

In the earlier first project (2012-2018) already most of the employees interviewed had been in contact with the Finnish Open InfraBIM. In design, the greatest benefits were achieved from more illustrative design, coordination of different types of technology and reduction of errors. In construction, faster works, material savings and quality improvements were reported. Turnover time was evaluated to be clearly faster in construction. Significant savings from the use of BIM were achieved.

In the second project (2016-2020) the report stated that the project has achieved significant cost savings of Euro 10 million, i.e. about 7% of the total project cost, efficiencies and quality improvements.

In the later third project (2019-2022), the realized reduction in construction time was about eight months in the end of 2021. The rapid progress of the work was due to new ways of working in design, construction and quality control. The time saving in design was about 20-22 weeks. All the machines were equipped with automatic machine control systems. Real-time quality control was seen to be preventing potential faults at an early stage during construction.

The implementation of the Open InfraBIM concept has been successful in Finland. Clear economic and technical benefits were observed and measured in all of the considered major design and construction projects carried out in 2012-2022. The most remarkable benefits were faster construction with reduction of construction time, cost savings up to 7% of total design and construction costs, and better completed quality of infrastructures. Most benefits were found from the latest project Kirri-Tikkakoski with remarkable time savings. The benefits of BIM based machine control and real-time quality control were emphasized in that project. This project has also used the most advanced and widest InfraBIM concept with early integration with all relevant stakeholders. The technology had already evolved considerably further, and people (an experienced team) had learned to build model-based.

The continuous development of Open InfraBIM seems evidently to be reflected in the increase of benefits in design and construction operations and processes. The progressiveness and competitiveness of the Finnish BIM concept in similar systems in other countries is difficult to assess on the basis of this study. Further development, wider information sharing and utilization of the Open InfraBIM in Finland and globally are suggested.

References

- [1] Costin, A. & Alireza, A. & Hanhin, H. & Stuart, S. C. (2018) Building Information Modeling (BIM) for Transportation Infrastructure – Literature Review, Applications, Challenges, and Recommendations. *Automation in Construction* 94 (2018), pp. 257-281.
- [2] Dodge Data & analytics (2017) Smart Market Report Top Business value of BIM for infrastructure.
- [3] Nhat Nam Bui (2021) Implementation of Building Information Modeling in Infrastructure Construction. Doctoral Dissertations at the University of Agder 329.
- [4] Bergs, R. A. & Winkels, H. J. (2016) *InfraBIM in den Niederlanden*. https://henry.baw.de/bitstream/20.500.11970/102344/1/04_Bergs-Winkels_InfraBIM.pdf
- [5] Boykov, V. N. & Skvorsov, A. V. & Gurev, V.A. (2020) *InfraBIM Open paradigm as the driver of information of the road sector in Russia*. IOP Conf. Ser.: Mater. Sci. Eng. **832** 012045.
- [6] Giovine, A. (2019) *Thesis: InfraBIM e construction management: valutazione di interoperabilita OPEN BIM*. <https://webthesis.biblio.polito.it/11128/1/tesi.pdf>
- [7] Halttula, H. (2020) *Enhancing Data Utilization in the Construction Project Lifecycle through early Involvement and Integration*. University of Oulu, Graduate School, C Technica, C750, 112 p.
- [8] Caterpillar (2016) *Comparison report, Caterpillar jobsite information study*, 22 p.
- [9] Caterpillar (2006) *Road construction – production study*. 26 p.
- [10] Kivimäki, T. & Heikkilä, R. (2015) *Infra BIM based Real-time Quality Control of Infrastructure Construction Projects*. ISARC'2015, The 32nd International Symposium on Automation and Robotics in Construction and Mining, 15-18 June, 2015, Oulu, Finland.
- [11] *Final report of Inframodel3 pilot project for data modelling-based planning and construction process*. Finnish Transport Agency, Planning Department. Helsinki 2015. Research reports of the Finnish Transport Agency 17/2015. 45 pages and 2 appendices. ISSN-L1798-6656, ISSN 1798-6664, ISBN 978-952-317-077-3.
- [12] Liikennevirasto (2015) *Tietomallipohjaisen suunnittelu- ja rakentamisprosessin Inframodel 3 pilotti, loppuraportti*.
- [13] BuildingSMART Finland (2022) *Infrastructure, YIV2019 guidelines, Inframodel, InfraBIM classification system, InfraBIM Glossary of Terms*, <https://buildingsmart.fi/en/infrabim-en/>
- [14] Netlipse (2018) *Preliminary Feedback Session. IPAT Pasila Riihimäki 1th phase. Evaluation report*.
- [15] YLE (2021) – the News Agency in Finland. *Mitä ihmettä? Moottoritie valmistuu kuukausia etujassa ja pysyy budjetissa*