LAB University of Applied Sciences

Benchmarking research work on the development state of BIM in The Netherlands

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Abstract

As the world evolves, so do the new technologies.

People have come up with different ways to make our life easier and our work.

BIM is one of the tools used in this generation that helps many construction companies and builders improve the quality of their work and simplify file exchange between different countries.

The task will be to benchmark the evolution and the current state of BIM in the Netherlands specifically.

This research was carried out in collaboration with BIM ICE (BIM-Integration of Higher and Continuing Education) which is co-funded by the European Union and LAB University of Applied Sciences.

This paper aims to determine the use of BIM in the Netherlands.

The method of search to obtain effective results will be by examining different sources, websites, and articles on the matter as well as regrouping results from a questionnaire survey, also on the matter.

This paper demonstrates that the Netherlands has got all the tools to use BIM and implement it in all the sectors of construction but is yet to do so because the professionals involved with the use of BIM are reluctant to use the BIM tools due to the lack of personnel with the necessary competencies, and the resistance to adopting innovative solutions among employees.

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Appendix 1. Survey contact letter

List of terms

BIM   Building Information modeling.

bSDD   buildingSMART Data Dictionary.

CityGML   An open standardized data model and exchange format to store digital 3D models of cities and landscapes. (BIM Loket.)

IFC   Industry Foundation Classes is an openBIM standard for data exchange, an object-based file format, intended to describe building and construction industry data. (BIM Loket.)

IFD   International Framework for Dictionaries.

mvdXML   A format that defines allowable values at attributes of data types.

1   Introduction

There have been several developments in Europe to this very date, different countries in Europe used to have different standards with different Computed Aided Design (CAD) software, tools and norms moreover in different languages across Europe, which had made it difficult and time-consuming to exchange designs between countries. For years companies and engineers relied on CAD-Solutions while doing their projects and work, however they have found it to be inefficient in handling major projects and in collaborating with a team of experts. This has led to the introduction of Building Information modeling (BIM) solution. BIM is an upgraded CAD solution that has now been widely adopted by many countries around the world.

The need for BIM in modeling today cannot be over-emphasized. Its application cut across Architecture, Building engineering; Road engineering; City modeling and more.

The goal of this paper is to evaluate different developments in BIM technology using the Netherlands as a case study. The history of BIM in the Netherlands, and the implementation of BIM to this day will be discussed. Different norms and standards will be reviewed. The various software used in the Netherlands will be presented.

2   Literature review

2.1   What is BIM?

There are many definitions for BIM. Some of the most notable definitions are:

1. Building Information Model: A digital model, for example, a building that consists of objects to which information is linked.

2. Building Information Management: Centralizing information during the entire life cycle of a building, to be able to use and share it.

3. Building Information Modeling: Focusing on the process of collaboration and information sharing.

    (buildingSMART.)

BIM, therefore, means that a virtual building is modeled with a computer, in which all information is included that is necessary for the construction process. The model is the basic source from which all documentation is created. (MagiCAD, 2009.)

The more people work with BIM in different areas, the various the definitions and meanings can and will be.

The most important aspect of BIM is therefore that a digital model or drawing not only consists of lines but also makes underlying information available to easily share with other parties in the building process. (MagiCAD, 2009.)

2.2   History of BIM in the Netherlands

In recent times people in the Netherlands have been trying to implement BIM in all the sectors of construction, and some schools have added BIM programs.

The idea of BIM cannot be attributed to one person, but rather to many different organizations and countries that throughout the years have made successful prowess in the sector of BIM. (LETSBUILD,2017.)

The BIM concept took shape in the 1970s and was originally called the Building Description System (BDS); The term "building model" first appeared in 1985 in a paper on architectural design and more specifically computer-aided drawing and computer-aided design. (LETSBUILD,2017.)

In 1992, the term "building information model" was first used in a paper on automation in construction (van Nederveen et al., 1992). Still, it took another 10 years before the terms

building information modeling and building information model (and the abbreviation BIM) were in common use. In 2002, Autodesk published a paper titled "Building Information Modeling". (LETSBUILD,2017.) (Figure1)
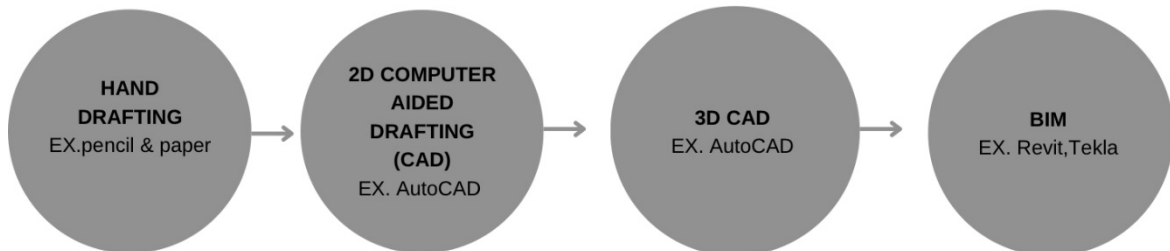

Figure 1 BIM evolution

According to van Nederveen (2009, 31), a Dutch article, the beginning of BIM in the Netherland goes back to 20-30 years ago, but it was mostly studied, and research related in the early 1980s, BIM was known in the United States as Building Product Models and in Europe, especially Finland, as Product Information Models. In both cases, the term 'product' was used to distinguish the model from 'process' models. The concept of BIM as known today just started in the early 1980s in an article by Robert Aish, an architect, working at the time for an architectural bureau where he discusses how BIM could be utilized, but that was just a small start to what happened a few years later in the late 1980s: Dwg files were shared instead of the regular drawings. The evolution continued with the introduction of object-oriented Computer Aided Design (CAD) in the early 1990s in which non-graphical information is linked to drawings.

A lot of software was used throughout the years (Figure 2).
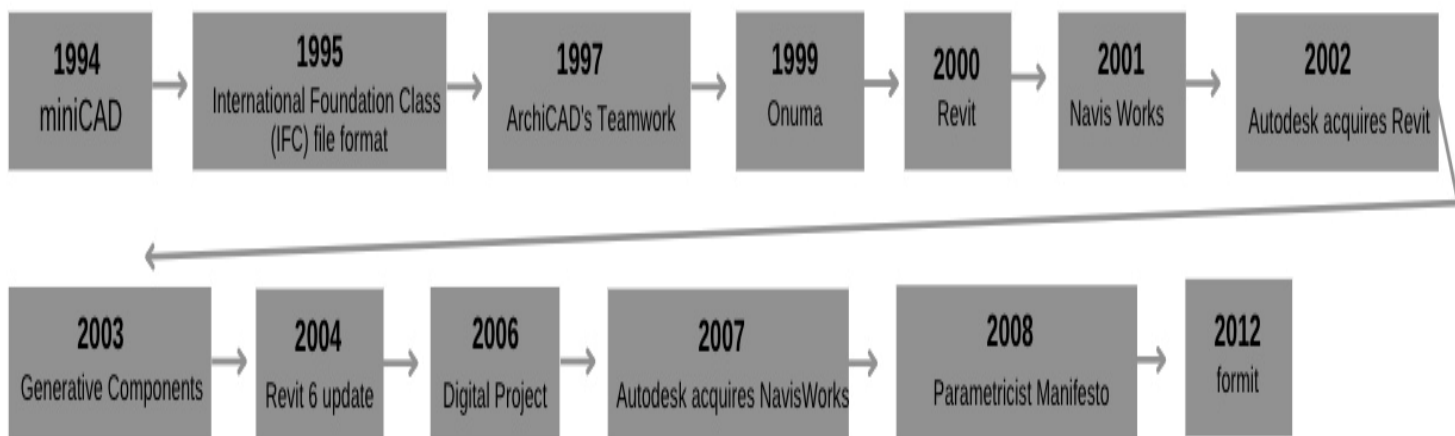
Figure 2 Map of how BIM has evolved software wise in the Netherlands.

3   Method of Search

To effectively survey the use of BIM in the Netherlands, different sources will be used.

The work will be based on:

1. Analyzing different surveys on BIM in the Netherlands.

2. Analyzing different official websites concerning BIM in the Netherlands.

3. Sending a survey questionnaire to different people working or having something in their work that involves the use of BIM e.g., University teachers, Engineers, Architects, and others.

4 Current situation of BIM in the Netherlands

The term BIM is now well integrated into the Dutch construction sector, would that mean that the Netherlands is moving towards a new development?

At first, BIM was mainly about 3D modeling, and later came the integration of all kinds of data sources. The Netherlands went from Building Information Model to Building Information Management. They are now at a tipping point in terms of digitization, companies must go along in order not to fall behind. (Nederveen, 2009.)

4.1 Benefits of using BIM in the Netherlands

BIM has simplified project developments procedures in the Netherlands today.

With BIM civil engineers and architects can work more clearly and efficiently. This makes the construction process more economical and faster.

Some the advantages of BIM in the Netherlands are:

1. Fewer design and construction errors during modeling.

2. Fewer failure costs.

3. Better cooperation with the other companies in the construction chain.

4. Faster data exchange.

5. Present visualizations at an early stage. (MagiCAD,2009.)

Thanks to the open standards and the sharing of relevant information, using BIM software is therefore not only an advantage for architects, but for the entire construction chain.

4.2 BIM software used In the Netherlands

A variety of BIM software is available today and used in many continents. However, the Netherlands and the rest of Europe use the same BIM software for executing projects.

Some of this software are:

1. Autodesk Revit.

2. ReCap.

3. Navisworks Manage.

4. BIM 360.

5. Autodesk Robot.

(Rijkswaterstaat, 2016.)

4.3   BIM developments

Over the years there has been some remarkable developments in the application of BIM

These developments have been pioneered by several projects such as Open BIM, Building smart, the COINS project, BIM Loket, Quick scan.

4.3.1   Open BIM

Open BIM is a unique opportunity to combine projects and different representations of buildings into a consistent model; a technology that allows design participants to interact, regardless of the tool used. Unlike CLOSED (or "proprietary") BIM, the OPEN BIM strategy provides the following benefits:

- The project managers can use an individual set of tools, which consists of the best solutions in their field and most optimally solves the set of project tasks.

- Project managers have full control over the components of the project, including updates to independent software.

It may sound redundant to talk about Open BIM when it comes to sharing and exchanging files between users. But Open BIM uses a set of solutions to reduce the risk of data loss, unlike working with a single BIM model (which combines several specialties but stores it in one file). (buildingSMART.)

As a result, designers get an understandable BIM built on open standards, which allows the use of data throughout the entire life cycle of a building: from construction to renovation or demolition.

In the Netherlands, BIM is not only about modeling it is also, and more importantly about information management. (Rijkswaterstaat, 2016.)

The Netherlands has been using Open Standards, they have developed the Dutch Information exchange standards in the Netherlands which have already been in practice in the country. When it comes to requirements for buildings, BIR (Building Information Counsel) is the structure that provided Information and requirements for the share of data.

Dutch people use their analogy of the buildingSMART Dictionary when it comes to requirements for a data structure such as CB-NL standards, which turn out to be a major development made by the Dutch and that provide clear requirements. (buildingSMART.)

The Dutch General Directorate for public Works and water management (Rijkswaterstaat), the organization responsible for managing and maintaining infrastructural facilities in the Netherlands has been encouraging steps taken towards the use of Open BIM on all projects in Europe due to its advantages which includes:

Open BIM brings many advantages, for example:

1. Software-independent collaboration.

2. Include all good applications.

3. All parties are included.

4. Connect different software.

5. Being able to offer a BIM 'as built' as open standards.

 (Cobuilder.2017.)

4.3.2 BuildingSMART

BuildingSMART can be understood as the global industry association that drives the digital transformation of the construction industry. buildingSMART strives for improvement by creating and applying open, international standards and solutions for infrastructure and buildings. buildingSMART is an organization of and for visionaries working on the transformation of the design, construction, operation, and maintenance of the built environment. buildingSMART is an open, neutral, and international not-for-profit organization. (buildingSMART.)

The chapter of buildingSMART that is predominant and used In the Netherlands is the buildingSMART Benelux (Belgium, Netherlands, and Luxemburg) represents three countries.

BuildingSMART Benelux organizes different webinars on buildingSMART IFC for the INFRA, which is a developing topic currently. The Dutch have been working a lot to be able to use open standards, Dutch came up with IfcRail, IfcRoad, and IfcBridges. (builsingSmart.)

Within the international buildingSMART community, an Infra Room has been established from which stakeholders from all over the world come together and work on the

development of open standards. The different rooms come together at least twice a year at a buildingSMART International Standards Summit, nowadays virtually. (builsingSmart.)

Building SMART has also been active in the Netherlands when it comes to open standards and sharing data.

4.3.3 The COINS project

The development for this phase is COINS (Constructive Objects and the Integration of Processes and Systems). This is one of the standards used in the Netherlands which started a few years ago, in 2003 to be more precise by a group of different entities working in BIM at the time the entities involved engineering companies, public principals, universities, research programs, software companies and so on. (BIM Loket, 2018)

COINS supports the exchange of digital information between different IT platforms and environments of parties involved in construction projects. The standard ensures that different types of information can be stored in one database, such as functions, requirement and object trees, GIS data, 2D drawings, 3D models, IFC models, and object type library. (BIM Loket, 2018.)

COINS complements standards published by buildingSMART such as IFC, IFD Library, and IDM. The core is formed by a neutral, software-independent data model, from which data can be sent in a neutral format and 'translated' into the software of various project partners. This means that the standard has a major influence on BIM processes. (BIM Loket, 2018.)

The main difference between these standards and different others when dealing with 3D design and any BIM data needed for a specific project is the communication content among participants which is the focus when it comes to COINS while others focus on the communication process.

COINS is built with two major parts, CEM and CBIM which stands for the COINS Building Information Model and The COINS Engineering Method, respectively.

The COINS Engineering Method or CEM is the COINS part that contains descriptions and definitions of different development that have been taking place in the field of BIM in the Netherlands whereas the COINS Building Information Model (CBIM) is the part of COINS that intervenes when it comes to the building Information model, the data of the object. In other words, COINS is CEM+CBIM. (BIM Loket, 2018.)

This open standard allows you to store different types of information together in one database. From job requirements to object types, this includes information such as functions, requirement and object trees, GIS data, 2D drawings, 3D models, IFC models, and object type library. The starting point for the exchange of data is a software-independent data model, this means that you can send data in a neutral format and 'translate' it to the software of different project partners. COINS 2.0 has made way for the international standard ISO 21597, Information Container for Data Delivery (ICDD), and the NTA 8035 (Dutch Technical Agreement). Nevertheless, COINS 2.0 is still used in various places in the Netherlands. For example, if an organization has set up software and has designed an Object Type Library with COINS 2.0 as a basis, or in ongoing projects that still work with this standard. COINS 2.0 regulates the exchange of digital building information via so-called 'information containers': clients and contractors share documents, datasets, and associated meta-information in structured zip files, via one independent model. (BIM Loket, 2018.)

4.3.4 BIM Loket

For years the Netherlands has been keen on implementing and utilizing Open standards in their projects, however for this to happen they quickly understood that they needed a gateway that would centralize everything and would be accessible to use.

In 2014 a group of Non-profit organizations set up a study in the Netherlands to figure out the best way to ensure and implement open standards in the Netherlands.

The Idea of making a gateway was the direct result of the study, which ultimately resulted in setting up a foundation that had the role of managing the specification for an OpenBIM gateway. The foundation worked for a year and by the end of 2015, they decided to start and launch the gateway BIM Loket, in other words, BIM Loket is essentially the gateway when it comes to BIM in the Netherland which results from the study made and a desire to implement OPENBIM standards. (BIM Loket.2016)

The BIM Loket was when launched intended to provide and be the Netherlands national source when it comes to BIM requirements, standards, and guidelines.

It was to encourage BIM use and be that national Source that it is today for millions of users throughout the Netherlands.

Making this gateway turned out to be an amazing idea since it helped to reduce the time consumption, meaning that all standards would be found in one unified and comprehensible system.

BIM loket also ensures that all the BIM standards are being followed.

This is possible, thanks to the Dutch Building Information Council which has been yearly for the past 20 years encouraging the implementation and the competitiveness in the sector of BIM. (BIM Loket.2018.)

4.3.5 Quickscan

Quickscan is a tool used in the Netherlands that allows measuring the BIM level of an organization, it provides a picture of the level of BIM, it is a list of multiple questions divided into four chapters:

- Strategy and policy.

- Organization and culture.

- Information flow and process.

- IT tools.

The Dutch sector of BIM uses QuickScan which provides them with insight into BIM, the BIM level of a structure, and possible points for improvement.

Contrary to perceived Ideas QuickScan

1. is not a software device.

2. Does not determine how rich a BIM model is.

3. Does not determine how a BIM project is done.

4. Extremely hard to use.

However, Quickscan can be resumed as a tool that:

1. Measures the level of BIM in a company.

2. Help raise the level of working with BIM in the Construction sector.

3. Makes a checklist of all BIM aspects.

4. Is an Unambiguous objective tool for mutual comparison. (Van Berlo,2016.)

4.3.6 digiGO

DigiGo is another development in the Netherlands according to BIM Loket that accelerates the digitalization of the building environment in the Netherlands, they help make all

information digitally accessible by all individual stakeholders. The results in the digital project file, digital asset information, and digitally available area of information. (digiGo.2017.)

5 Standards

Let us think, for example, of engineers, consultancy firms, contractors, and architects, they all work with their software and systems. They send the data from their aspect models to a joint BIM model. Because everyone sends their data, certain uniform agreements must be made. These agreements are called the BIM standards.

BIM standards are therefore agreements that are generally made regarding a BIM model. BIM standards must be supported the most important thing about a BIM standard is that it is supported. Suppose all agree to drive on the left instead of on the right. That is fine in principle if everyone does it together. If anyone keeps driving on the right, you have a problem. In virtually every world, standards must be agreed on. Lego is one example that can be taken to explain a BIM standard. (BIM Loket, 2020.)

Lego has become big because they came up with a standard in a simple way to stack blocks on top of each other. They have further developed these blocks over many years for people to make beautiful buildings today. However, you can still use the blocks from the past in your new creations. In addition, there are hundreds of different Lego packages. Because Lego uses the same standard in every package, you can simply combine all these packages. (BIM Loket, 2019.)

Making agreements in the digital world with such a standard agreement can also be made in the digital world. Computers themselves are quite stupid. It is nothing more than zeros and ones. They are systems that are designed to send information back and forth. There are smart(er) pieces of software to check that information. A good example of this is a spell checker. A spell checker works reasonably well but quickly finds the matter too difficult. For example, when you use two different languages together, or when it comes to sentence structure. So, a spell checker only really works if everyone writes in the same way. Within the world of BIM, this principle works the same. An agreement must make joint about how information is recorded and (more importantly) these agreements must all be shared.

There are several BIM standards, such as NL-SfB, Basis ILS, ILS O&E, and the NLRS. By adopting these standards, you make your work interchangeable and reusable. (BIM Loket, 2019)

5.1 NEN-EN-ISO 19650

The international standard NEN-EN-ISO 19650 is regarded worldwide as the standard for the management of digital information in the life cycle of construction works. At the end of 2018, the European Standards Committee for BIM (CEN/TC 442) published the first two

parts of this standard. In 2019 this standard was adopted by the Netherlands and published by NEN (for the time being unfortunately only in an English version).

ISO 19650 describes the collaborative processes for effective information management. This concerns the entire delivery and operational phase of a building. Originally, this standard was introduced to promote the use of a common language within BIM and to encourage professionals in the built environment to adopt BIM. The standard series provides a general description of concepts such as Level of Information Need (LOIN), Exchange Information Requirements (EIR), BIM Execution Plan (BEP), and Common Data Environment (CDE). (BIM Loket, 2019.)

Because the content of the standard is of a general nature, every organization is currently giving a twist to what NEN-EN-ISO 19650 requires, at its own discretion. To help with this and to prevent many different interpretations of (parts of) ISO 19650, the standards committee CEN/TC 442 is developing practical guidelines ('Technical Specifications') in addition to the standard. Each guideline deals with one of the standards mentioned (LOIN, EIR, BEP, and CDE). The guidelines are expected to become available drop by drop in 2021 and 2022. (BIM Loket, 2019.)

5.2 IFC

IFC is a neutral and open file format for exchanging BIM-specific information (model objects and their properties) between software applications. IFC provides a digital description of the built environment, including construction and civil works. With IFC, the entire construction column, from architect to contractor and property manager, can work with the same intelligent data, within their applications. (BIM Loket, 2019)

BIM BASIC ILS

A user guideline has been agreed on around IFC at the initiative of several Dutch market parties. This BIM basic ILS contains agreements about the exchange format, the basic structure, and how you must safeguard object information. In addition to IFC, the open BIM standard NL-SfB is also used.

This standard is used as the data model for semantic conventions and data formats and is managed by BuildingSMART international.

IFC is established in the international standard ISO 16739-1:2018. The Netherlands is a member of the BuildingSMART chapter Benelux which has as function to provide a smooth exchange of model objects and their properties, between different software applications. (BIM Loket, 2018.)

5.3 NL/SfB

NL/SfB is the most used classification for building components in the Netherlands. Construction and installation companies code with these open standard layers and objects in BIM and CAD systems and use NL/SfB to organize information from suppliers. To make NL/SfB future-proof, efforts will be made soon to expand the electronic use of the standard. A logical consequence is that a link is also immediately sought with (the further development of) open standards with a comparable goal, such as IFC, CB-NL, and bSDD.

NL/SfB is a classification of building components and installations (called 'elements'). This standard is widely used in the construction and installation industry when designing, realizing, and managing buildings. NL/SfB has been used for many years to encode layers and objects in BIM and CAD systems and to organize information from suppliers of construction products. The coding is also used in (NEN) standards for, among other things, construction cost estimates and condition measurement of buildings and installations. (BIM Loket, 2019.)

5.4 NLCS

NLCS is the CAD standard of the Dutch civil engineering sector. This open standard contains agreements for dealing with metadata, digital drawing, the appearance of the drawing, and – above all – the coding system and layer structure of drawings. (BIM Loket, 2016.)

5.5 City Geographic Markup Language (CityGML)

CityGML ensures unity and coherence in the representation of topographical objects (such as lampposts and traffic signs) in 3D city plans and regional models. This standard places objects in classes describe them unambiguously and specify properties, such as appearance and dimensions.

This standard ensures that the same language is used worldwide when representing objects in cities and landscapes in 3D. Due to the unambiguous definitions, described objects can be easily transferred from one 3D model to another. The results are more efficient work and a reduction in failure costs.

Its function is to enable cost-effect and work on 3D city and landscape models, it can also be understood as an open standard for the exchange of 3D geo-information. (BIM Loket, 2016.)

5.6   BIM basic infrastructure

Better use of digitization and computerization is an important 'driver' in enabling a productivity leap. The seamless exchange of digital information between clients and contractors is essential in this respect and accelerates the digitization of the infrastructure sector. This is only possible if all parties involved speak the same language. That is why the Department of Engineering Offices Construction Companies (VIB) of Bouwend Nederland and the BIM Loket is introducing the BIM basic Infra. With these agreements on data exchange, the sector is taking an important step towards better digital collaboration.

The initiators express the expectation that a growing number of parties in the infrastructure sector will join the initiative to use these basic agreements for a 3D model. The BIM Loket wholeheartedly supports this initiative. All relevant documents have therefore already been made available via our website. As of October 1, 2021, the management of the BIM basic Infrastructure has also been transferred to the BIM Loket. (BIM Loket, 2020)

Client, contractor, supplier, and subcontractor in the infrastructure thus have a common language for 3D modeling. The BIM basic Infra is not a new standard but an answer to the question: how is the exchange of digital information going to be in the infrastructure in a structured and unambiguous way?

Agreements have been made with BIM basic Infra about the exchange of models, such as file names and type of CAD files (such as. Dwg). But also, which geographical coordinate system is used to position a bridge or road so that all models fit together? In addition, what information is being recorded, and added to 3D models, such as materials used (such as concrete or asphalt)? (BIM Loket, 2019.)

5.7   VISI

VISI is an open standard for digital communication. With the help of VISI you determine when (process), who (role), what (information), and to whom (role) supplies. That way people can know where they stand from each other. You are free to shape your collaboration the way you want. Changes in the collaboration agreements are always traceable. VISI will then help you fulfil your agreements. You always know which actions you, or the other person, still need to perform. You know if your message has arrived. Transfer of work, from one employee to another, is seamless. Communication can be found for all involved, without mutual dependence. In the event of a dispute, it is immediately clear how the collaboration went. (BIM Loket, 2019)

6   Results of the questionnaire

A survey among different BIM users in the Netherlands has also been carried out, this task was challenging since no contact in the Netherlands was found.

The decision to send a plethora of emails containing the questionnaire to some engineers, architects, university teachers, students, and different BIM users in the Netherlands was the most sensible.

In total 30 emails were sent and only two answers were received.

The ratio is low, not to say negligible, but for the sake of the survey, it was decided to consider their answers.

Two answers were received to the survey, one BIM user specializes in HOUSE BIM and the other response comes from an Infra BIM specialist.

Only the unanimous answers were taken into consideration since there were only a two of them.

Here is a summary from the answers received from the questionnaire survey:

1. 50-70% of construction and design companies in the Netherlands operate in BIM.

2. The three main hindrances for design and construction companies when they were (are) transferring from 2D to BIM are:

A. Organisations work effectively without the use of BIM.
B. Lack of personnel with necessary competencies in the labor market.
C. Resistance to change and use the innovative solutions among employees.

3. When designing houses, the parts of the project that are still made generally without BIM are:

A. Architectural.
B. Labour safety.
C. Fire safety.

4. Typical indicators for using BIM in the projects:

A. Projects that are bigger than some m2 limit.
B. Projects that cost more than some € limit.
C. At the request of the client organization.
D. The use of BIM is mandatory due to government regulations.

5. The file exchange method that is used most widely when the design project is in the running:

A. E-mails and messages.

6. The way BIM data is generally transferred between stakeholders in construction projects:

A. Only IFC standard and IFC compliant models.

7. Other fields than house BIM being utilized in house projects:

A. Geotechnical models.
B. City models.
C. Infra models.
D. Virtual models (and game engines).

8. The way they know the following international: BIM standards or related concepts (1 being the least and 5 being the most):

A. BEP (BIM Execution Plan) 4.
B. EIR (Exchange Information Requirements) 4.
C. CDE (Common Data Environment) 4.
D. MVD (Model View Definition) 4.
E. BCF (Building Collaboration Format) 5.
F. COBIe (Construction Operations Building Information Exchange) 3.
G. IFC (Industry Foundation Classes) 5.

9. Architectural design:

A. Autodesk Revit.

10. Structural design:

A. Autodesk Revit.

11. HVAC design:

A. Autodesk Revit.

12. Water supply design:

A. Autodesk Revit.

13. Electrical engineering:

A. Autodesk Revit.

14. Cost analysis:

A. Excel.

15. How the use of infra models in projects widespread is:

A. 70-90%.

16. what the infra models are typically used for:

A. Lane design.
B. Pipeline networks design (water/gas/heat/oil/etc).
C. Area planning.
D. Machinery control in infra projects.
E. Quantity take off and cost estimation.
F. Scheduling.

17. Whether the infra models are utilized in building construction or industrial construction projects:

A. Yes, for both building construction and industrial construction projects.
B. Infra models are not used in these projects.

18. National guideline for infra modeling in the Netherlands.

A. According to the ISO19650, ISO9001, and ISO27001.

19. Evaluation of the qualifications of AEC universities graduates in the field of BIM on a scale from 0 to 5, where:

A. Graduates are familiar with the basics of one or more BIM software but need additional training.

20. Whether students and academic staff in AEC universities in the Netherlands use BIM in their project work:

A. Yes, but the transition to BIM is not completed fully.

21. The main obstacle to further development in the study and application of BIM technologies in AEC universities in the Netherlands:

A. Lack of interest in BIM technologies among the university management.
B. Lack of knowledge in BIM technologies among the academic staff.

22. The situation with the implementation of OpenBIM in the Netherlands is that:

A. Many construction companies, architectures, structural engineering, and engineering companies are aware of BIM and Open standards, but overall knowledge is still in very early stages. Governments are still struggling with BIM data and what it is capable of.

23. The way they see the use of BIM developing in near future:

A. BIM development is highly underestimated during the implementation phase. Most innovations come from BIM enthusiasts but not much from higher management. Change management needs to be considered when successfully implementing BIM in any organisation. Key factors in successful change management are strategic programs for Technology, People, Culture, and Structure. If the foundation of Information Management is solid within a company/organisation, then they can start using data to predict future insights.

7 Conclusions

The survey and the research were enlightening, in the sense that now the situation of BIM in the Netherlands can be understood, regardless of the challenges encountered during this survey.

The following statements can be confirmed:

1. The background of BIM in the Netherlands.

2. The way it has carried on throughout the years.

3. The different developments that have been happening in the Netherlands.

4. The software used.

5. The different standards and requirements.

All in all, considering this report and the data from the survey here are the conclusions made when it comes to the use of BIM in the Netherlands.

1. BIM is known in the Netherlands.

2. The Netherlands has a gateway called BIM Loket which centralizes various standards and requirements.

3. The Netherlands has different standards for City modeling, INFRA modeling, House modeling, and many others.

4. The Netherlands shares a common BuildingSMART with Belgium and Luxembourg called BuildingSMART Benelux.

5. The notion of Open BIM is quite known among engineers and a few BIM users.

References

Krzysztof W., 2019. Top 12 benefits of BIM technology – Why should I use BIM? [Cited 11 August 2019] Available at: https://bimcorner.com/benefits-of-using-bim-technology.

Radboud, B. 2018. BIM Loket – BIM Loket The Dutch BIM gateway.

Retrieved on 20 June 2018. Available at:

https://www.icis.org/wp-content/uploads/2018/07/2018_ICIS_BIMLoket.pdf

NIBS (2007), National Building Information Modeling Standard, National Institute of Building Sciences, United States

van Nederveen, S. Beheshti, R. Willems, P.2009. Building Information Modeling in the Netherlands: A Status Report.

Available at: https://www.irbnet.de/daten/iconda/CIB18802.pdf.

Organization and digitization of information about buildings and civil engineering works, including building information modeling (BIM). Information management using building information modeling. 1Part 1: Concepts and principles (ISO 19650-1:2018), 2018.

Cornips,M.H 2005 NL/SfB-tabellen Including reconditioned Element method'91

Retrieved in 2005. Available at:

https://stprodeuwmystabu002stor.blob.core.windows.net/overig/NL-SfB_BNA_Boek_2005-ISBN-10%2090-807626-3-6.pdf

Sarah Lorek (2022) What is BIM (Building Information Modeling). [Cited 6 April 2022] Available at: https://constructible.trimble.com/construction-industry/what-is-bim-buildinginformation-modeling

Reuver, Stoter, Zlatanova, 2011 3D Pilot Eindrapport werkgroep 3D Standaard NL.

Retrieved on 4 July 2018. Available at:

http://www.gdmc.nl/publications/reports/NCG_53.pdf.

Spekkink, D. 2016. BIM Loket en COINS.

. Retrieved in 2016. Available at:

https://www.crow.nl/downloads/pdf/contracteren/visi/20161122/bim-loket-en-coins.aspx.

What We Do - buildingSMART International, n.d. Retrieved on 3 April 2022. Available at: https://www.buildingSMART.org/about/what-we-do/

Loket, 2018 Nederlandse CAD Standaard voor de GWW-sector.

Retrieved on 5 January 2018. Available at:

https://download.cadac.com/nedinfra/Formele-beschrijving-NLCS.pdf.

Rudden,K. 2018 BIM and ISO 19650 from a project management perspective.

Retrieved on 15 May 2018. Available at:

https://www.rif.no/wp-content/uploads/2020/01/BIMbooklet390764_18_RIF.pdf.

Gawlak, D.2015.Quality management systems — Requirements.

Retrieved on 23 September 2018. Available at:

https://ch97a3a0kw31390rw3nfrzf3-wpengine.netdna-ssl.com/wp-content/up-loads/2020/11/ISO-9001-2015-Fifth-Edition.pdf

Pijffers, E. Vermeer, D. 2016. Nederlandse Revit Standards.

Retrieved on 23 September 2016. Available at:

https://www.itannex.com/wp-content/uploads/2016/10/Handleiding_Neder-landse_Revit_Standards.pdf.

van Berlo, L. Dijkmans, T, Hendriks, H. Spekkink, D. Pel, W. 2012. BIM QUICKSCAN: BENCHMARK OF BIM PERFORMANCE IN THE NETHERLANDS.

Retrieved on 1 June 2012. Available at:

https://itc.scix.net/pdfs/w78-2012-Paper-30.pdf.

van Berlo, L. Sebastian, R. 2010. Tool for Benchmarking BIM Performance of Design, Engineering and Construction Firms in The Netherlands.

Retrieved in November 2012. Available at:

https://www.researchgate.net/publication/228740990_Tool_for_Benchmarking_BIM_Per-formance_of_Design_Engineering_and_Construction_Firms_in_The_Netherlands.

Brandtlaan, W. 2009.BuildingSMART Benelux.

Retrieved on 1 June 2009. Available at:

https://pdfslide.tips/document/buildingSMART-benelux-stabu-van-media-als-files-en-data-bases-de-objecten-worden.html?page=1.

van Leeuwen, J. Van Zutphen.1994. Architectural Product Modelling: A Case Study.

Retrieved in August 1994. Available at:

https://www.researchgate.net/publication/228742257_Architectural_Product_Model-ling_A_Case_Study.

MagiCAD.2009.BIM adoption in Europe,current state,challenges and vision of tomorrow

Retrieved in March 2009. Available at:

 https://www.magicad.com/en/bim/

Koehorst, B.2016. BIM-implementation at Rijkswaterstaat

Retrieved on 6 April 2016. Available at:

https://unece.org/DAM/trans/doc/2016/TEM/TEM_66_SC/BIM_implementation_Netherlands_Benno_Koehorst_Warsaw.pdf

Appendices

Appendix 1. Survey contact letter

Dear [person's name],

My name is Josue Lhodi Kabasela I am a double degree student at LAB University of Applied Sciences in Finland.

I am writing my bachelor thesis about the BIM-use in The Netherlands for the BIM-ICE project, which is currently benchmarking the BIM-use in five European countries. We have understood that the BIM-competence is at a high level in your country and BIM is extensively integrated into the building processes. Thus, we would be willing to learn more about these issues in your country.

In the BIM-ICE project we are developing BIM-education in the LAB University of Applied Sciences. Benchmarking the status of BIM-use with other countries will help us to identify the development needs.

We have created an online survey to collect insights about the BIM-use in the construction sector. The survey is targeted to BIM-experts in five countries selected for benchmarking. The answering is anonymous and will take 15-20 minutes at maximum.

Please feel free to send this link to also your colleagues who might be competent and give answers to the survey?

Link for the questionnaire will close on 21st of May. Please find the survey here: https://link.webropolsurveys.com/S/DFB7D37B9C3D464E

The BIM-ICE project (BIM-Integration in Higher and Continuing Education, 2020-2022) is financed by the EU. More information about the project: *https://bim-ice.com/*

BR
Josue Lhodi kabasela