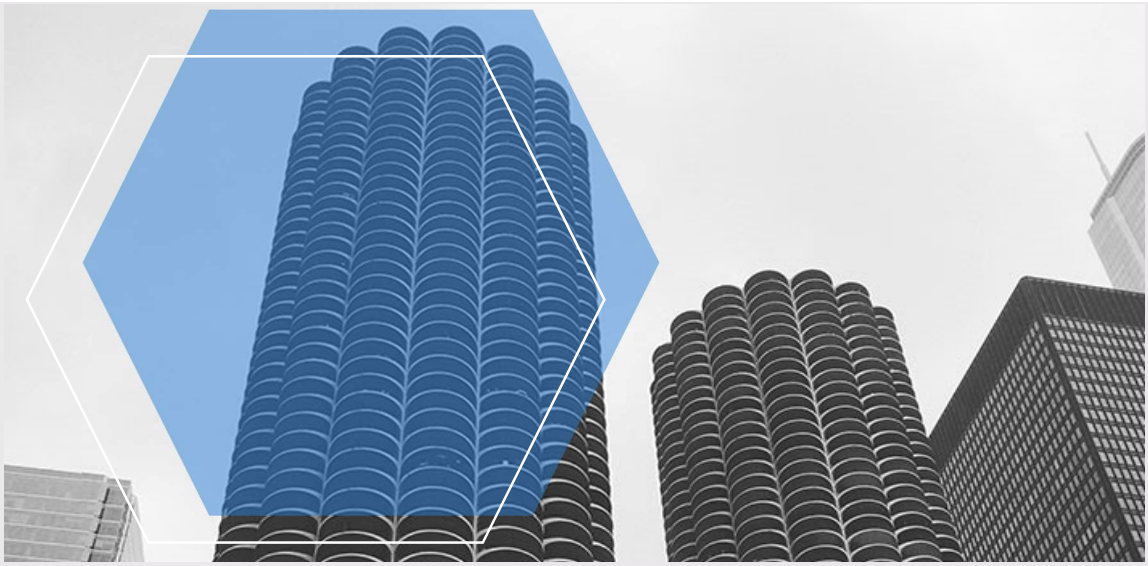
Benedict
BIM-enabled Learning Environment for Digital Construction



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INSIDE THIS ISSUE

PROJECT PROGRESS: THE VIEW FROM BOLOGNA

Digitalization of the construction sector - Building Information Modelling - is surely the current answer to all the specific production issues that affect the Real Estate and Construction REC industrial sector. Building Information Modelling (BIM) is a process management strategy that can be of capital importance in improving construction efficiency. The BIM approach has many dimensions, i.e. goals and objectives, and the fourth one concerns time – oriented construction management. BIM 4D represents the simulation of the construction project concerning project planning, scheduling, controlling including jobsite design.

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FIGURE 2 -
MARCO ALVISE BRAGADIN, PHD

FIGURE 3 -
CATERINA MORGANTI, PHD

FIGURE 4 -
UGO MARIA CORAGLIA, PHD

It involves the development of the BIM-based information model of the construction jobsite by identifying the technological model that contains project information related to jobsite layout and the simulation of construction operations at a layout level and at a workspace level. BIM 4D model simulates in a virtual enviroment the various subsequent construction stages, as planned by construction project schedule. The BIM-enabled Learning Environment (BLE), can be used to implement BIM 4D project planning and control for learners and future practictioners, and it is in this line that the work done by the Alma Mater Studiorum University of Bologna Team fits. The Italian research team is composed of Marco Alvise Bragadin, Associate Professor of Building Production at the University of Bologna, he has been teaching at the University of Bologna since 1999 and he has been researcher and assistant professor at UNIBO from 2005; Caterina Morganti, postdoctoral research fellow and adjunct professor, she has contributed in several research programs about architectural drawing, representation and surveying, in particular, her research interests are directed at new digital detection and modeling techniques; and Ugo Maria Coraglia, fixed-term researcher, he currently carries out his research in the area of design and testing of digital BIM technologies for the assessment of the effects of climate change on the built environment at the scale of the building. Also involved in the project are students from courses in *Advanced Building Site* (Module of Sustainable Building Process Workshop I.C.) of Second cycle degree programme (LM) in Building Engineering - Architecture; *Building Sites and Production T* of First cycle degree programme (L) in Building Engineering; *Construction Management and Building Site Organization* (Module of Building Sites I.C.) of Single cycle degree programme (LMCU) in Architecture and Building Engineering; and *Materials and Technologies for Historic Buildings* of Second cycle degree programme (LM) in Engineering of Building Processes and Systems. Students in different courses are expected to produce project models through BIM methodology.

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DEVELOPING PILOT MODULES FOR THE BIM-ENABLED LEARNING ENVIRONMENT (BLE)

In the Benedict project, the development of pilot modules for the BIM-enabled Learning Environment (BLE) coincides with Intellectual Output 4 (O4) which is developed by the Unibo team. All partners have been actively involved, as each partner is responsible for developing a pilot module and thus is involved in the design, development, and validation of learning activities. Each partner is responsible for customizing each pilot course to suit the specific user groups and local conditions. For efficient development, the three partner institutions (Unibo, Taltech, and Tampere) are focused on several pilot courses for which they have particular expertise and experience. These are coordinated, customized, and developed so that the pilot courses are of great interest to all user groups in the three partner countries. Based on the user experiences of the three partner universities, pilot modules are developed to systematically cover everything that the three types of users (teachers, students, system administrators) need to know. These pilot modules are standard practice for the implementation of all further BLE learning modules that will be included in the system in the future. The pilot modules were delivered in specific lab classes. Teachers and system administrators participated in learning preparation activities prior to course delivery. The pilot modules will be finalized after their demonstration and receipt of feedback from all stakeholder groups.

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PARTNER ORGANISATIONS

TALLINN UNIVERSITY OF TECHNOLOGY, ESTONIA

TAMPERE UNIVERSITY, FINLAND

UNIVERSITY OF BOLOGNA, ITALY

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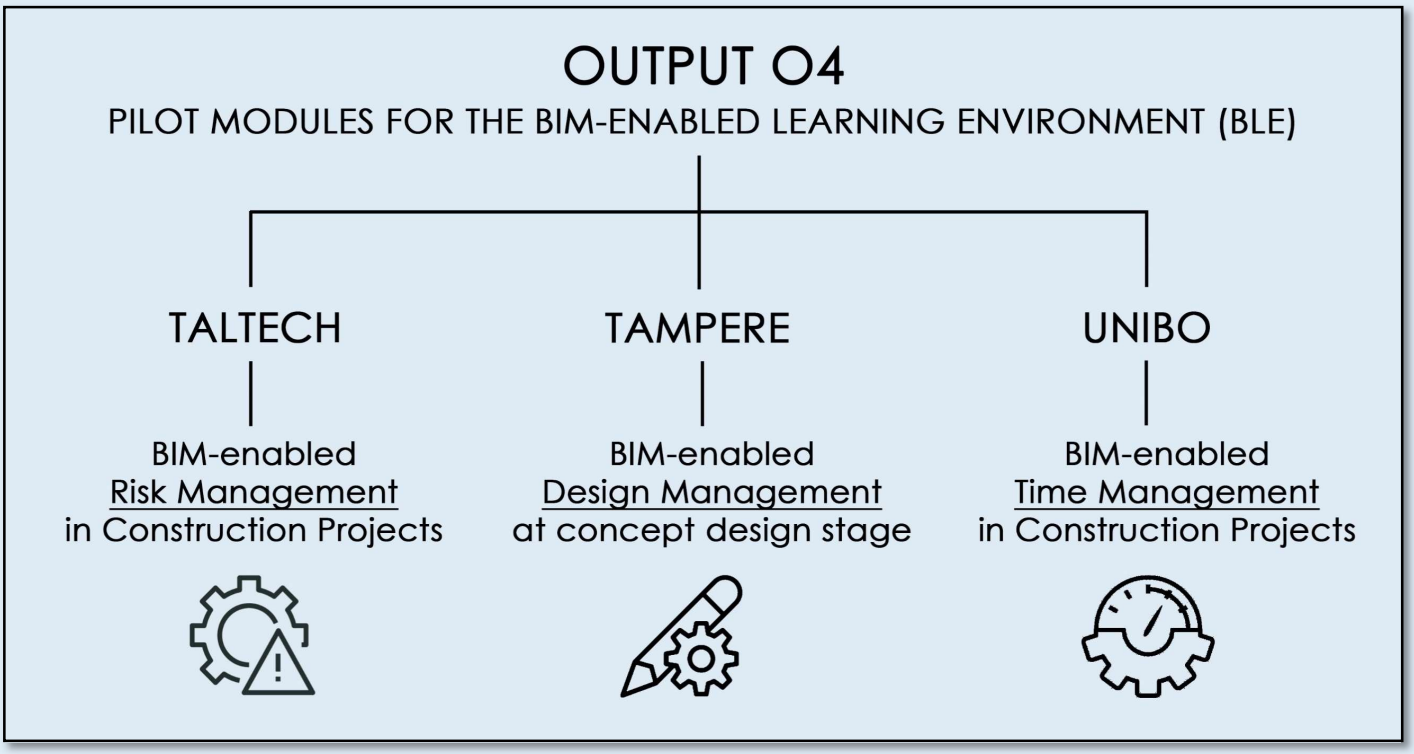

FIGURE 5 - OUTLINE OF PILOT MODULES

The pilot modules were divided as follows: Taltech dedicated to the preparation of the module *BIM-enabled Risk Management in construction projects*; Tampere dedicated to the preparation of the module *BIM-enabled Design Management at concept design stage;* and Unibo dedicated to the preparation of the module *BIM-enabled Time Management in construction projects.*

Students after completing the module of *BIM-enabled Risk Management in construction projects* are able to describe the process, tools and techniques of project risk management (in a BIM-based work process); understand risk and project risk management concepts; understand the BIM work flow with respect to risk management and, more generally, are able to apply the project risk management process, tools and techniques in a realistic project scenario. They can evaluate the identified risks in terms of their relative significance and recommend appropriate mitigation actions; can critically analyse the risk management process and the industrial work flow in order to recommend improvements.

After completing the module *BIM-enabled Design Management at concept design stage*, the students understand the concept design stage processes, and their own role during the stage; understand the connection between different roles, design disciplines and design options; are able to interpret design documents; are able to function in their role independently; are able to collaborate and communicate with other stakeholders; know the common BIM requirements; and are able to apply the common BIM requirements into their role specific tasks.

After completing the module *BIM-enabled Time Management in construction projects* students are able to describe the process, tools and techniques of project time management in construction (in a BIM-based work process); understand scheduling and project scheduling concepts; understand construction job site and site optimization concepts; understand the BIM work flow with respect to job site design, project time management and, more generally, are able to apply the project time management process, tools and techniques in a realistic project scenario; can evaluate project schedule, estimate activity durations and resource allocation in terms of their relative significance towards total project duration; can critically analyze the construction job site and the industrial work-flow of operations in order to recommend improvements.

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REFLECTING ON THE LEARNING AND TEACHING EXPERIENCES WHEN THE TAMPERE (TAU) PILOT MODULE WAS DELIVERED TO STUDENTS

TAU pilot module, Design management, was delivered to a group of Sustainable Urban Development (SUD)degree students in late September – early October. The pilot, which consisted of four design management meetings, simulated the concept design stage of a construction project using the BIM-enabled Learning Environment (BLE). A challenge for the facilitation of students during the pilot was that they had very limited knowledge of building construction projects, as the SUD degree programme focuses on urban environments and there is a very limited number of courses which address building construction specifically. The pilot was part of one of these courses, Construction Management, in the third year of the degree. Regardless of the limited knowledge, the students were open to the challenge and with only some initial anxiety, were ready to run the design management meetings on their own.

The facilitators' role was to observe the meetings, and after each meeting offer ideas for improvement and guidance for the next steps.

This Design management pilot was built around the BIM model of the project, a cheerleading training building (see Figures 6 and 7). During the pilot course the students analysed the model for preparing themselves for the design management meetings.

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Each student chose a role for themselves e.g. client, client's project manager, architect, BIM coordinator, or cost estimator. Some roles were played by a small group of students (2-3) as the tasks were more time-consuming than in other roles.

Information was provided through the BLE. This included the project brief and information about responsibilities in each role, and depending on the role, additional information about the project. The BLE included also a BIM viewer, a data extraction tool, and a concept stage BIM model for the students to use. The students used these in the meetings to communicate the design and to discuss how the design meets the client's needs. As an example of tasks between the meetings, the cost was estimated based on the space types and quantities extracted from the model, and the BIM coordinator ensured the model quality and prepared a BIM Execution Plan for the project.

The experience was positively engaging for both the students and the facilitators. Students enjoyed the autonomy and the role-play. They were also quickly comfortable with the BIM model as the representation of the design and a communication vehicle.

FIGURE 6 - DTC VISUALIZATION

FIGURE 7 - DTC INTERIOR

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MULTIPLIER EVENT #2B: DEMONSTRATING THE BIM-ENABLED LEARNING ENVIRONMENT TO FOREIGN ACADEMICS

TALLINN 17TH OCTOBER 2022

A second face-to-face multiplier event was held at Nordic Hotel Forum in Tallinn on October 17th where the Benedict Project was introduced and the BIM-enabled Learning Environment (BLE) demonstrated to academic colleagues from the University of Central Lancashire (UK), University of Colombo (Sri Lanka), University of Huddersfield (UK), University of Ruhuna (Sri Lanka), University of Sri Jayawardhanapura (Sri Lanka) and Vilnius Tech (Lithuania).

The 22 delegates to the event were first welcomed by Irene Lill - Head of the Building Lifecycle Research Group. The Benedict Project was then introduced with demonstrations of the BIM-enabled Learning Environment platform and the Pilot Courses by Emlyn Witt and Raido Puust. Tiia Rüütmann presented the Common Learning Approach and Assessment Tools that have been developed within the project and Ergo Pikas presented on Learning Resources: using real project data in teaching - opportunities and experiences. Raido Puust then gave a short lecture on Administration of Online Coursework and Examinations.

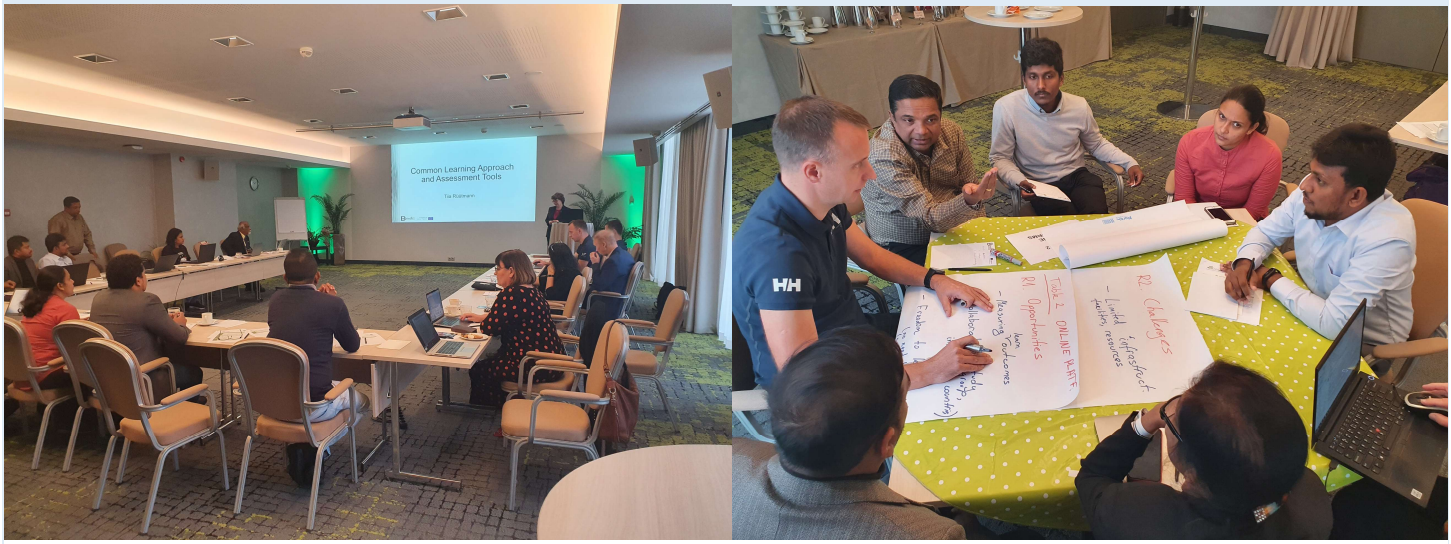

FIGURE 8 - multiplier event in tallinn 17th october 2022

The event culminated with facilitated discussions on the themes:

- *Digital Learning Resources*
- *Online Platforms*
- *Coursework and Assessment.*

The discussions were organised in 3 rounds using the World Cafe method with 3 cafe (discussion) tables, each dedicated to one of the 3 discussion themes and hosted by an expert in that area from the Benedict project. In the first round, table delegates discussed opportunities in relation to the themes, in the second round, challenges, and, in the third, they derived a common understanding for a way forward. In this way, key aspects of the Benedict project were considered in the context of the delegates' own teaching and learning contexts.

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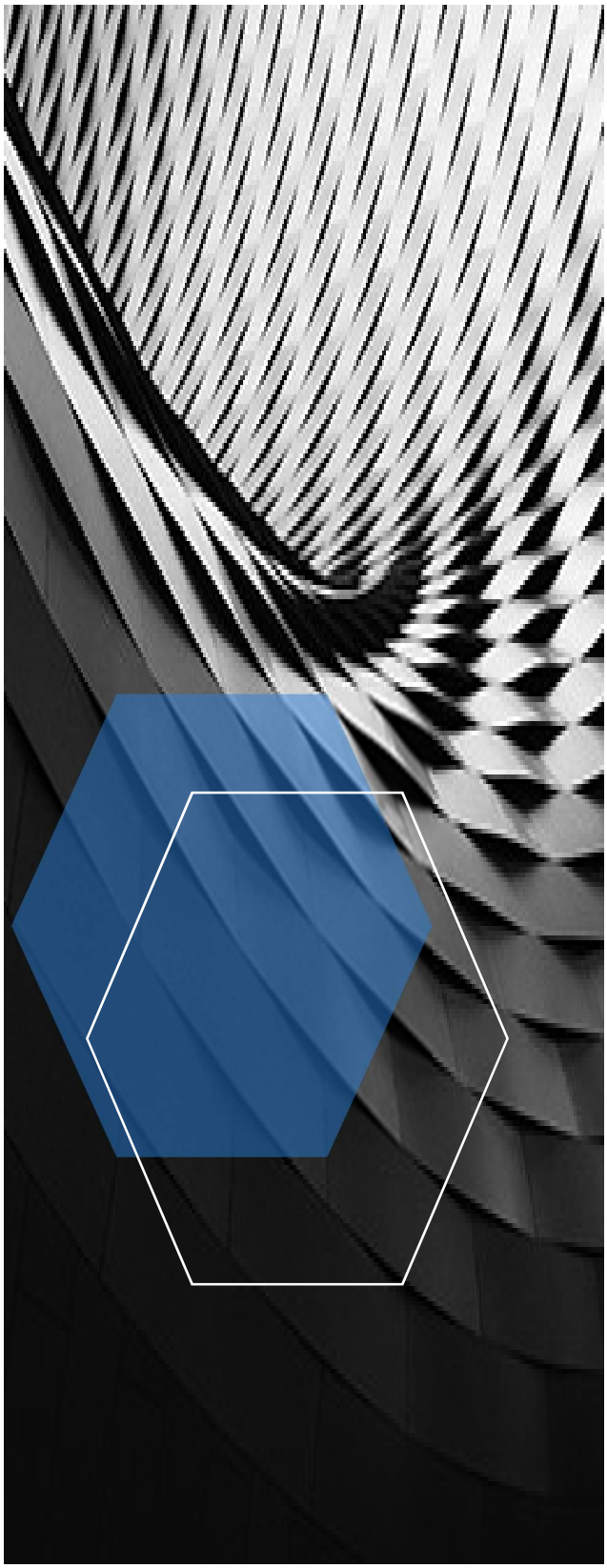

ASSOCIATE PARTNERS

ESTONIA

Ehituskeskus (Construction Centre)

Novarc Group AS

FINLAND

RIL (Finnish Association of Civil Engineers)

BuildingSMART Finland

ITALY

Istituto Istruzione Professionale Lavoratori Edili (Building school)

CMB Societa Cooperativa Muratori e Braccianti di Carpi

Associazione Italiana di Ingegneria Economica (Certified Cost Engineers Society)

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