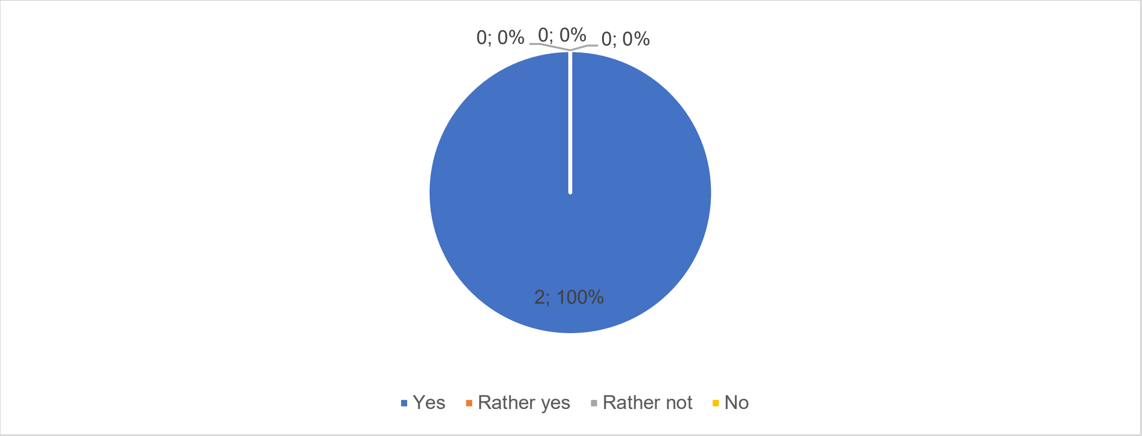
Question #21

Briefly comment on the use of the BIM method for the project development if you can:

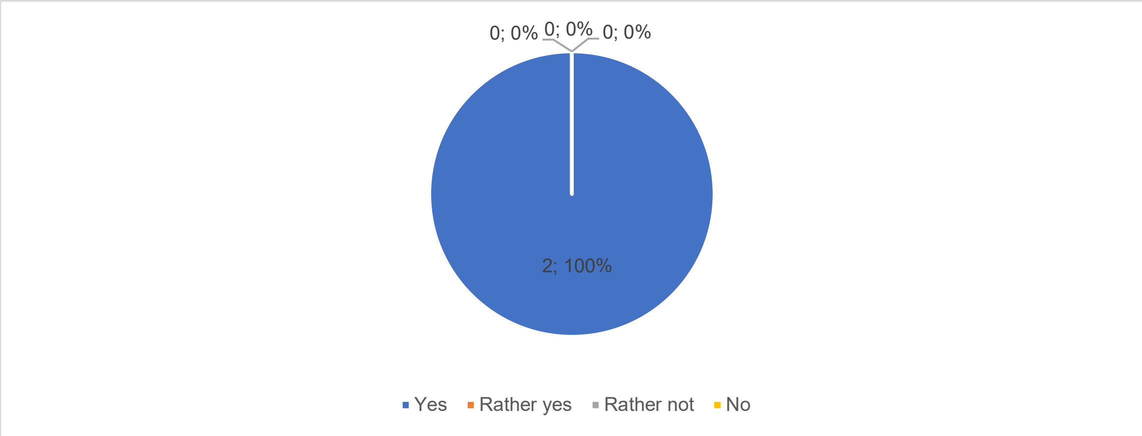
Question #1.	**Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?**
Yes	2
Rather yes	0
Rather not	0
No	0
Total	**2**



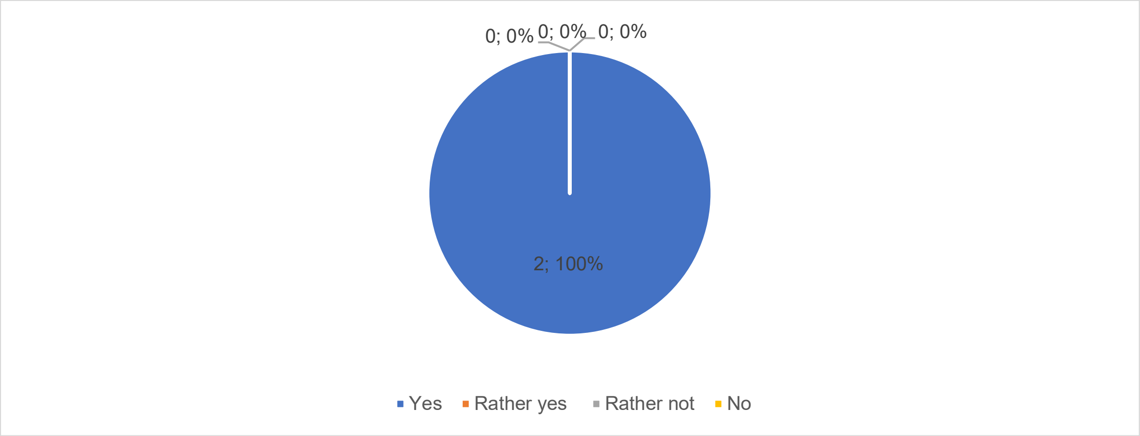
Question #2.	I consider BIM a helpful design tool:
Yes	2
Rather yes	0
Rather not	0
No	0
Total	**2**



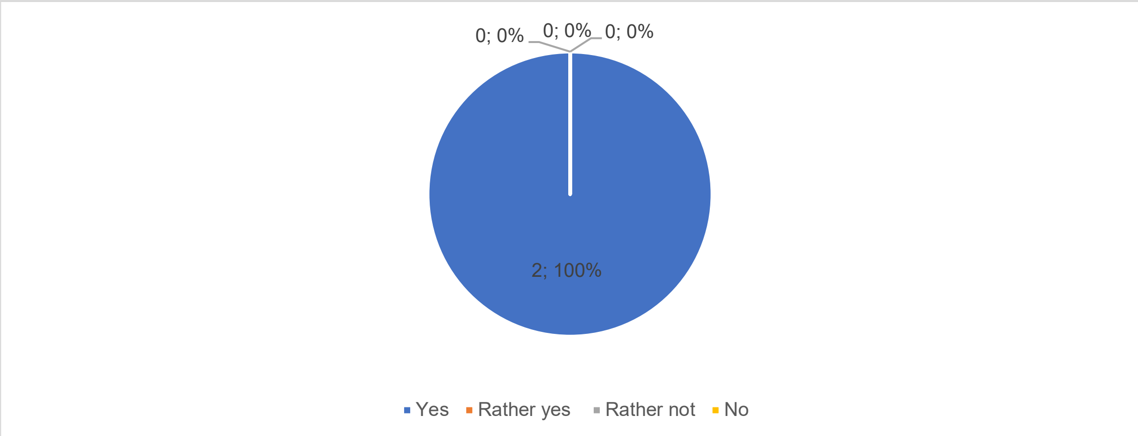
Question #3.	I understand BIM as a method for the creation of an information model and data sharing via the common data environment (CDE):
Yes	2
Rather yes	0
Rather not	0
No	0
Total	**2**



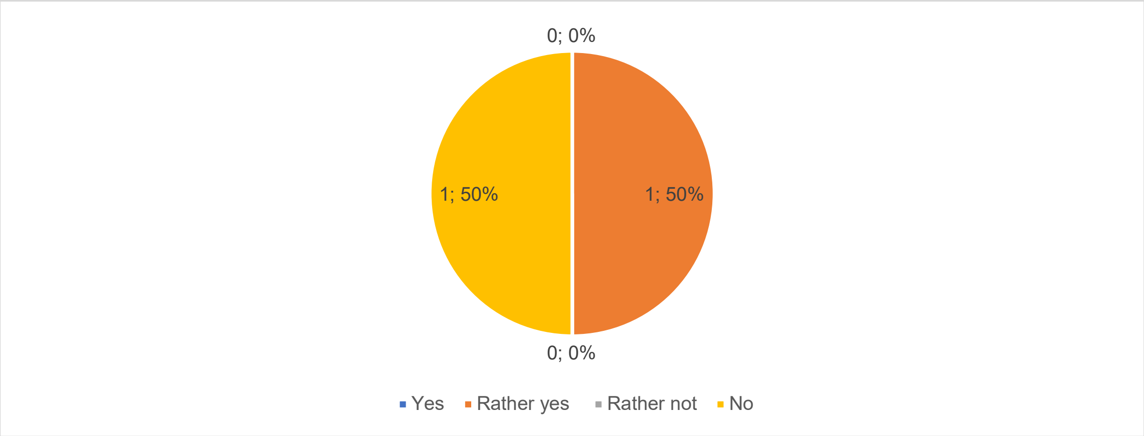
Question #4.	**If BIM is used, architects must also employ the BIM information model:**
Yes	2
Rather yes	0
Rather not	0
No	0
Total	**2**



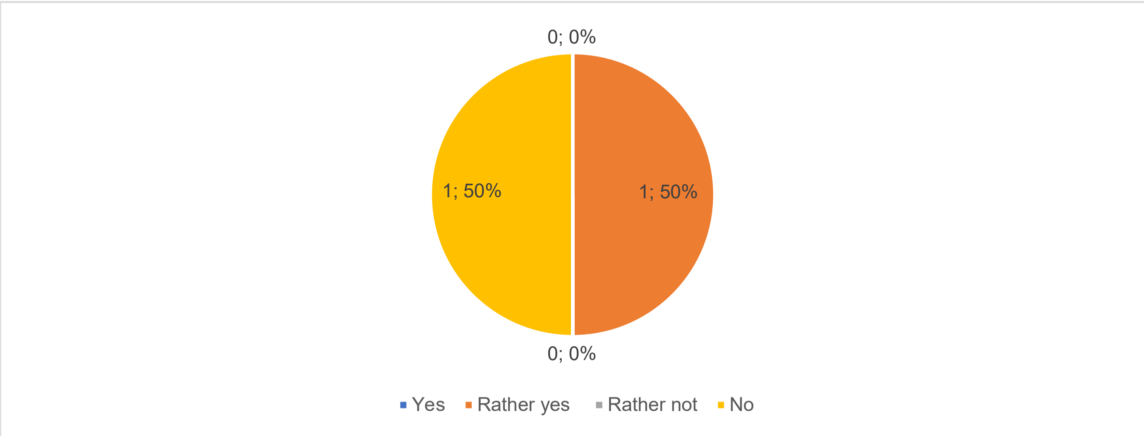
Question #5.	**If BIM is used, architects must also employ the CDE (common data environment):**
Yes	2
Rather yes	0
Rather not	0
No	0
Total	**2**

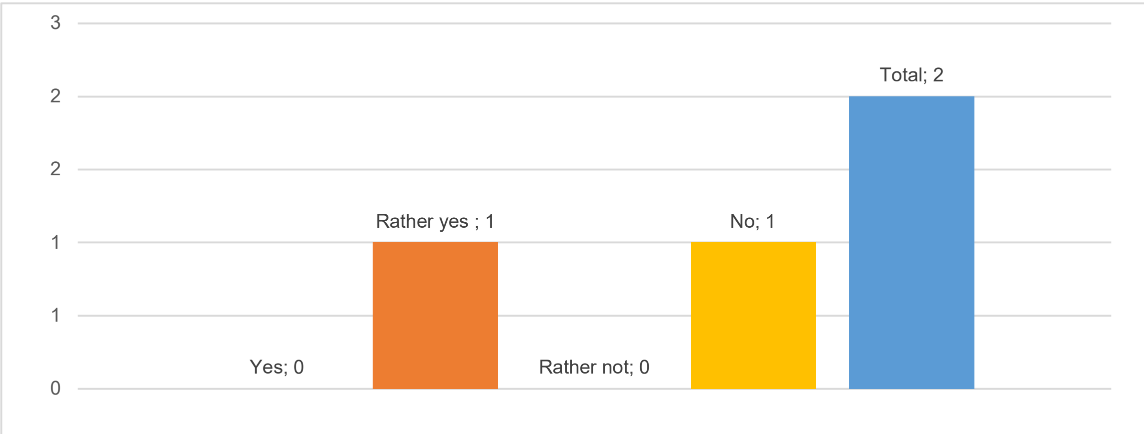


Question #6.	**The scope of a project does not matter if BIM is used:**
Yes	0
Rather yes	1
Rather not	0
No	1
Total	**2**

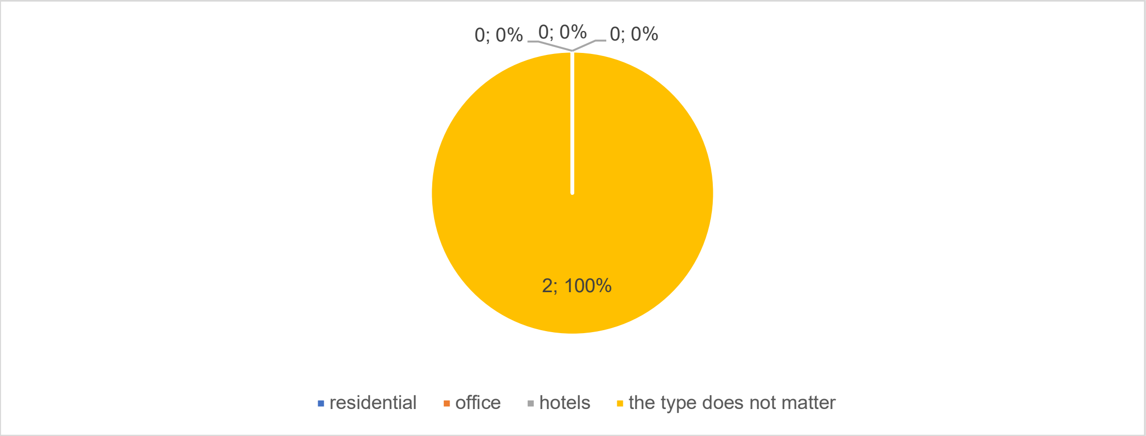


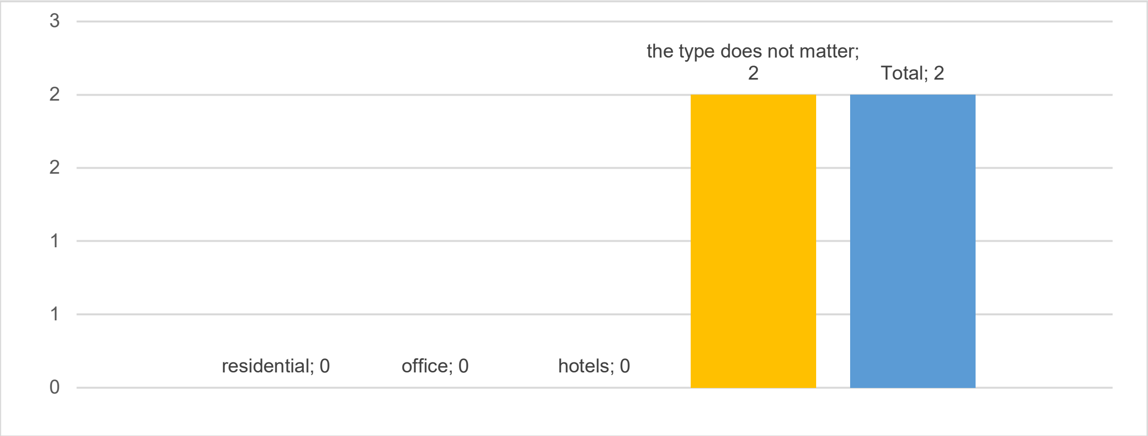
Question #7.	**If the BIM method is used, the project typology does not matter:**
Yes	0
Rather yes	1
Rather not	0
No	1
Total	**2**



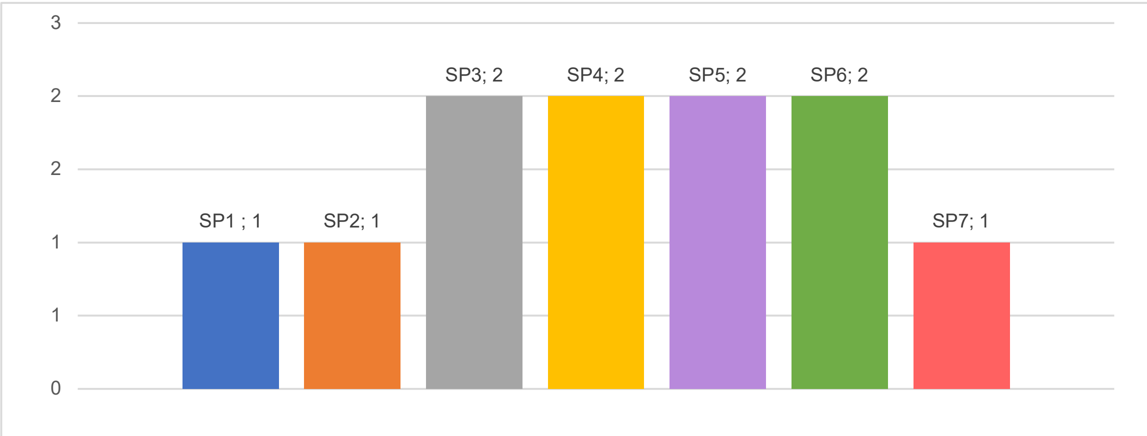


Question #8.	The BIM method suits the following project types:
residential	0
office	0
hotels	0
the type does not matter	2
Total	**2**

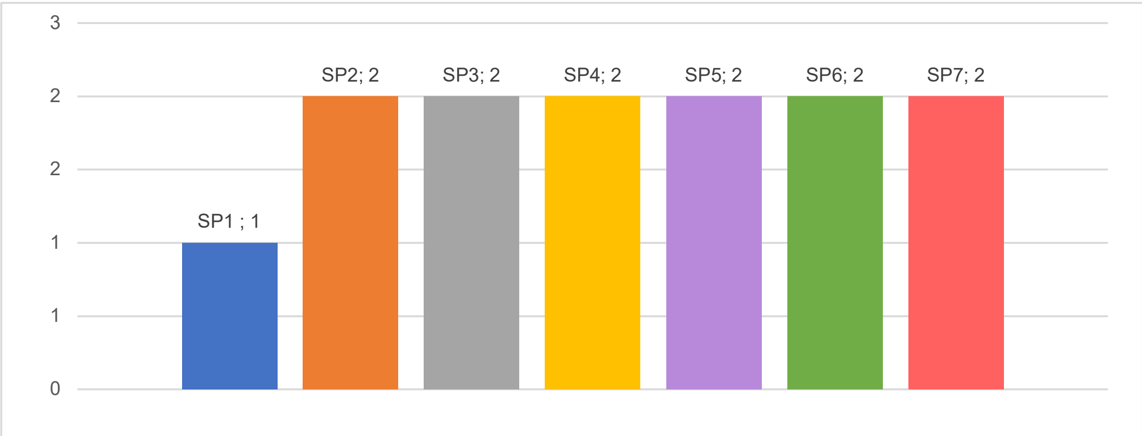




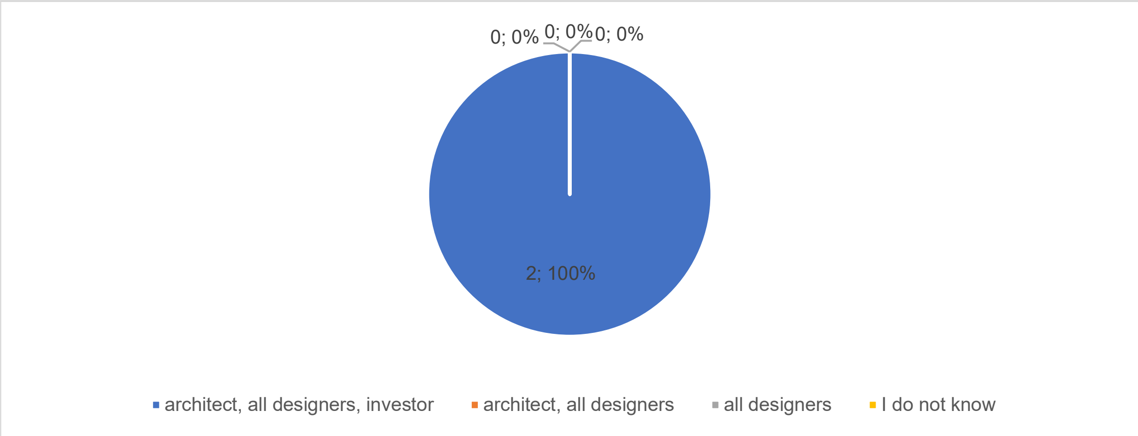
Question #9.	**Indicate the project stages in which developing a digital building information model makes sense:**	
SP1	Project Initiation	1
SP2	Preliminary – Concept Design	1
SP3	Land Zone Permit Design	2
SP4	Building Permit Developed Design	2
SP5	Detailed Design	2
SP6	List of Works and Deliverables	2
SP7	Architect's Supervision	1
Total		**11**

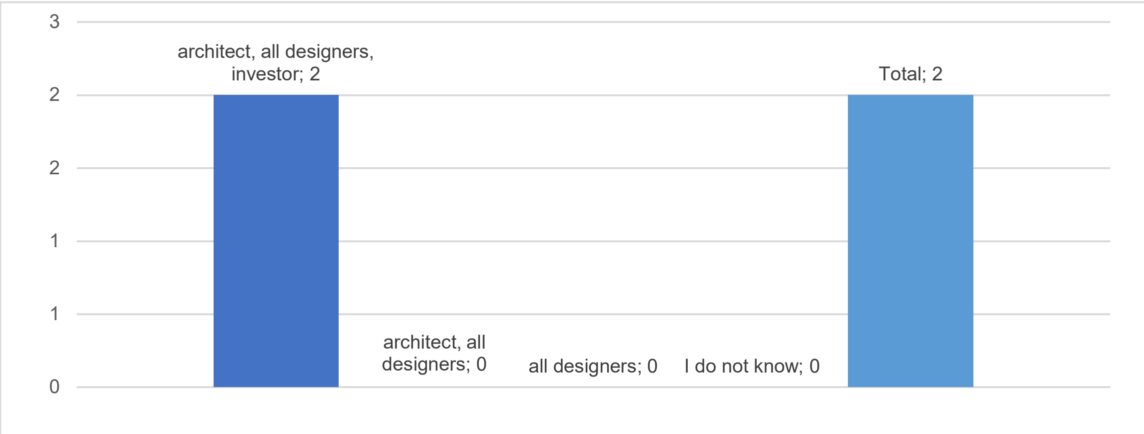


Question #10.	**Indicate the project stages in which using the common data environment (CDE) makes sense:**	
SP1	Project Initiation	1
SP2	Preliminary – Concept Design	2
SP3	Land Zone Permit Design	2
SP4	Building Permit Developed Design	2
SP5	Detailed Design	2
SP6	List of Works and Deliverables	2
SP7	Architect's Supervision	2
Total		**13**

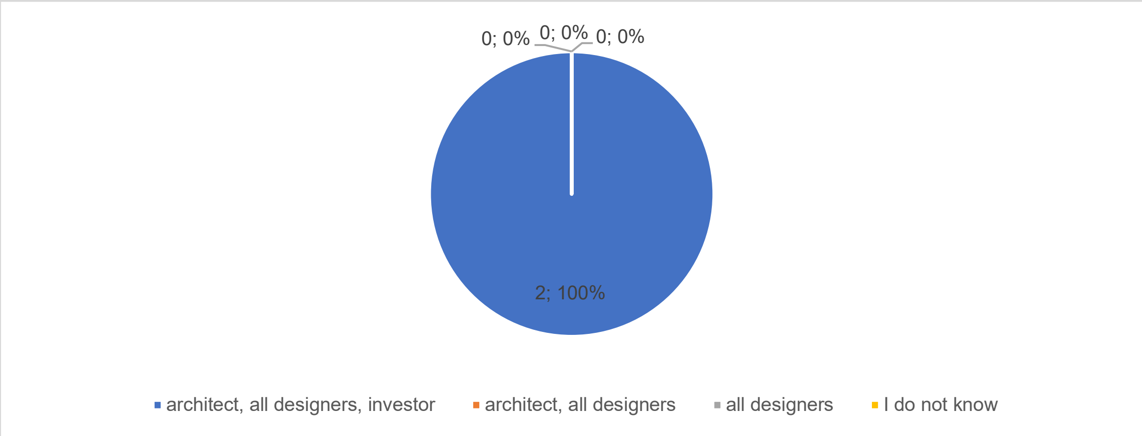


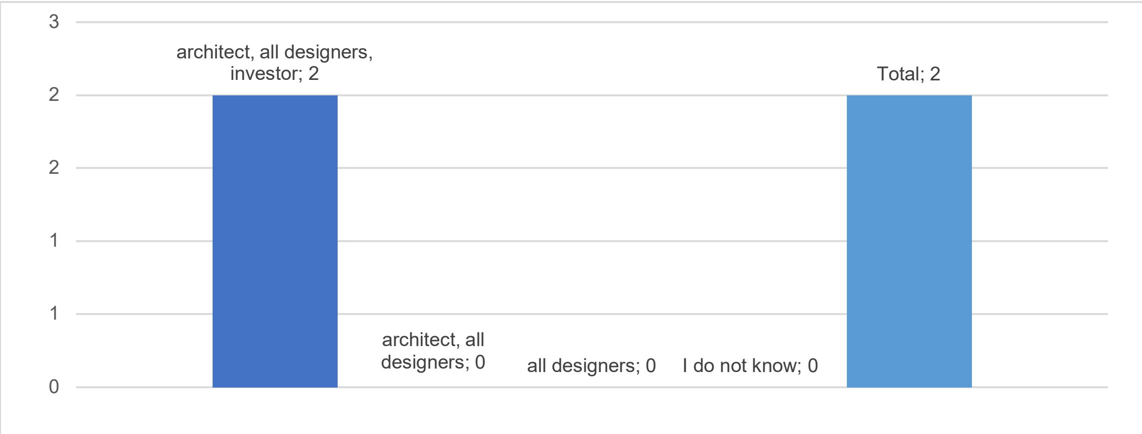
Question #11.	**Indicate who must use the (digital) building information model (IMS) for a meaningful design process:**
architect, all designers, investor	2
architect, all designers	0
all designers	0
I do not know	0
Total	**2**



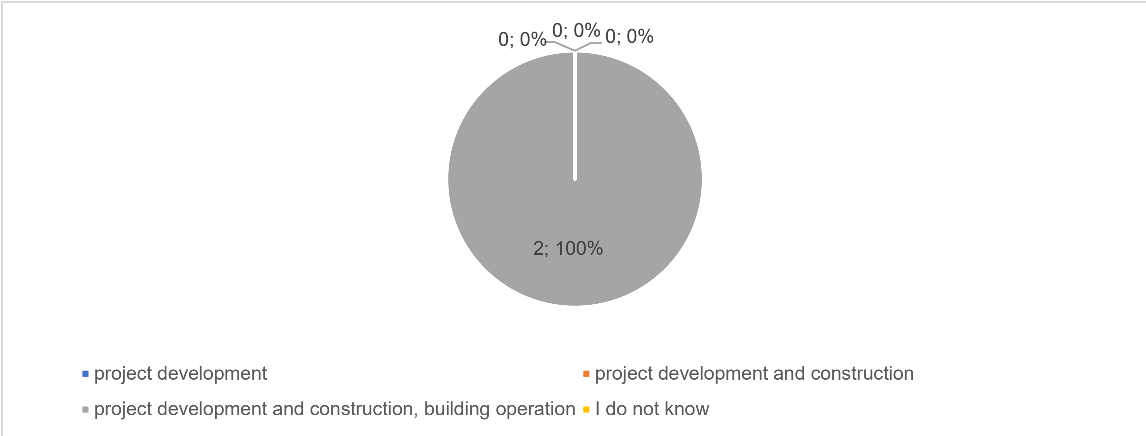


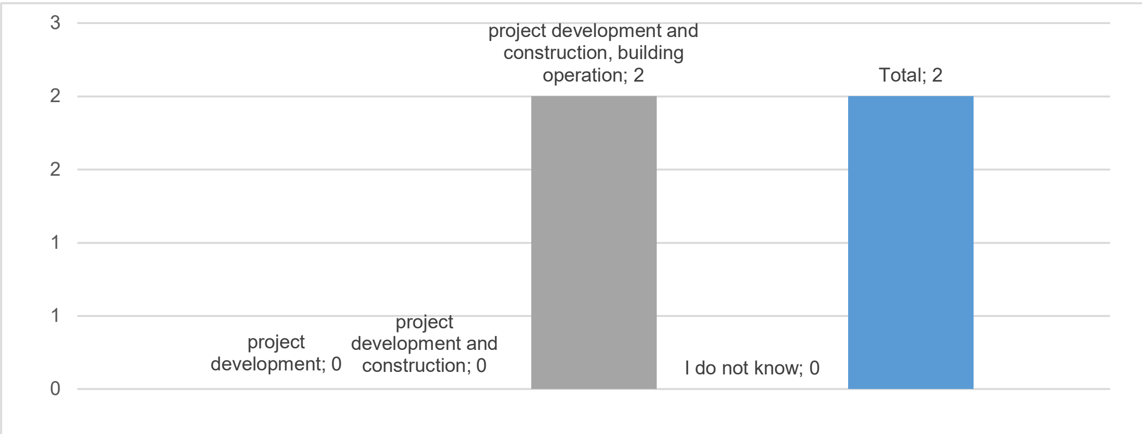
Question #12.	**Indicate who must use the common data environment (CDE) for a meaningful design process:**
architect, all designers, investor	2
architect, all designers	0
all designers	0
I do not know	0
Total	**2**



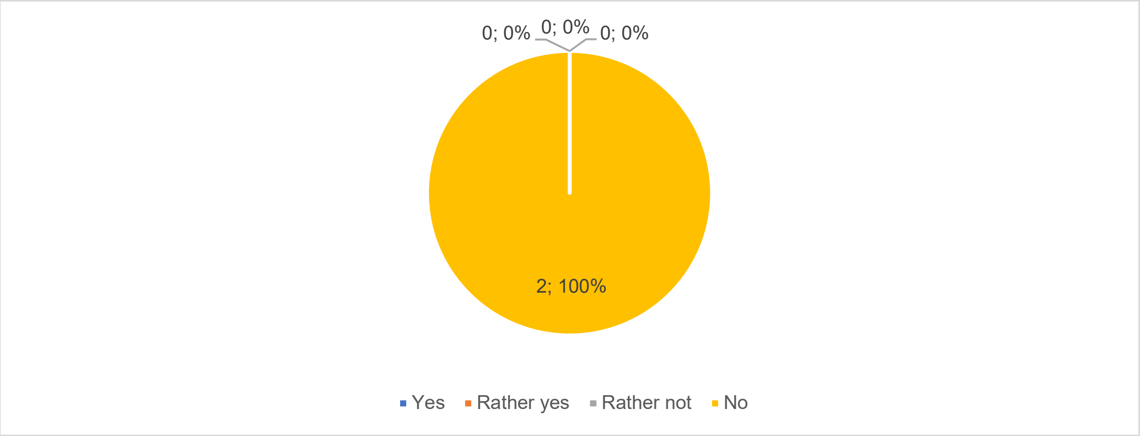


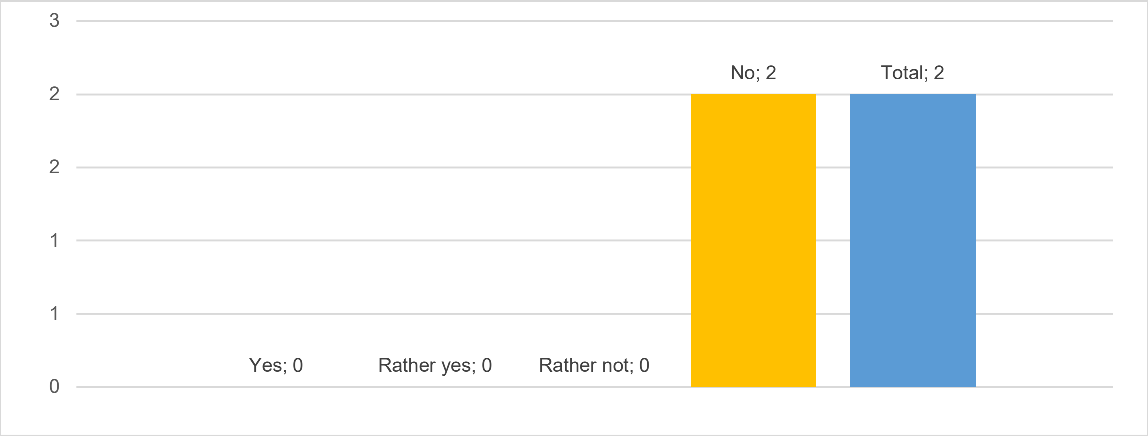
Question #13.	The advantage of using the BIM method is reflected in the following stages of the life cycle of the construction:
project development	0
project development and construction	0
project development and construction, building operation	2
I do not know	0
Total	**2**



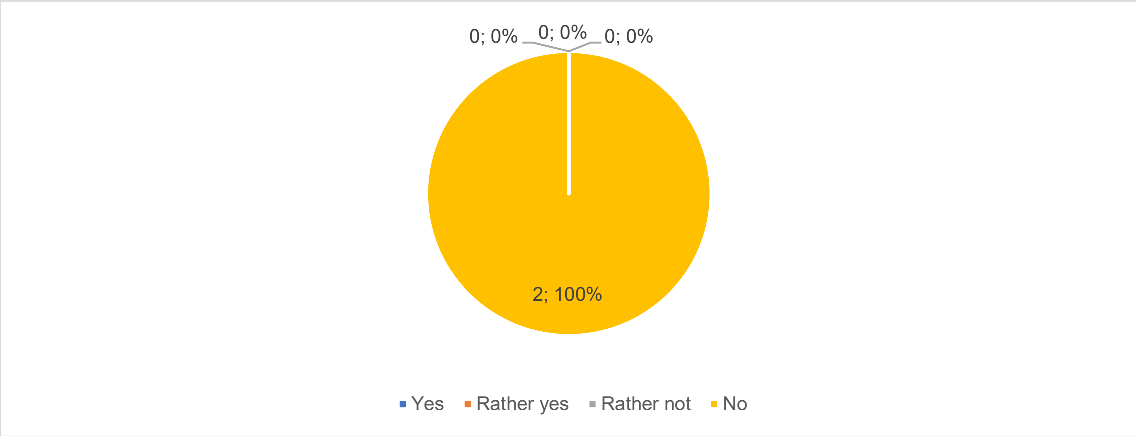


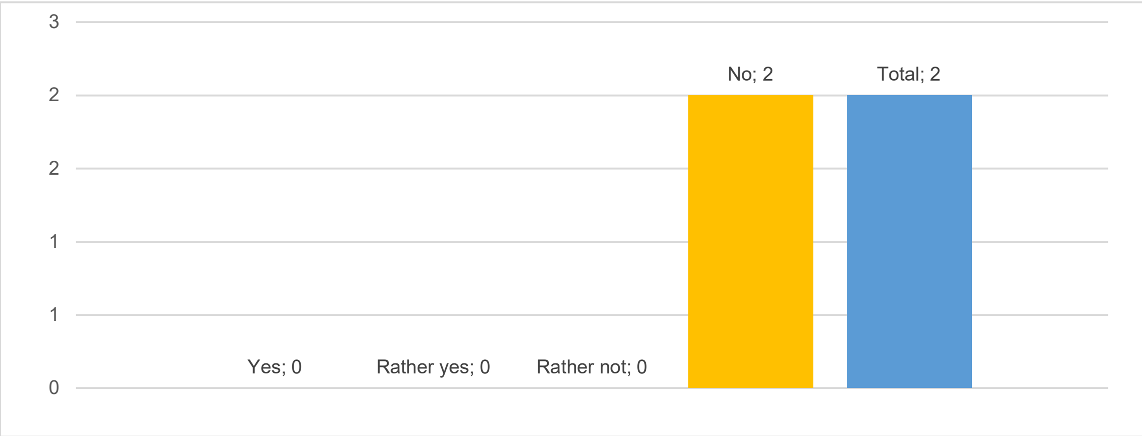
Question #14.	**Using BIM, the information details in individual stages differ from those used in the conventional design process:**
Yes	0
Rather yes	0
Rather not	0
No	2
Total	**2**



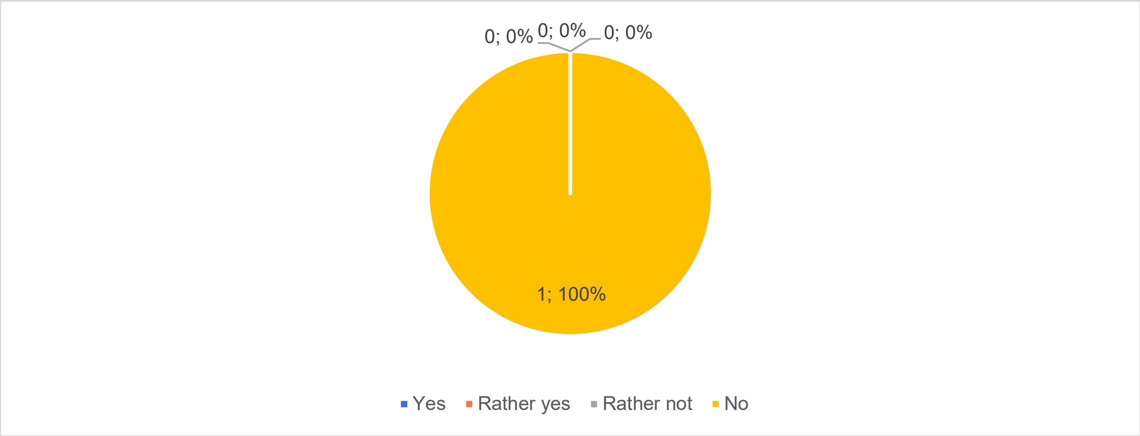


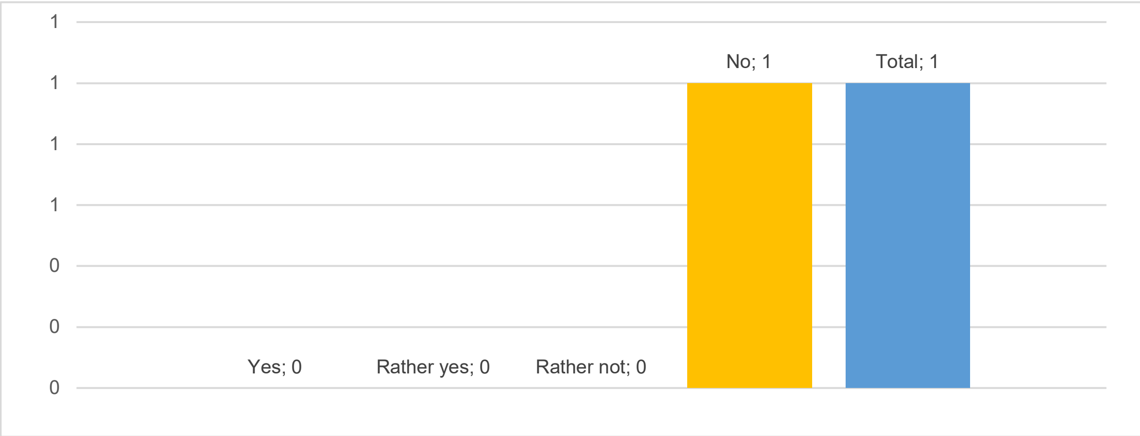
Question #15.	**Is it necessary for architects using the BIM method to provide more detailed information than those requested during the conventional design process?**
Yes	0
Rather yes	0
Rather not	0
No	2
Total	**2**





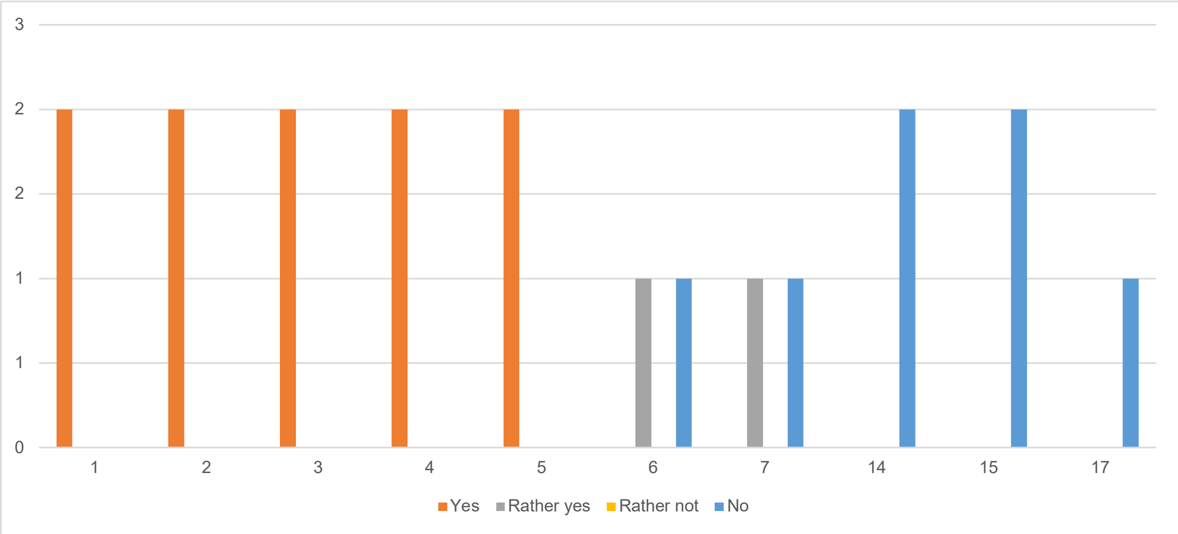
Question #17.	**I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).**
Yes	0
Rather yes	0
Rather not	0
No	1
Total	**1**

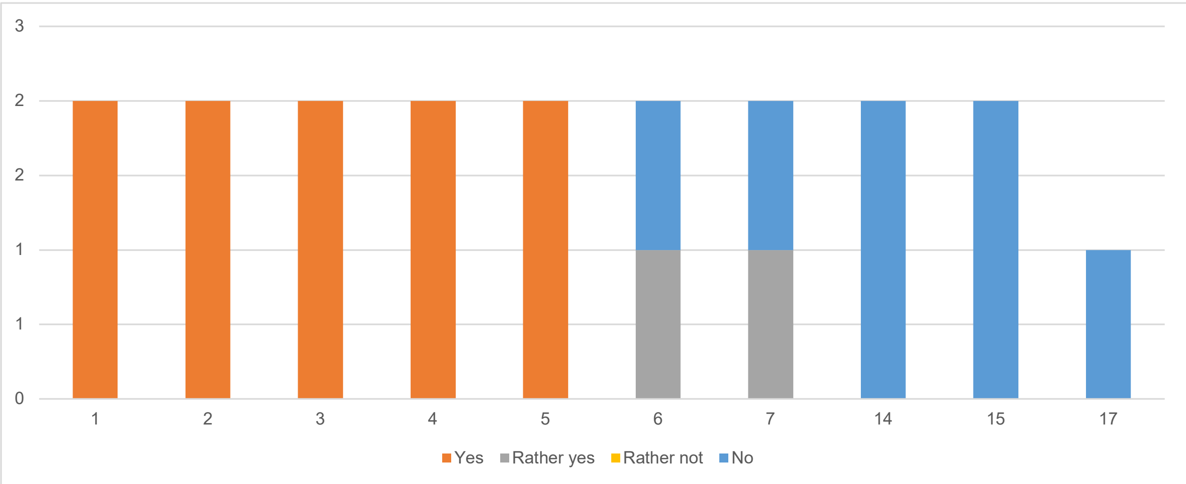




Summary Graphs

Question	1	2	3	4	5	6	7	14	15	17
Yes	2	2	2	2	2	0	0	0	0	0
Rather yes	0	0	0	0	0	1	1	0	0	0
Rather not	0	0	0	0	0	0	0	0	0	0
No	0	0	0	0	0	1	1	2	2	1
Total	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**





Questionnaire: Clarification Replies

Question #1

Is it necessary that a Design Work Contract contains requirements to develop a (digital) building information model and use the common data environment (CDE)?

- If you want to design in BIM, then yes.

Question #6

The scope of a project does not matter if BIM is used:

- It's about the choice of the contracting authority. However, from 1.7.2023 it will have to apply to all above-limit contracts.

Question #7

If the BIM method is used, the project typology does not matter:

- No, it doesn't matter.

Question #8

The BIM method suits the following project types:

- It depends, technically and organizationally simple, although even relatively large buildings do not need to be implemented using the BIM method.

Question #16

Describe briefly, if you can, what fundamental data architects should provide in different design stages if using the BIM method:

- In principle the same as they are used to when designing without BIM.
- SP1:
    - Parametric specification.
- SP2:
    - Basic information model of the building meeting the parameters.
- SP3:
    - Information model of the building IMS for Land Zone Permit Design.
- SP4:
    - Information model of the building IMS for Building Permit Developed Design.
- SP5:
    - Information model of the building IMS for Detailed Design.
- SP6:
    - List of Works and Deliverables (the output is created over the data of the building information model in the relevant SW).

- SP7:
    - Control of compliance of the Detailed Design, it is necessary to modify the information model of the construction due to changes to the construction before completion and to approve them, reporting of defects, etc.)

Question #17

I use the digital BIM information model for expert assessment (positioning on the plot, structural design, and similar).

- Not yet, but we're getting there.
- I can't answer that, but it's a goal. We haven't tested how well it works/doesn't work.

Question #18

Describe, if you can, the basic requirements on architects' work briefly if employing the BIM design method:

- The principle of design is no different, but BIM is a method of organizing and sharing information, i.e. the required structure and forms of outputs must be foreseen in advance, compliance with data standards.
- There is no need for the architect to use BIM when preparing the design/plan study. From the next stages of documentation Land Zone Permit Design, Building Permit Developed Design, Detailed Design must have an information manager + individual professions and their partners must work in a shared environment, which is a change for all and likewise the architect's work is transferred to the digital world from the "tracing paper".

Question #19

Describe the basic benefits of architects' use of the BIM design method briefly if you can:

- Significant facilitation of coordination of project work e.g. between professions, detection of clashes, checking compliance with parameters, easy preparation of reports, much avoidance of misunderstandings with the investor and contractors.
- None in the Concept Design. Additional stages = better coordinated project that does not contain so many errors. Better collaborative environment and information sharing for all involved.

Question #20

Describe the fundamental problems of architects' use of the BIM design method briefly if you can:

- There is a need to overcome the barrier of different approach, methodology, SW tools, communication and data transfer habits, and to be much more organized and consistent in all steps.
- Reluctance to work in a shared environment.

Question #21

Briefly comment on the use of the BIM method for the project development if you can:

- From the point of view of the client (I am not a designer). The BIM method of preparation forces the client to think much better about the requirements for the building in the parametric specification option, which significantly facilitates the design phase. At the same time it is then possible to verify compliance assignment much better. With the use of CDE it is then much easier to share, discuss, approve and generally access valid versions of the documentation, which is a great advantage.
- It is the future that is inevitable. For some it will be like going from drawing boards to AutoCAD. But otherwise it will provide better and more actual project information for everyone, which can then be used in building management instead of filing documentation in boxes after implementation and having the manager create a series of excel spreadsheets that don't share information with each other.

Annex C
Project Charts

Charts List:

1. Actions related to BIM acc. to CCAET Standards
2. Plans of Work Overview: Comparison of international plans of work
3. Principal Works Scope Split between Architect and Engineers
4. Principal Design Team Matrix / BIM Sub-models Types and Codes / Type of Authorization
5. The BIMo Scheme, The DiBM scheme
6. Project Organizational Scheme
7. Life-Long Cycle of Construction

Actions related to BIM

acc. to CCAET Standards

This document:

1. Specifies the content and scope of BIM activities during the entire design process.

2. Is based on Professional Performance Standards (PPS) of Czech Chamber of Authorized Engineers and Technicians Active in Construction (CCAET), compiled by Lucie Martínková in cooperation with Aleš Marek, Jaroslav Synek and Lukáš Vacík, published in 2021.

3. Is in relation with Service Phases of Performance Standards and Documentation, CCA, 2018.

Keyterms:

EIR	Exchange Information Requirements
BIMo	Building Information Model
DiBM	Digital Building Information Model
CDE	Common Data Environment
PaBDiM	Partial Building Digital Model
Ge/GrD	Geometric and Graphic Detail
NGI	Non-Graphic Information

Note:

1. geometric detail G and information detail I, including terminology and keys is part of the specific supplement compiled by a joint workgroup of The Czech Chamber of Authorized Engineers and Technicians (CCAET) and ČKA (The Chamber of Czech Architects (CCA)

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PROJECT STAGE PS 1 –

JOB PREPARATION (BP)

Standard actions

1. Specification of necessary BIM source documents:
    a. The evaluation of entry BIM data
    b. The analysis of the scope of requirements on BIM
    c. Obtain client's entry requirements:
        i. „BIM Protocol ", incl. supplements:
        ii. Client's requirements of data (EIR)
        iii. Requirements on the CDE (communication, incl. a CDE operation document template
        iv. Requirements on the BEP incl. a CDE operation document template
    d. Solving the CDE ISO 27000 security
    e. Mutual approval of the BIM Protocol
    f. Signing the BIM Protocol
2. Contract draft incl. BIM documents:
    a. Work Contract + BIM Protocol

PROJECT STAGE PS 2 –

DESIGN DOCUMENTATION / STUDY (DDS)

Standard actions

1. Analysis and updates of BIM source documents:
    a. evaluation
    b. analysis of the scope of the brief
2. BIMO setting up – start:
    a. The BEP concept preparation (according to the BEP template for the BIMO – DIBM phase and the project stage ‘study’
    b. The BEP concept approved by all involved parties
3. Establishing the DIBM:
    a. The DIBM organization and structure (for details – see BEP)
    b. The establishment of the installation „master-control model“ (a model with the context, landscape for positioning the building according to requirements set in BEP, positioning in S-JTSK GPS system)
    c. Construction:
        i. Establishing a partial DIBM architecture/construction and construction/structural sections
        ii. The preparation and development of namely:
        iii. The development of the „Conceptual (volumetric) model“– architecture-construction
        iv. The installation of the „Conceptual model“ into the „ control model “
    d. Building environment (MEP):
        i. No need to develop a partial DIBM
        ii. Specification of spatial requirements on mechanical plants and primary backbone services
4. DIBM Level of detail:
    a. G0: concept detail as specified in the BEP
    b. I0: minimal information details as specified in the BEP
5. Communication, data sharing (CDE):
    a. Establishing and launching of the CDE
6. End of the stage – BIM submission:
    a. BIMO the scope according to the Work Contract
    b. DIBM as per the BEP in a proprietary format
    c. BEP complete, updated, including supplements

Above-standard activities

Preparation of other partial DIBMs, etc.

PROJECT STAGE PS 3 –

PLANNING PERMISSION DOCUMENTATION (PPD)

Standard actions

1. Analysis and updates of BIM source documents:
    a. evaluation
    b. analysis of the scope of the brief
2. BIMO setting up – start:
3. The BEP concept preparation (according to the BEP template for BIMO – DIBM phase and the project stage 'DUR – planning documents')
4. The BEP concept approved by all involved parties
5. Establishing the DIBM
    a. DIBM organization and structure (for details – see BEP)
    b. Specification of the scope and goals for which the DIBM should be used; particularly for:
        i. Developing the elementary drawings according to Regulation No. 499/2006 Coll.
        ii. Basic spatial coordination
    c. Common architectural-construction and structural project:
        i. Updated scope:
            1. of the installation „control module "
            2. of the partial DIBM as the „Conceptual (mass) model"– architectural-construction section
6. Building environment (MEP)
    a. Partial DIBM is not needed
    b. The need to specify spatial requirements on mechanical plants and primary backbone services
7. DIBM Level of detail
    a. G0: concept detail as specified in the BEP
    b. I0: minimal information details as specified in the BEP
8. Communication, data sharing (CDE):
    a. Establishing and launching of the CDE
9. End of the stage – BIM submission:
    a. BIMO the scope according to the Work Contract
    b. DIBM as per the BEP in a proprietary format
    c. The BEP complete, updated, including supplements

Above-standard activities

1. The development of partial MEP DIBMs
    a. HVAC&R (design of backbone routes, installation of primary technology & equipment)
    b. Plumbing (design of backbone routes, installation of primary technology & equipment)
    c. Electricity (design of backbone routes, installation of primary technology & equipment)
2. The DIBM as a groundwork for establishing a preliminary cost estimation

PROJECT STAGE PS 4 –

PROJECT DOCUMENTACE FOR BUILDING PERMISSION OR PERMITTED DEVELOPMENT (DSP)

Standard actions

1. Analysis and updates of BIM source documents:
    a. evaluation
    b. analysis of the scope of the brief
2. Development of the BIMO:
    a. The BEP concept preparation (according to the BEP template for the BIMO – DIBM phase and the project stage ‘DSP – documents for building permission’
    b. The BEP concept approved by all involved parties
3. Establishing the DIBM:
    a. DIBM organization and structure (for details – see the BEP)
    b. Specification of the scope and goals for which the DIBM should be used; particularly for:
    c. Developing the elementary drawings according to Regulation No. 499/2006 Coll.
    d. Basic spatial coordination according to the scope set in the BEP
    e. Preparation of the „coordination model “
4. Architecture/construction
    a. updating:
        i. installing the „master-control model“(a model with the context, the landscape for positioning the building according to requirements set up in the BEP, positioning within the S-JTSK GPS)
        ii. the partial DIBM of the AST (architecture/construction section)
        iii. preparing a partial DIBM of the STA (architecture/construction section)
5. Building environment (MEP):
    a. The development of partial sections of the DIBM needed for spatial coordination; these are particularly: HVAC&R, Plumbing, HV and LV electricity, I&C, MAVS, water, or gas fire sprinklers
    b. The specification of spatial requirements on mechanical plants and primary backbone services
6. DIBM Level of detail:
    a. G2: concept detail as specified in the BEP
    b. I2: minimal information detail as specified in the BEP
7. Communication, data sharing (CDE)
    a. Data update, adding new participants
8. End of the stage – BIM submission:
    a. BIMO the scope according to the Work Contract
    b. DIBM as per the BEP in a proprietary format
    c. BEP complete, updated, including supplements

Above-standard activities

1. DIBM as a groundwork for establishing a Preliminary cost estimate and construction budget
2. The establishing of basic technical parameters of MEP technologies (machinery)

PROJECT STAGE PS 5 –

EXECUTION PROJECT DOCUMENTATION (EPD)

Standard actions

1. Analysis and updates of BIM source documents:
    a. evaluation
    b. analysis of the scope of the brief
2. Development of the BIMO:
    a. BEP concept preparation (according to the BEP template for BIMO – DIBM phase and the project stage ‘DPS – execution documents’
    b. BEP concept approved by all involved parties
3. Establishing the DIBM:
    a. DIBM organization and structure (for details – see the BEP
    b. Specification of the scope and goals for which the DIBM should be used; particularly for:
        i. developing the elementary drawings according to Regulation No. 499/2006 Coll.
        ii. detailed spatial coordination according to the scope set in the BEP
        iii. preparation of the DIBM as a groundwork for the BOQ
4. Architecture/construction
    a. Updating and complementing:
    b. The installation „master-control model “(a model with the context, the landscape for positioning the building according to requirements set up in the BEP, positioning within the S-JTSK GPS)
    c. the partial DIBM of the AST (architecture/construction section)
    d. preparing a partial DIBM of the STA (architecture/construction section)
    e. a „coordination model “
5. Building environment (MEP)
    a. Updating and complementing partial sections of the DIBM needed for spatial coordination; these are particularly: HVAC&R, Plumbing, HV and LV electricity, I&C, MAVS, water, or gas fire sprinklers
    b. Updating the specification of spatial requirements on mechanical plants and primary backbone services
6. DIBM Level of detail:
    a. G3: detail as specified in the BEP
    b. I3: minimal information detail as specified in the BEP
7. Communication, data sharing (CDE):
    a. Data update, adding new participants
8. End of the stage – BIM submission:
    a. BIMO the scope according to the Work Contract
    b. DIBM as per the BEP in a proprietary format
    c. BEP complete, updated, including supplements

Above-standard activities

1. Creation of models for construction realization: production and/or assembly
2. Verification special models

PROJECT STAGE PS 6 –
LIST OF WORKS AND DELIVERABLES (LWD)

Standard actions

1. Analysis and updates of BIM source documents:
    a. evaluation
    b. analysis of the scope of the brief
2. Development of the BIMO:
    a. specification of goals and the scope for which the DIBM is to be used
    b. the development of the BEP (according to the BEP template for SPD=List of Works and Deliverables)
    c. approval of the BEP concept by all involved parties
    d. BIMO - DIBM is used as
        i. A groundwork for compiling a detailed BOQ
        ii. A groundwork for compiling a specification and a list of works and deliverables
3. Establishing the DIBM:
    a. without any modifications, it remains within the scope of the DPS stage (execution)
4. DIBM LOD:
    a. ditto PS 5
5. Communication, data sharing (CDE):
    a. Data update, adding new participants
6. End of the stage – BIM submission
    a. BIMO the scope according to the Work Contract
    b. DIBM as per the BEP in a proprietary format
    c. BEP complete, updated, including supplements

Above-standard activities

1. Designers cooperating during the tendering stage in the field of BIM
2. Designers assist with using the BIMO and the DIBM to elaborate a quotation for the construction of the building)

PROJECT STAGE PS 7 –
ARCHITECT'S SUPERVISION DURING CONSTRUCTION (AS)

Standard actions

1. Analysis and updates of BIM source documents
2. BIMO:
   a. designers' cooperation with the Main Contractor in the preparation of the BIMO-DIBM and an updated the DIBM of the as-built documents
3. BEP:
   a. the development of the BEP (according to the BEP template for the AD stage (= architect's supervision))
   b. specification of goals and the scope for which the DIBM is to be used, especially:
   c. the specification of the scope and manner of cooperation and handing over alterations arising during construction compared to the issued execution documentation (DPS)
   d. the specification of the implementation of alterations belonging to the architects' supervision (AD) stage
   e. the solving of responsibilities and competencies
4. DIBM:
   a. the processing of modifications resulting from the AD stage in terms of geometry and graphic form (regarding the information it remains within the scope and LOD of the DPS stage)
   b. Alteration documents are issued – see the item above
   c. Basic drawings are published needed for the Final Inspection – the scope as per Regulation 499/2006 Coll.
   d. Handing over the DIBM, the specification of the format.
5. DIBM level of detail:
   a. G3, I3 (ditto the execution stage (DPS))
6. Communication, data sharing (CDE):
   a. Data update, adding new or removing old participants, and similar
7. Job handover:
   a. BIMO the scope according to the Work Contract
   b. DIBM the scope according to the BEP in a proprietary format
   c. BEP stage complete, updated, including supplements

Above-standard activities

1. Designers cooperating during construction – activities needed to keep the DIBM as an updated source document on the level of detail for the execution (DPS) for future use that do not belong into the AD stage
2. Especially the following issues remain to be solved:
   a. The scope of works needs to be specified
   b. The Time Plan delated to the DIBM
   c. Responsibilities and competencies
   d. Communication methods
   e. The method of handing over source documents from the Main Contractor to the DIBM's designer
   f. The method of linking documents developed during construction to the DIBM

Plans of Work Overview

Comparison of International Plans of Work

	Pre-Design		Design				Bidding	Construction	Handover	In Use	End of Life
RIBA	0	1	2		3	4		5	6	7	
(UK)	Strategic Definition	Preparation and Briefing	Concept Design		Spatial Coordination	Technical Design		Manufacturing and Construction	Handover	Use	
ACE	0	1	2.1	2.2	2.3	2.4		3		4	5
(Europe)	Initiative	Initiation	Concept Design	Preliminary Design	Developed Design	Detailed Design		Construction		Building Use	End of Life
AIA	0		1		2	3	4	5			
(USA)	Pre-Design		Schematic Design		Design Development	Construction Documents	Bidding	Construction Administration			
APM	0	1	2		3	4		5	6	7	
(Global)	Strategy	Outcome Definition	Feasibility		Concept Design	Detailed Design		Delivery	Project Close	Benefits Realization	
CCA	0	1	2	3	4	5	6	7			
(CR)	Project Groundwork	Project Initiation	Preliminary – Concept Design	Land Zone Permit Design	Building Permit Developed Design	Detailed Design	List of Works and Deliverables	Architect's Supervision			
AED	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*			
(CR)	*Pre-project Preparation*	*Project Analysis / Preparation*	*Architectural Study*	*Planning Permit Document*	*Building Permit Document*	*Execution Drawings*	*Tender Document*	*Architectural Supervision*			

https://www.architecture.com/-/media/GatherContent/Test-resources-page/Additional-Documents/2020RIBAPlanofWorkoverviewpdf.pdf

Principal Works Scope Split between Architect and Engineers

A. General Works Scope Split

- **„Design Architect "(DA)** will provide all necessary activities:
    - to develop general architectural design according to client's instructions
    - elaborate all necessary drawings for all design stages, incl. interior design of public spaces
    - ensure architectural supervision and approvals of relevant drawings for all design stages
    - ensure general architectural supervision during construction, incl. Snag List preparation
    - attend design / client's meetings
    - Interior Design (ID) according to required design information in Service Phases (SP), i.e., finishing, Mechanical Electrical Plumbing (MEP) fixtures, furnish ability by furniture etc.
    - principal „Landscape Design "(LD) according to required design information of Service Phases (SP), i.e., relationship of the building to the surrounding terrain, terrain shaping, surface specifications, MEP equipment requirements, landscape architecture specification etc.

- **„Local Engineer "(LE)** will provide all necessary activities to develop detail design according to:
    - DA general design
    - client's instructions

  and will:
    - elaborate all necessary project documents
    - negotiate project with municipality bodies to obtain all necessary permits
    - prepare all documents for bidding and signing contract with contractor,
    - prepare all necessary documentation for the realization of the project – construction, excluding the workshop drawings
    - ensure detail architectural and technical design supervision during construction
    - support client to obtain occupancy permit in the end
    - ID technical support
        - in compliance with:
            - Czech Construction Code and related
            - Czech / Prague Technical Code
            - Czech Architects / Engineers Fee Scale

B. Detail Works Scope Split Specification by Design Stages / Service Phases (SP)

SP 1 AN - Project Analysis / Preparation Phase

- DA activities:
    - consultations (meetings, e-mails, conference calls)
- LE activities:
    - LE will hand-over to DA all relevant information (documents, drawings, texts, surveys etc.)
    - consult with DA
    - attend client meetings
    - organise design team meetings
- final product:
    - Architectural / Engineering Design Contract, incl. Responsibility Matrix

SP 2 AS - Preliminary Design / Architectural Study

- DA activities:
    - concept design development in coordination with LE
    - client's and LE comments implementation
    - hand-over of final version of architectural study digitally, incl. all necessary renderings
    - consultations (e-mails, conference calls) and workshops
- LE activities:
    - definition of construction program
    - specification of missing surveys
    - negotiate with all necessary authorities
    - structural drawings schematic drawings make
    - MEP layouts / operating schematic drawings make
    - transport schematic drawings make
    - technical Client's Brief elaboration
    - approval of architectural study
    - consult and inform DA
    - attend client meetings
    - organise design team meetings / consultations
- final product:
    - Architectural Study, incl. Client's Brief

SP 3 PP - Planning Permit Document

DA activities:

- update (if necessary) and hand-over final version of architectural study digitally (AutoCAD, Revit, Archicad, Ms Office etc.), document update will be based on client's and LE comments and will be sufficient for planning permit document make; study will include all necessary renderings
- architectural study updates according municipality bodies requirements (LE will provide additional information on these requirements)
- consultations (e-mails, conference calls) and workshop
- planning permit drawings approval

- LE activities:
  - analysis of all known information and specification of missing / outstanding points
  - establish the design principles in cooperation with all members of the design team in accordance with client's requests
  - co-ordination among all disciplines / consultants
  - make of a planning permit (PP) document based on architect's drawings and Client's Brief document
  - underwrite the PP documentation in accordance with Czech laws
  - the PP document will face all Czech codes, laws, and other regulations valid on site
  - the PP document will be issued bilingually, Czech and English. Czech version will be legally valid
  - submit BP doc to all authorities to obtain necessary statements and/or rulings
  - implement all necessary conditions which will appear in Planning Permit procedure into the final version of PP document
  - submit final version of PP doc to the Construction Dept. to obtain Planning Permit
  - LE will co-ordinate the whole PP process to obtain PP.
  - attend client meetings
  - organise design team and permit team meetings
- final product:
  - PP documentation
  - PP ruling

SP 4 BP - Building Permit Document

DA activities:

- update (if necessary) and hand-over final version of architectural drawings digitally (AutoCAD, Revit, Archicad, Ms Office etc.), document update will be based on client's and LE comments and will be sufficient for building permit document make; study will include all necessary renderings
- architectural drawings update according to municipality bodies requirements
- consultations (e-mails, conference calls) and workshop
- building permit drawings approval

- LE activities:
  - analysis of all known information and specification of missing / outstanding points
  - establish the design principles in cooperation with all members of the design team in accordance with client's requests
  - co-ordination among all disciplines / consultants
  - make of a building permit document (BP) based on architect's drawings and Client's Brief document
  - underwrite the BP documentation in accordance with Czech laws
  - the BP document will face all Czech codes, laws and other regulations valid on site
  - the BP document will be issued in Czech with English summary
  - submit BP doc to all authorities to obtain necessary statements and/or rulings
  - implement all necessary conditions which will appear in Building Permit procedure into the final version of BP document
  - submit final version of BP doc to the Construction Dept. to obtain Building Permit
  - LE will co-ordinate the whole BP process procedure to obtain BP.
  - attend client meetings
  - organise design team and permit team meetings
- final product:
  - BP documentation
  - BP ruling

SP 5 ED - Execution Drawings

- DA activities:
  - update (if necessary) and hand-over final version of architectural drawings digitally, (AutoCAD, Revit, Ms Office), document update will be based on client's and LE comments and will be sufficient for execution drawings make; architectural drawings will include all necessary architectural details to fully understand materials and shaping
  - consultations (e-mails, conference calls) and workshop
  - execution drawings approval
- LE activities:
  - Execution drawings Document will be based on final version of BP document and will give clear requirements to the quality and characteristic attributes of the building, i.e., drawings at scale 1/50 to 1/1 and all necessary schedules
  - LE will update all design principles in co-operation with all members of the design team in accordance with valid building permit and client's requests
  - LE will co-ordinate among all disciplines / consultants
  - attend client meetings and construction progress meetings
  - organise design team and permit team meetings
- final product:
  - Execution Drawings

SP 6 TD - Tender Document

- DA activities:
    - update (if necessary) and hand-over final version of architectural drawings digitally, (AutoCAD, Revit, Ms Office etc.),
    - consultations (e-mails, conference calls) and workshops
    - tender drawings approval
    - information flow during the bidding procedure
    - consultations (e-mails, conference calls) and workshop
- LE activities:
    - LE will prepare concept of this document and will hand it over to client and/or project management for approval
    - Tender Document make; Doc will be based on final version of BP and/or Execution Drawings made by this time
    - LE will co-ordinate among all disciplines / consultants
    - LE will organize / co-ordinate and complete all necessary bidding packages
    - quantity surveyor will make bill of quantities make, incl pricing
    - attend client meetings
    - organise design team and permit team meetings
    - support client to obtain best price
    - LE will attend meetings with potential contractors / subcontractors
- final product:
    - Tender drawings packages
    - Tender Text
    - Bill of Quantities, excl. Pricing

SF 7 AR – Architectural Supervision / Construction Period and Completion

- DA activities:
    - architect's site visits
    - consultations (e-mails, conference calls) and workshops
    - approval of important works regarding design
    - architect 's punch list elaboration
- LE activities:
    - support project manager activities and site inspector activities
    - support site quantity surveyor activities
    - general architectural and MEP installation make supervision
    - attend site progress meetings / weekly
    - attend contractor / subcontractor meetings / weekly
    - providing necessary explanations for contractor
    - general approvals of production / workshop documentation
    - providing statements on the contractor's requirements concerning changes
    - support client during

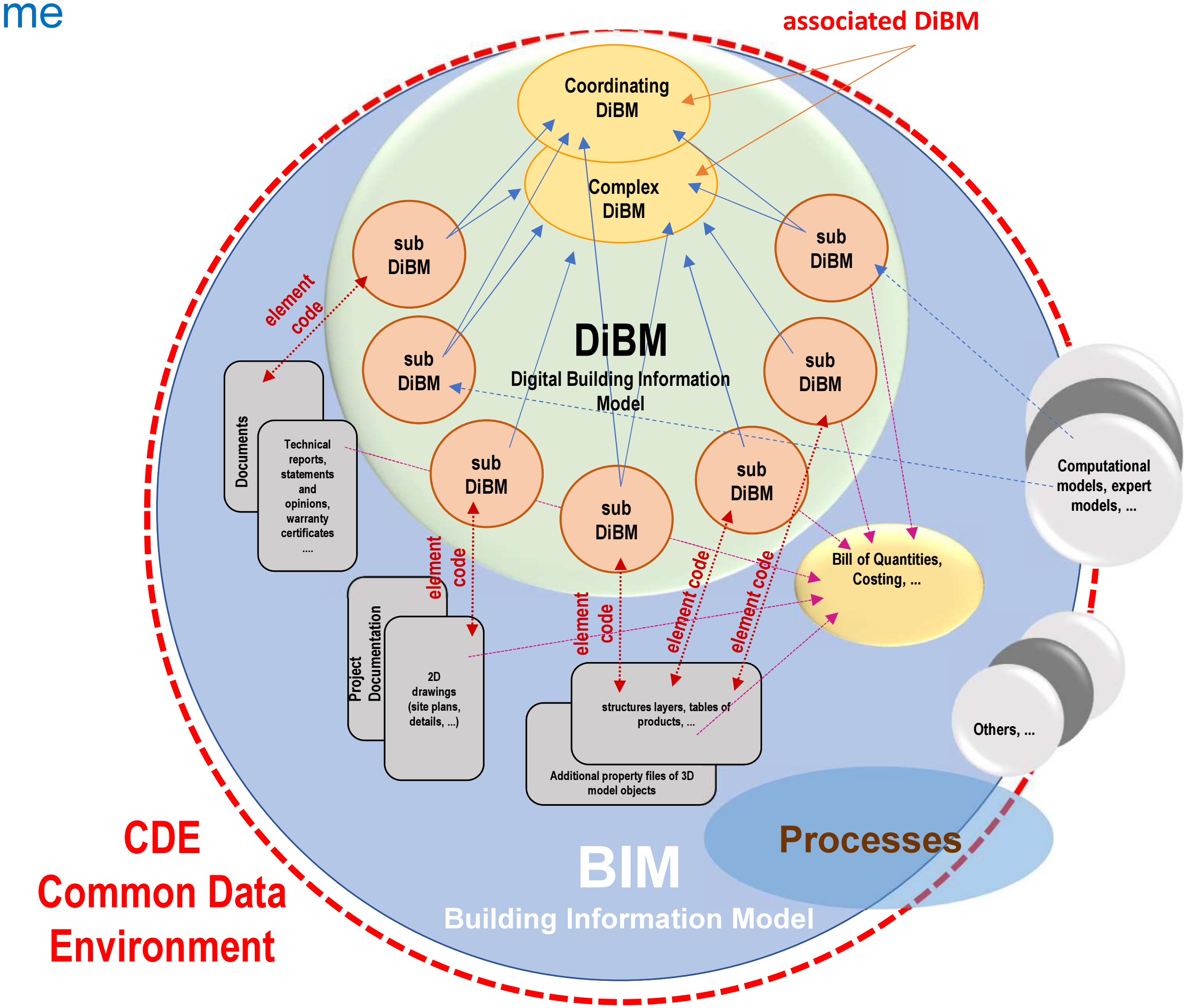
        - building complex testing
        - building hand-over procedure
        - commissioning procedure
        - practical completion
    - final Snag list preparation
    - confirming that the defects have been executed to the satisfaction of the Architect
    - co-operate with contractor to elaborate As-Built Drawings
    - supporting preparation of documents for Permit of Use (occupancy permit)
- <u>final product:</u>
    - Permit-of-Use Approval

Principal Design Team Matrix / BIM Sub-models Types and Codes / Type of Authorization

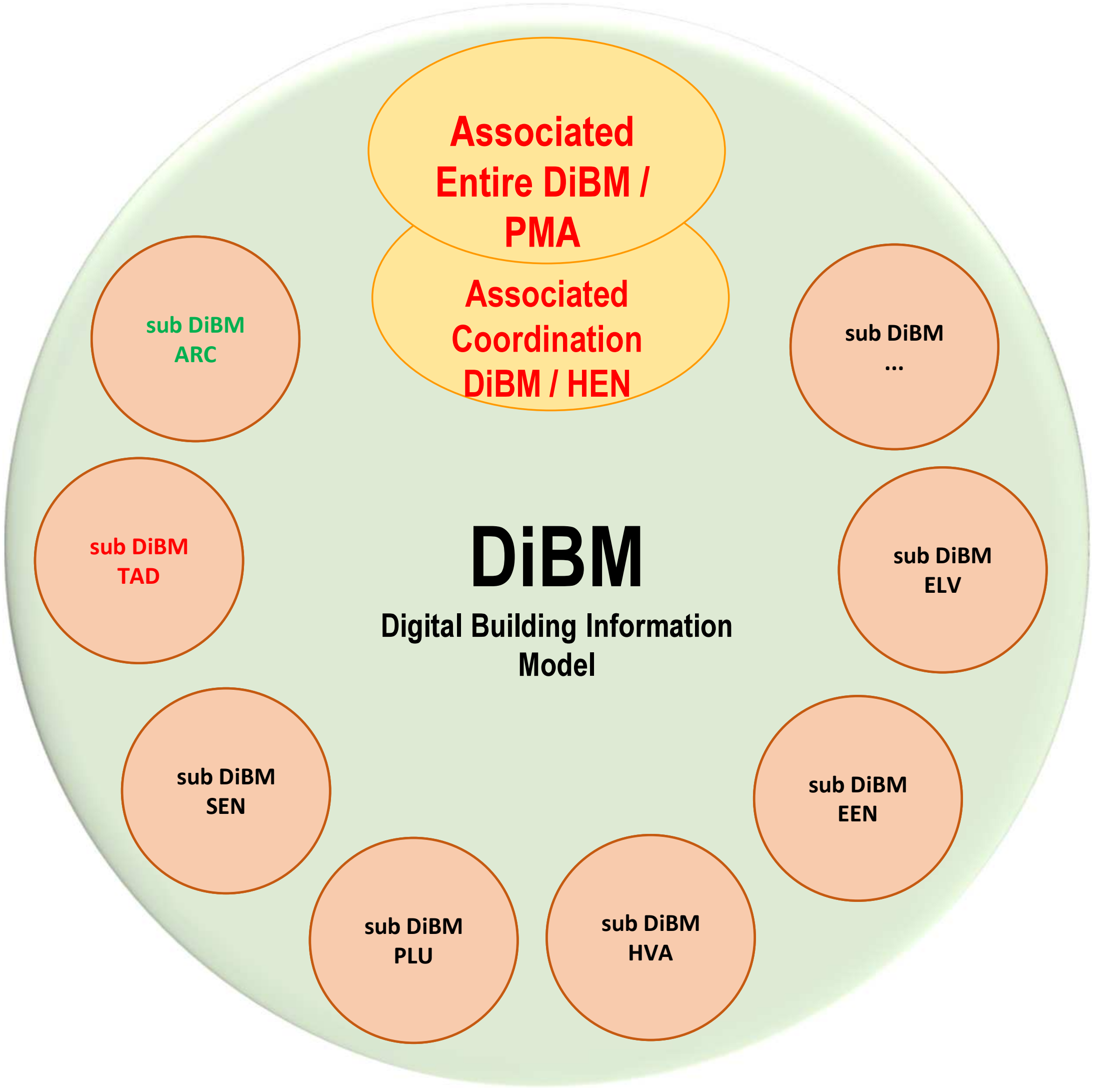
it.	*Discipline code*	*Drawings / BIM model type*	*DiBM Sub-model code*	*Requested type of authorizatio*	*Discipline specification*
0.	**PER**	**BIMo**			**Permitting**
1.	**ARC**	**DiBM**	**ARC**	**AA**	**Architect (building and landscape (initial) design)**
2.	**PMA**				**Project Management / Head Engineer / BIM Manager**
2.1	PMA	BIMo	PMA		Project Management / Administration
2.2	HEN	BIMo	HEN	EA	Head Engineer / Spatial Coordination
2.3	BIM	DiBM	BIM		BIM Manager / Coordinator
3.					**Consultants**
3.1	EIA	CAD			EIA / encl. 3 and 4
3.2	FEN	DiBM / CAD	FEN	EA	Fire Engineering
3.3	LAS				Life & Safety
3.4	ACU	DiBM / CAD	ACU	EA	Acoustics / Vibrations Engineering
3.5	ESM	DiBM / CAD	ESM	EA	Energy Simulations and Modelling
3.6	DLI	DiBM / CAD	DLI		Day Lighting / Insolation
3.7	GTI	DiBM / CAD	GTI	EA	Geotechnical Investigation / Interpretation
3.8	BPI	DiBM / CAD	BPI	EA	Building Physics / Waterproof / Thermal Isolations
3.9	FEN	DiBM / CAD	FEN	EA	Facade Engineering
3.10	LEB	CAD	LEB		LEED / BREEAM
3.11	QSQ		QSQ		Cost Planning / Bill of Quantity
3.12					Other Consultants (Undergound etc.)
4.	**TAD**	**DiBM**	**TAD**	**EA**	**Technical Architectural Dwgs (incl. BIM model)**
5.	**SEN**	**DiBM**	**SEN**	**EA**	**Structural Engineering / Piles / Pit Excavation**
6.	**PLU**	**DiBM**	**PLU**	**EA**	**Plumbing (sewerage, water distribution, gas distribution)**
7.	**HVA**	**DiBM**	**HVA**	**EA**	**HVAC**
8.	**EEN**	**DiBM**	**EEN**		**Electrical Engineering / Grounding / Lightning / Stray Currents**
9.	**ELV**	**DiBM**	**ELV**		**Extra Low-Voltage / IT / AV / Security (burglar alarm, CCTV, ACS, PA)**
10.	**BMS**	**DiBM / CAD**	**BMS**		**BMS**
11.	**IST**	**CAD**			**Infrastructure**
11.1	RTR			EA	Roads / Traffic
11.2	UTI			EA	Utilities (diversions, connection lines, areal lines)
12.	**LAN**	**CAD**		**AA**	**Landscape**
12.	**CIV**	**DiBM / CAD**		**EA**	**Civil Engineering Constructions**
13.	**SPA**				**Special Packages**
13.1	LVT	DiBM / CAD	LVT		Lifts / Vertical Transportation
13.2	WMA	CAD			Waste Management
13.3	IRR	DiBM / CAD		EA	Irrigation
13.4	SPR	DiBM / CAD		EA	Sprinklers
13.5	ESE	DiBM / CAD		EA	Fire Heat / Smoke Exhaust
13.6	ISI	CAD			Information Signage
13.7	KEQ	DiBM / CAD			Kitchen Equipment
13.8	INT	DiBM / CAD			Interior
13.9					Other Consultants (if necessary)
14.	**SLO**	**CAD**			**Site Logistics**

subject note	*abbreviation*	*description*
Project documentation:		scope and content according to Decree 499/2006, related Annexes
		documentation sections according to Decree 499/2006, related Annexes
BIM:		sub-models division according to documentation sections
		data standards of sub-models according to Decree 499/2006, related Annexes
	BIMo	Building Information Model
	DiBM	Digital Building Information Model
		data standards specified in DSB, published by CAS
	DSB	data standard for buildings
	CAS	Czech Agency for Standardization
		updated details in BEP for each design phase
Authorization:	AA	authorised architect, specialisation / field, according to the Authorisation Act
	AE	authorised engineer, specialisation / field, according to the Authorisation Act

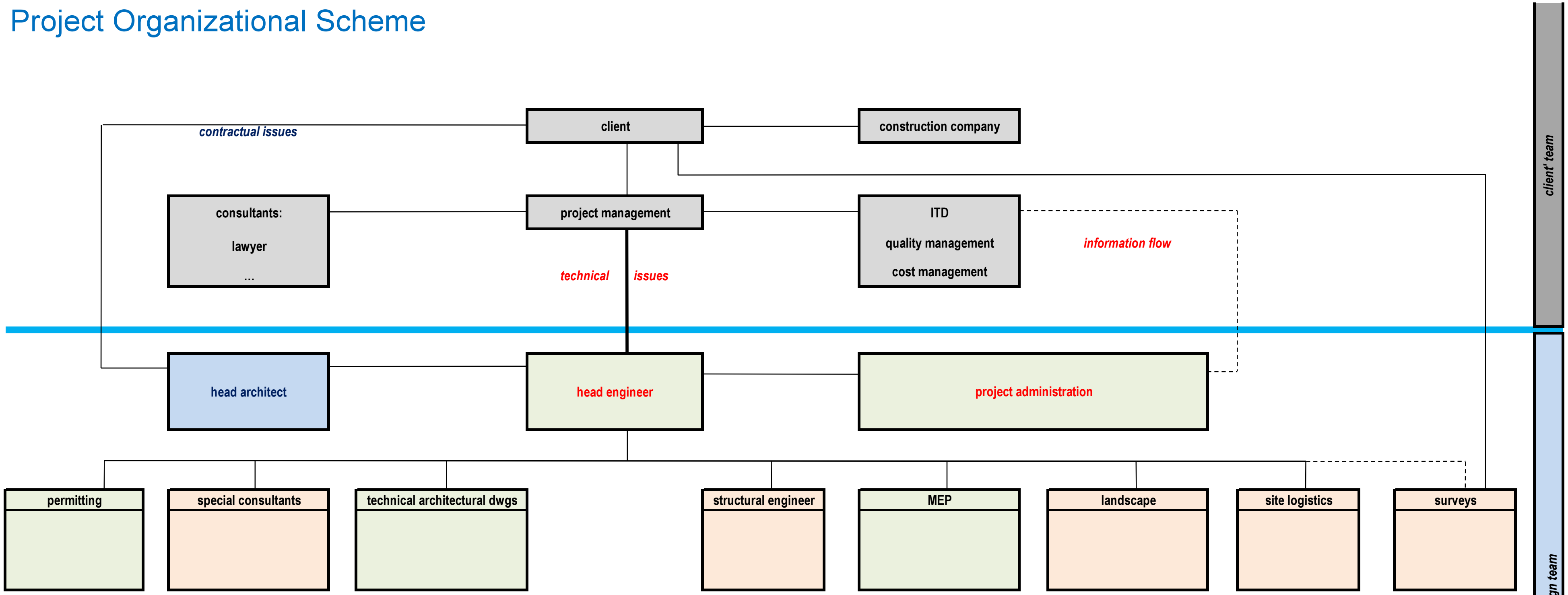
The BIMo Scheme



The DiBM Scheme



Project Organizational Scheme



LEGEND

client's team		
design team	head architect	
	head engineer	
	technical design team	
	in house consultants	
	consultants / sub-contracted	
	surveys / subcontract	organized by head enginner (extras)

Life-Long Cycle of Construction

Construction Project Life Stages

		Construction Project Life Stages	Service Phases acc. to CCA / CCAET	Decree 499 / 2006 Coll.	Service Phases Description	Target Exploitable Product / Outcome of Lifelong Cycle Phase	BIM Outcome	form of BIM activities	Elaboration
1.	1.	**Pre-Design**	-	-	Strategic Definition	Outcome definition	-	-	Builder
	2.		-	-	Project Groundwork	Investment intention	Model of the existing state of the building	DiBM	Builder
	3.		SP 1	-	Project Initiation	Contract for work	Pre - feasibility model	BIM Protocol	Builder / Designer
2.	1.	**Design**	SP 2	-	Preliminary – Concept Design	Building design	Project information model	BIMo, DiBM, CDE, BEP	Designer
	2.		SP 3	Annex no.1	Land Zone Permit Design	Decision of the building placement	Project information model	BIMo, DiBM, CDE, BEP	Designer
	3.		SP 4	Annex no.12	Building Permit Developed Design	Issuance of a building permit	Project information model	BIMo, DiBM, CDE, BEP	Designer
	4.		SP 5	Annex no.13	Detailed Design	Issue of project documentation	Project information model	BIMo, DiBM, CDE, BEP	Designer
	5.		SP 6	-	List of Works and Deliverables	Issue of project documentation	Project information model	BIMo, DiBM, CDE, BEP	Designer
3.	1.	**Construction**	SP 7	-	Architect's Supervision	Construction handover protocol	Electronic construction diary	-	Contractor
	2.		-	-	Contractor's documentation	Issue of project documentation	Contractor's information model	BIMo, DiBM, CDE, BEP	Contractor
	3.		-	Annex no.14	As Built Documentation of Constructio	Issuance of approval for building use	Information model for approval		Contractor
4.	1.	**In Use**	-	-	As Built Documentation of Constructio	Documentation for reconstruction and/or modernisation of the building	Information model for reconstruction and/or modernisation	BIMo, DiBM, CDE, BEP	Contractor / Owne
	2.		-	-	As Built Documentation of Constructio	Documentation for facility management	Information model for facility management	BIMo, DiBM, CDE, BEP	Contractor / Owne
	3.			-	As Built Documentation of Constructio	Documentation for facility operation	Information model for facility operation	BIMo, DiBM, CDE, BEP	Contractor / Owne
5.	1.	**End of Life**	-	Annex no.15	Documentation of Demolition Works	Removal of the Building	Information model for building removal	BIMo, DiBM, CDE, BEP	Owner
	2.		-	-	Documentation for Building Use	Use of building elements / materials for another building construction	Information model for building reuse	BIMo, DiBM, CDE, BEP	Owner

Keyterms:

BIM Protocol	Annex to the Contract for work
BIMo	Building Information Model
DiBM	Digital Building Information Model
CDE	Common Data Environment

Annex D
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