# Best Practices and First Steps of Implementing BIM in Landscape Architecture and its Reflection of Necessary Workflows and Working Processes

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**Abstract:** In current discussions digitization is a keyword. The building industry, especially the profession of landscape architecture doesn´t exploit its full potential. Building Information Modeling (BIM) offers a various range of possibilities. Efficient usage is so far a major challenge, because existing standards and workflows are established on requirements, defined by architecture and infrastructure industry. First steps to foster current national and international efforts for establishing BIM in Landscape Architecture are being presented and further strategies are named.

**Keywords:** Building information modeling, landscape architecture, PDT, IDM, IFC

## 1 Introduction

Building Information Modeling (BIM) is a constantly evolving and increasingly widespread method of modeling a building throughout its lifecycle, digitally providing all information relevant to planning, construction, maintenance and deconstruction. Looking at the entire life cycle, it is also possible to gain information on sustainability of a building or building object at an early stage and set the course for sustainable construction (KREIßIG 2016). On one hand, the importance of digitization, even at the federal level, is given a very high priority in Germany, while on the other hand fundamental deficits still need to be worked through. In construction industry, this is impressively clear: according to digitization index middle class, construction industry in the industry comparison on the penultimate place (DEUTSCHE TELEKOM AG 2017). Digital tools have been used in construction industry for decades, but "the degree of reuse of digital information once generated remains far behind any other industry" (BORRMANN 2015). Based on the work performed by the Landscape Institute (LI) and the Norwegian BIM for Landscape initiative, a multiple-case case study examines how far the experience and achievements from Norway and the UK can be transferred to the needs and characteristics of Germany.

## 2 Problem Statement and Objectives

The transfer and application of BIM in landscape architecture in Germany has been focussed in the last two years with increasing intensity both nationally and internationally by the working group "BIM in Landscape Architecture" of buildingSMART e.V. and FLL e. V. Key work results were provided by the BIM Working Group of the Landscape Institute in the UK with the development of "product data templates (pdt) for the landscape sector" (LANDSCAPE INSTITUTE 2016a).

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A first step towards landscape-specific components was made by the work of the Norwegian BIM for landscape initiative, which has developed the "Informasjonsmodell for landskapsobjekter", an object listing of landscape architecture relevant building objects, which can be used as a basis for standardization (STATENS KARTVERK 2016).

They worked out an object list, which identified and classified potential objects regularly used in landscape planning. To provide a usability in BIM-models an object hierarchy has been established, wherein a number of main objects are divided in building or construction objects. These objects can be subdivided in components. Predefined parameters are attached to each object in a spreadsheet, provided that parameters from main objects are inherited to subsequent objects (WIK et al. 2018). The project development expands the amount of information given to each object. Therefor six project phases are distinguished. Each phase corresponds as shown in Figure 1 to a particular Level of development (LOD).

| OBJECT SPREADSHEET | | | | | | |
|---|---|---|---|---|---|---|
| **Tree** | | | | | | |
| | Programfase (LOD 000) programming | Skisseprosjekt (LOD 100) sketch proposal | Forprosjekt (LOD 200) preliminary project | Detaljprosjekt (LOD 300) detail project | Byggefase (LOD 400) construction | FDVU (LOD 500) operations and maintenance |
| | 0 | 1 | 2 | 3 | 4 | 5 |
| Parameter name | | | | | | |
| Type Tree | | x | x | x | x | x |
| Height | | | | x | x | |
| Spread | | | | x | x | |
| Girth | | | | x | x | |
| Clear stem height | | | | x | x | |
| Root protection and condition | | | | x | x | |
| Form specified | | | | x | x | |
| planting distance | | | x | x | x | x |
| planting system | | | x | x | x | x |
| Origin | | x | x | x | x | x |
| Stakeout data | | | | | x | |
| Ultimate height | | x | x | x | | x |

**Fig. 1:**
Extract of the object spreadsheet "Tree" (WIK et al. 2018)

The UK approach has been comparable to the Norwegian object list. The Landscape Institutes BIM Working Group established so called Product data templates (PDT). The use of PDT empowers manufacturers and suppliers to supply consistent and comparable product information. The templates don't differentiate between LOD or project phases but list all possible parameters in one spreadsheet (see Figure 2). This information can be deployed in the BIM-Model from planning to maintain the building. All project participants refer to relevant information on individual products in standardized form and thus across systems. The templates are publicly available (LANDSCAPE INSTITUTE 2016b) and refer to pdt from other disciplines like Building Services Engineers (e. g. CIBSE).

Both the UK pdt and the Norwegian object list are focused on national requirements. Even though the object hierarchy approach is anchored in the Norwegian geospatial object standard and can be used in the SOSI-format ("Samordnet Opplegg for Stedfestet Informasjon" or

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**Flora**
**Product Data Template**

| | | | | |
|---|---|---|---|---|
| Template Category | **Flora** | | | |
| Template Version | v6.1 | | | |
| Category Description | Plant species grown for the purpose of planting out in a landscape. | | | |
| Classification System | | | | |
| Classification | Value | | | |
| Suitability for Use | | | | |
| Template Custodian | Landscape Institute | | | |
| **Information Category** | **Parameter Name** | **Value** | **Units** | **Notes** |
| **Manufacturer Data** | | | | |
| Specifications | Supplier | | Text | |
| Specifications | Supplier Website | | URL | |
| Specifications | Product Range | | Text | |
| Specifications | Product Model Number | | Text | Or Code |
| Specifications | CE Approval | | Text | Number, Yes, No |
| Specifications | Product Literature Webpage | | URL | |
| Specifications | Product Features | | Text | Free text to describe product |
| **Naming Data** | | | | |
| Specifications | Product Code | | Text | |
| Specifications | Botanical Name | | Text | |
| Specifications | Alternative Botanical Name | | Text | Or Names |
| Specifications | Common Name | | Text | Or Names |
| Specifications | Category or Class | | List | Or Type. Select from list |
| Specifications | Sub-Category or Sub-Class | | List | Select from list or type to define new value |

**Fig. 2:** Extract of the pdt spreadsheet "Flora" (LANDSCAPE INSTITUTE 2016)

more commonly "Systematic Organization of Spatial Information") both require undergoing an international standardization process.

The Informasjonsmodell for landskapsobjekter and the pdts both emphasize generating standardized specification for implementing BIM in Landscape Architecture, and implementation shows good results. Especially developing spreadsheets/pdts seems to meet current requirement of the software developers, suppliers and architects. Based on the standardized structure of the pdts, a mapping to the minimum required exchange information for the individual IFC Version (e. g. IFC 4.0) can be fixed. While the information in the pdts are standardized, the assignment of the relevant information for the IFC data exchange can be readapted newly regarding new requirements (e. g. IFC 5.0, …).

If pdts are available for individual products in the BIM process, they further can be customized by the specialist planner, starting with the manufacturers, to 'project-specific' product data sheets (pds).

A transfer of the results into an international accepted applicable standardization process, for example for the IFC format, has not yet taken place. Now it is important to define the most important requirements on the part of builders, landscape architects, contractors, manufacturers and facility management (THON & PETERS 2018).

Focusing on the German sector, there are currently no bindingly specified levels of detail and no generally recognized standard for levels of detail in BIM models. For a smooth and loss-free cooperation in the planning process, it has to be clarified which processes are relevant for landscape architectural construction projects and which interfaces are to be operated.

One-to-one transmissions from other disciplines as architecture or infrastructure sector are estimated to work only partially. Differences, e. g. due to the dynamic change of the "building material" plant or uneven terrains, are to be considered as well as structural differences on planning, construction and maintenance level.

## 3 Materials and Methods

Conducting expert interviews with representatives of the various stakeholder groups (builders, planners, software companies, manufacturers, contractors and facility managers) as well as the analysis of completed and partially accompanied projects will provide information on the transferability and the necessary modifications and further developments of the findings from Norway and Great Britain. When adapting existing product data templates, the necessary adjustments for usability with German standards must be taken into account. It seems that maintenance and care of the building objects in particular must be focussed more intensively.

Furthermore, elaboration of exemplary Information Delivery Manuals (IDM), e. g. "IDM Plants", is a necessary prerequisite. An IDM as part of the BIM execution plan identifies and describes the amount and time of delivering information for each participant, to foster all processes during a lifecycle of a built asset. This landscape-architecture-specific IDM has to be supplemented by the necessary Model View Definitions (MVD), which ensure that all information already stored or to be stored in the BIM-Model are compatible with respective requirements and fit tailor-made to the respective actors. Building objects stored in the BIM-model can be distinguished in different stages of elaboration, specified as "level of detail" or "level of development" (LOD), whereat a LOD 100 shows the minimal, and LOD 500 shows the maximum state of elaboration.

Figure 3 shows the interaction between PDT and the information, which is stored in the BIM-Model. The interaction between the BIM-Model and the information in the building objects is filtered by MVD. While the Level of Development/Details (LOD) rises, the more precise and detailed information is shown in the BIM-Model.

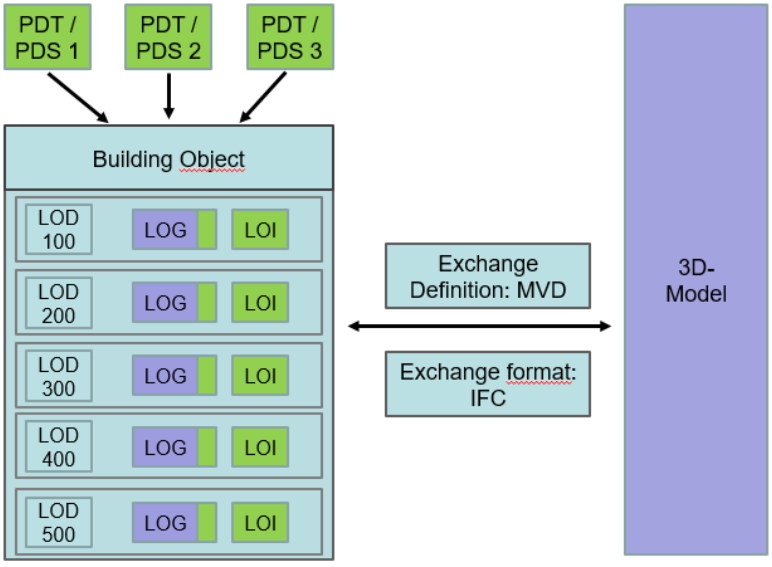


**Fig. 3:** Interaction PDT, PDS / LOD / 3D-Model inside the BIM-Model

# 4 Discussion

The examples above were developed by the idea of creating an IDM plant. It shows that all relevant parameters across all dimensions (geometry, time, costs, etc.). have to be taken into account when developing the PDT as a fundamental carrier of the product-specific information. Each participant needs different information at varying times. It's important, to identify the minimum requirements for information and geometry in the lifecycle, a look at the factor "Costs" shows the need of the BIM-Model to provide different information at different times.

A tender information put in a PDS will have to be used and complemented by the landscape architect during the planning-process with additional information about building and maintenance. Thus, the information of a component expands successively.

The LOD has to be separated, as in Figure 3, in the LOI and the LOG. The representation of the cubature of the crown and root space is indispensable for the detection of collisions. Regarding the workflow it has to be checked, which information remains permanently in the model. For the as-built model, there is no need for a 3D plant model with photorealistic leaf representation in the sense of a lasting maintenance of the building (see Figure 4).

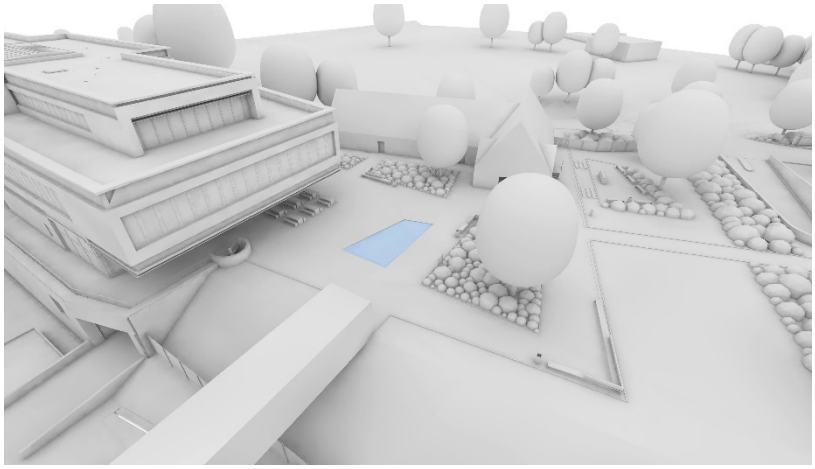

**Fig. 4:** Example of a screenshot of a 3D-BIM-Model (courtesy of scape Landschaftsarchitekten GmbH, Düsseldorf)

# 5 Conclusion and Outlook

To identify processes and participants, an interim result is the simplified visualization of the process-mapping (see Figure 5) of the authors. Based on this, detailed elaborations of necessary IDM (e. g. IDM Plants) will be developed referring to both international and national standards series such as DIN EN ISO 29481 (Norm DIN EN ISO 29481-1) and VDI 2552 (VDI Richtlinie 2552).

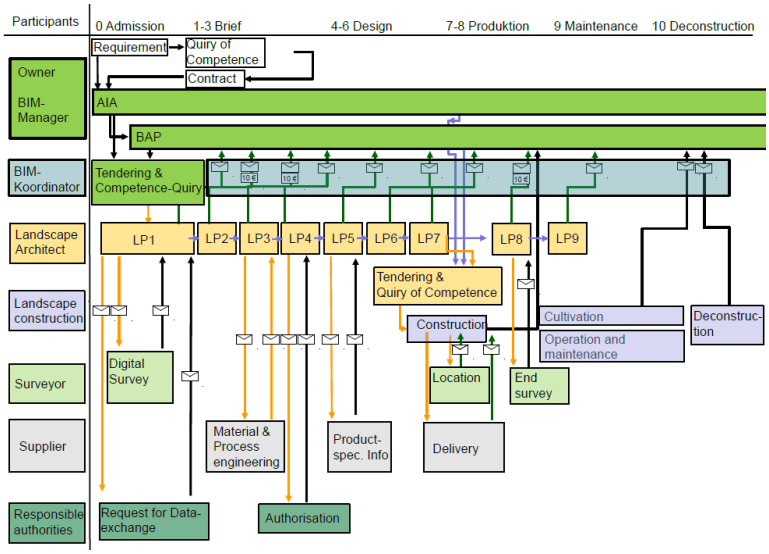


**Fig. 5:** Draft „Process Representation“; adapted from: Bundesarchitektenkammer 2017, HOAI, Bischof et al. 2018, corresponding to ISO 22263

Further elaboration will enable all participants, builders, landscape architects, contractors, manufacturers and facility management to take an active part in using BIM. Transforming pdt to national needs whilst complying with international standards will enable both software developers and manufactures e. g. to have a standardized format to supply information. Therefore, it is important to define a common denominator, to which components and objects are indispensable. It emerged clearly that there has to be both parameters defined by the manufacturer, and parameters defined by the planner along with planning progress.

On behalf of the previous work of the Norwegian BIM for landscape initiative and the experience from the development of PDT by the Landscape Institute, a draft for a German standard “PDT Plant” is currently being drawn up in cooperation with several experts (see Figure 6). The main objective has been a holistic approach. Therefore, master data of the delivered objects, planting instruction, durability and lifetime information, as well as information on process engineering, maintenance and sustainability shall be included.

Currently, further national drafts for PDT are being developed: “PDT Stair”, “PDT Retaining Wall” and “PDT Hard Surface”. Results will be presented in autumn 2019.

Expressing the needs of the landscape profession is essential for helping to integrate its demands in international standardization processes. Open BIM as favoured prospective method demands open standards like the Industry Foundation Classes (IFC), which have to be usable in all the participants’ software environment. Here existing formats can be adapted and modified. Existing IFC Stairs for example doesn’t fulfil all requirements, such as the slope of each level, and needs therefore further development.

**Pflanze**
**Produktdatenvorlage**

| Produktdatentabelle für: | Pflanzen | | | |
|---|---|---|---|---|
| Version | v. 1.1 | | | |
| Urheber: | | | | |
| Betreiber: | | | | |
| Informationsart | Parameter Name | Einheit | Inhalt | *Bemerkung* |
| **Herstellerdaten** | | | | |
| Hersteller | | Text | | |
| Adressdaten | | Text | | |
| Kontaktdaten, mit Webseite | | Text | | |
| Ust-ID-Nr | | Text | | |
| Steuernummer | | Text | | |
| Registernummer | | Text | | |
| Pflanzenpassnummer | | Text | | |
| | | | | |
| **Stammdaten** | | | | |
| Pflanzennummer/ Produktcode | | Text | | |
| Botanischer Name | | Text | | |
| Botanischer Name (Synonym) | | Text | | |
| Deutscher Name | | Text | | |
| Deutscher Name (Synonym) | | Text | | |
| Kategorie | | Liste | | |

**Fig. 6:** Extract of a draft for a possible German "PDT Plant"

## References


BISCHOF, M., BOUGAIN, A., GANTNER, J., HAUSKNECHT, K., HEINS, C., KIRMAYR, T. et al. (2018), BIMiD-Leitfaden. So kann der Einstieg in BIM gelingen. 2. Auflage. Hrsg. vom Fraunhofer IBP.

BORRMANN, A. (2015), Building Information Modeling. Detail, 6/2015, 602-607.

BUNDESARCHITEKTENKAMMER (Hrsg.) (2017), BIM für Architekten. Leistungsbild Vertrag Vergütung. http://www.aknw.de/fileadmin/user_upload/Publikationen-Broschueren/BIM-BAK-Broschuere-WEB.pdf.

DEUTSCHE TELEKOM AG (Hrsg.) (2017), Digitalisierungsindex Mittelstand. Der digitale Status quo des deutschen Mittelstands.

HOAI (2013), Verordnung über die Honorare für Architekten und Ingenieurleistungen (Honorarordnung für Architekten und Ingenieure – HOAI). BGBl. I S. 2276.

KREIßIG, J. (2016), BIM, Nachhaltigkeit und Zertifizierung | DGNB Blog. Hrsg. von der Deutschen Gesellschaft für Nachhaltiges Bauen – DGNB e. V., Stuttgart. http://blog.dgnb.de/bim-nachhaltigkeit-zertifizierung/.

LANDSCAPE INSTITUTE (2016a), BIM for Landscape. Taylor and Francis; ProQuest, Abingdon, Ann Arbor, Michigan.

LANDSCAPE INSTITUTE (2016b), PDT store Landscape Institute. Landscape Institute. https://www.landscapeinstitute.org/technical-resource/pdt-store/.

NORM DIN EN ISO 29481-1 (2018), DIN EN ISO 29481-1:2018-01.

STATENS KARTVERK (Ed.) (2016), SOSI generell objektkatalog Landskapsarkitektur. Versjon 5.0. https://www.kartverket.no/globalassets/standard/sosi-standarden-del-1-og-2/sosi-standarden/sosi-standarden-5.0/sosi_landskapsarkitektur_5.0.pdf.

THON, A. & PETERS, A. (2018), BIM in der Landschaftsarchitektur. Neue Landschaft, 9, 28-32.

VDI RICHTLINIE 2552, Oktober (2018), Building Information Modeling.

WIK, K. H., SEKSE, M., ENEBO, B. A. & THORVALDSEN, J. (2018), BIM for Landscape: A Norwegian Standardization Project. Journal of Digital Landscape Architecture, 3-2018, 241-248. https://gispoint.de/fileadmin/user_upload/paper_gis_open/DLA_2018/537642026.pdf.