

# DEVELOPMENT OF BIM AND AUTOMATION BASED TOTAL PROCESS FOR INFRA CONSTRUCTION – THE STATE OF THE ART IN FINLAND

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## ABSTRACT

A large research and development program called RYM PRE (Process Re-Engineering) has been active in Finland since 2010. As a part of the program, a work packet Infra FINBIM is focused on the development of new national process model, specifications and requirements for the whole Finnish Infra Industry. In the Infra FINBIM, total 15 companies and main owners and 3 research organisations are included. The work is further continuing. The main achieved results up today have been the first specifications and requirements of the BIM based total process for infra sector, about 30 different pilot projects for testing of the new design and construction process models producing a lot of results and observations, a new open information transfer format Inframodel3 based on LandXML standard, the achieved acceptance of the Building SMART organization for support of international development, utilization and extension of the format within the whole infra industry, processes, software and other technical equipment. An evaluation of the results and this work will be drawn.

## KEYWORDS

*Infra, BIM, Automation, Total Process.*

## INTRODUCTION

In infra sector a lot of data has been lost during transfer from one design phase to another in design-construction interface as well as from finished project to owner for maintenance and upkeep phase. Much overlapping work has been needed when adapting the information to different needs, duplicate work was seen completely unproductive. The procurement methods for transport infrastructure projects has not supported, let alone contribute, to the exploitation of technology and all the available information. The information has been delivered using the 2-D paper print-out method, which has forced to re-model the information to 3-D model for site surveys and machine controls. Some of the contractors have used 3-D machine control in their contracts, but due to the lack of 3-D modeling, have been forced to re-model paper information into 3-D models.

To implement information technology effectively into civil construction process, the whole process needs to be considered, changed and determined again utilizing the means and basic features of information modeling (see Heikkilä & Jaakkola 2006). The main idea is to perform different work tasks at different phases of the total working process three-dimensionally and save the data created to the special information models of the each working phase. The idea is then to upgrade, expand and exploit the original data model throughout the operational process.

The main aim of the Infra FINBIM research work packet was aimed to develop a new Building Information Modeling (BIM) and automation based process and model, in which the intelligent

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information contents of different data models needed can be created, used and utilized throughout the infra construction and maintenance process and work phases. This development work has been done starting very practically from the production point of view. Thus, the key players in this work have been contractors.

The goal of Infra FINBIM research was to develop and realize a new information modelling and automation based process and model, in which the intelligent and information contents of different models needed can be created, used and utilized throughout the infra construction, maintenance, rehabilitation and maintenance process and work phases. The process reaches and extends the whole life cycle of the main infra products, i.e. highways, railways and bridges. The aim was to create and establish a systemic change into infra sector in Finland, which is needed to enable and support the comprehensive development and utilization of information modelling and automation potentials and possibilities. Also, the aim was to develop international competitiveness into Finnish infra companies, other infra participants and research organizations.

## METHODS

### Establishing and organising the research work of the Infra FINBIM

A new business concept was established in Finnish Innovation System. In 2009, company Rym Oy (<http://www.rym.fi/en/>) was founded as the strategic centre for science, technology and innovation of build environment in Finland. In 2010, Rym Oy started the first research program called RYM Process Re-Engineering having the total budget of 21 MEUR, scheduled 2010-2013 and collecting together 37 companies and 6 research organizations for the planned research activities. The research work was divided into 6 work packets, i.e. Model Nova, NewWow, BIMCON, DRUM, Infra FINBIM and BIMCity. The resources of Infra FINBIM include about 6 MEUR, total 15 enterprises and 3 research organizations. One of the special features of the PRE program is that the research implementation is guided by the companies.

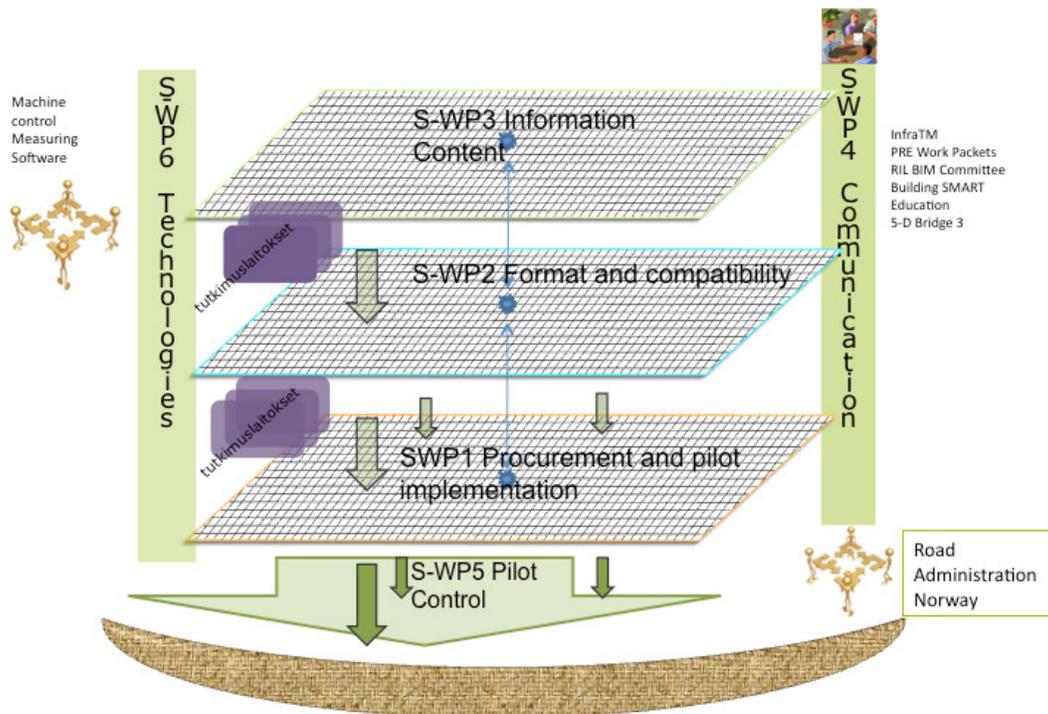


Figure 1 – The process model and key idea of InfraFINBIM work.

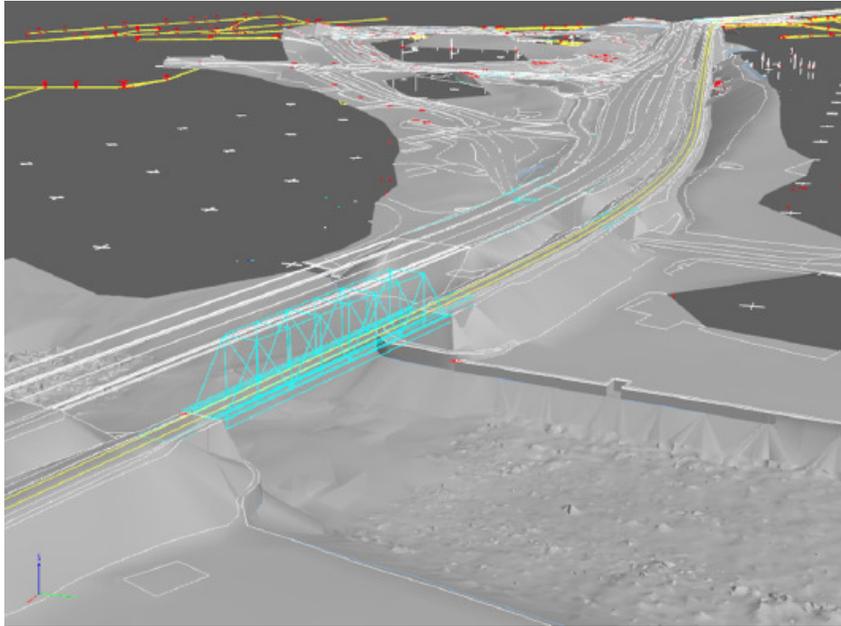


Figure 2 – A scene to the coordination model of a pilot project (Savonlinna) of the Infra FINBIM.

The Infra FINBIM has been divided into 6 different sub work packets SWP-1...6 as briefly follows: The aim of the SWP-1 “Procurement methods” was set to develop such procurement methods, which support the BIM based methods. The SWP-2 “Interfaces and standards” aims to develop the needed terminology, numbering and the next extension for the Inframodel open data transfer used in Finland. The SWP-3 “New design and construction processes” aims to Develop and publish the new BIM based guidelines and requirements for the infra sector in Finland. The SWP-4 “Information communication” aims to keep the Infra FINBIM participants as well as the whole industry informed about the Infra FINBIM work and the next public steps in infra sector. The SWP-5 “Pilot Projects” aims to test and further develop the new BIM models and make the big change be possible to happen during the set schedule. The SWP-6 “Technology” tries to activate the technology companies to develop Inframodel3 export and import features to their systems.

## RESULTS

The companies and people involved in the work have showed such an amazing commitment and collaboration to this collaborative development work, all the specialists are needed together to develop the new requirements. Infra BIM - a draft of National Requirements (Specification) for BIM based Total Process in Infra Construction and Maintenance Tasks, still mostly under development, deadline Summer 2013. A new Extension “Inframodel3” based on International LandXML standard for Open Information Transfer between all of the work phases, Building SMART cooperation and worldwide support started. Experiments in Total 30 different Pilot Projects testing the different parts of the Infra BIM.

The development work for the new extension of the LandXML1.2 standard has produced the first draft of Inframodel3. The format has been published in the open web page ([http://www.infrabim.fi/infrabim\\_uusi/inframodel\\_3.html](http://www.infrabim.fi/infrabim_uusi/inframodel_3.html)). Currently, the key software companies, Tekla Oyj (software Tekla Civil), Vianova Systems Finland Oy (Novapoint), Sito Oy (CityCAD) and Bentley Finland (Inroads) are implementing the export and import tools needed. The participation of other technology companies is supported by arranging different co-operative workshops with Infra FINBIM key partners and identified main technology companies as well as offering information available for the whole industry through a public web site ([http://www.infrabim.fi/infrabim\\_uusi/index.html](http://www.infrabim.fi/infrabim_uusi/index.html)). The international

Building SMART organization has 2012 accepted this Finnish extension for LandXML1.2 standard to be internationally supported for open information transfer purposes.

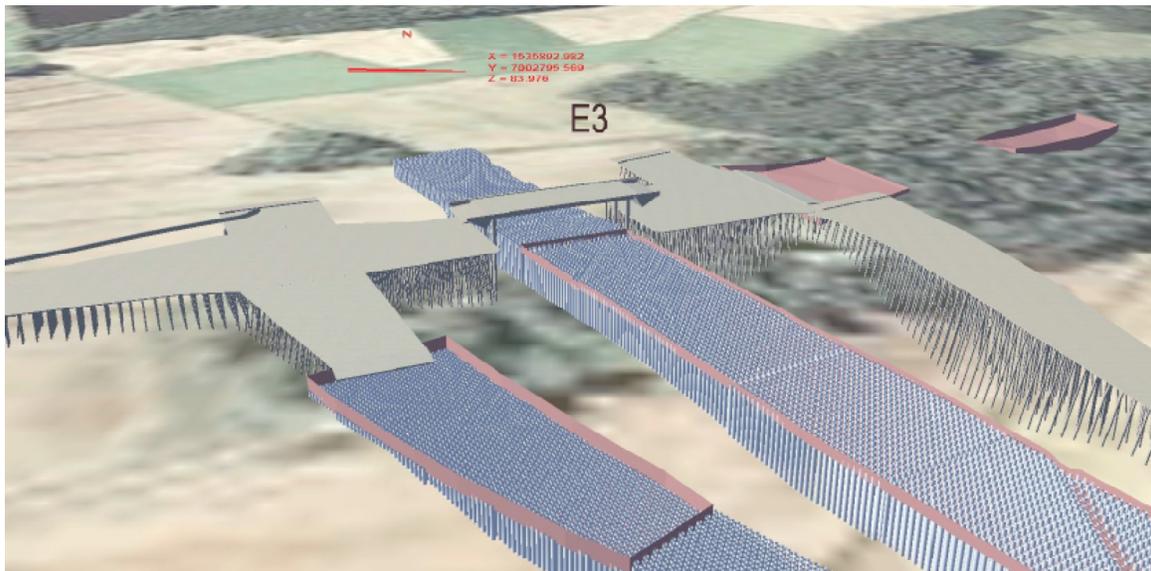


Figure 3 – A scene to the coordination model of a pilot project (VT8-BIM) of the Infra FINBIM.

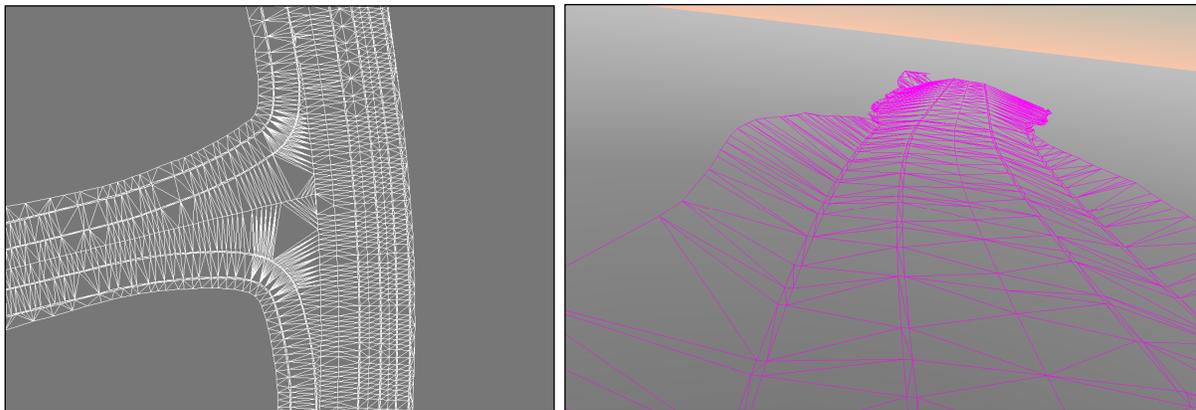


Figure 4 – Examples of the accurate design models: the left side - a cross-section, the right side a straight road surface (Stenius, S. 2011).



Figure 5 – Example of the development of procurement methods: in the pilot projects of Espoo city, the use of 3-D machine guidance systems and 3-D models were required by the owner (Tanska, H. 2013).

## CONCLUSIONS

National BIM Specifications are needed to realize the large transition and jump of infra industry to the BIM based working level. The development of the general guidelines as well as large commitment to the new working method is possible only with the full cooperation of the field. Open information transfer formats will play the key roles when trying to improve the information transfer between work phases, individual software and systems. More and more international cooperation will be need in this development.

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