

Digital Competencies in the future of construction



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BIMcert Conference

22nd January 2020

***Reducing the energy footprint
in the built environment***

**Digital Competencies in
the future of
construction**

-

**BIMCERT
Contribution**

António Aguiar Costa

Instituto Superior Técnico,
Universidade de Lisboa





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Automation in Construction

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Integration of LCA and LCC analysis within a BIM-based environment

Rúben Santos^{a,*}, António Aguiar Costa^b, José D. Silvestre^b, Lincy Pyl^a

^a Vrije Universiteit Brussel (VUB), Pleinlaan 2, 1050 Brussels, Belgium
^b CERIS, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais 1, 1049-001 Lisboa, Portugal



Sustainable Cities and Society 41 (2018) 275–285

Contents lists available at [ScienceDirect](#)

Sustainable Cities and Society

journal homepage: www.elsevier.com/locate/scs




BIMSL: A generic approach to the integration of building information models with real-time sensor data

Miguel Alves^a, Paulo Carreira^a, António Aguiar Costa^{b,*}

^a INESC-ID, Instituto Superior Técnico, Universidade de Lisboa, Portugal
^b CERIS, Instituto Superior Técnico, Universidade de Lisboa, Portugal



Building and Environment 169 (2020) 106568

Contents lists available at [ScienceDirect](#)

Building and Environment

journal homepage: <http://www.elsevier.com/locate/buildenv>




Can HVAC really learn from users? A simulation-based study on the effectiveness of voting for comfort and energy use optimization

Paulo Carreira^{a,b,*}, António Aguiar Costa^c, Vitor Mansur^{a,b}, Artur Arsénio^a

^a Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001, Lisboa, Portugal
^b INESC-ID, Rua Alves Redol 9, 1000-029, Lisboa, Portugal
^c CERIS, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001, Lisboa, Portugal



BIM-based life cycle assessment and life cycle costing of an office building in Western Europe

Rúben Santos^{a,*}, António Aguiar Costa^b, José D. Silvestre^b, Thomas Vandenberghe^c, Lincy Pyl^a

^a Vrije Universiteit Brussel (VUB), Pleinlaan 2, 1050, Brussels, Belgium
^b CERIS, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais 1, 1049-001, Lisboa, Portugal
^c BESI, Avenue des Communautés 100, 1200, Woluwe-Saint-Lambert, Brussels, Belgium



Some of the work developed by the WP3 Leader on BIM

WP3
Leading Role:
Responsible for the development of the learning platform for BIMcert.

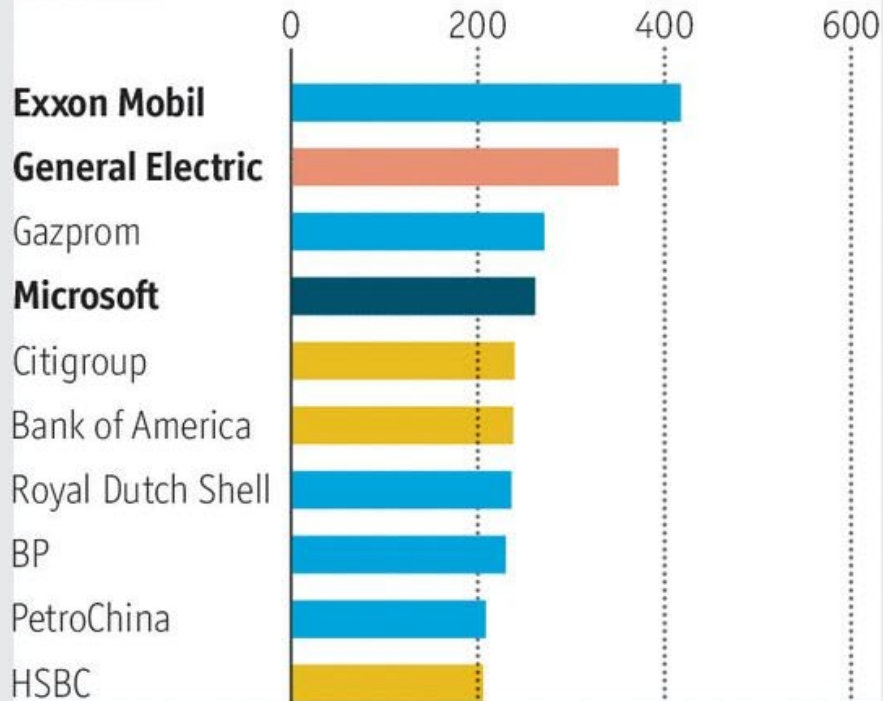


A virtually new world

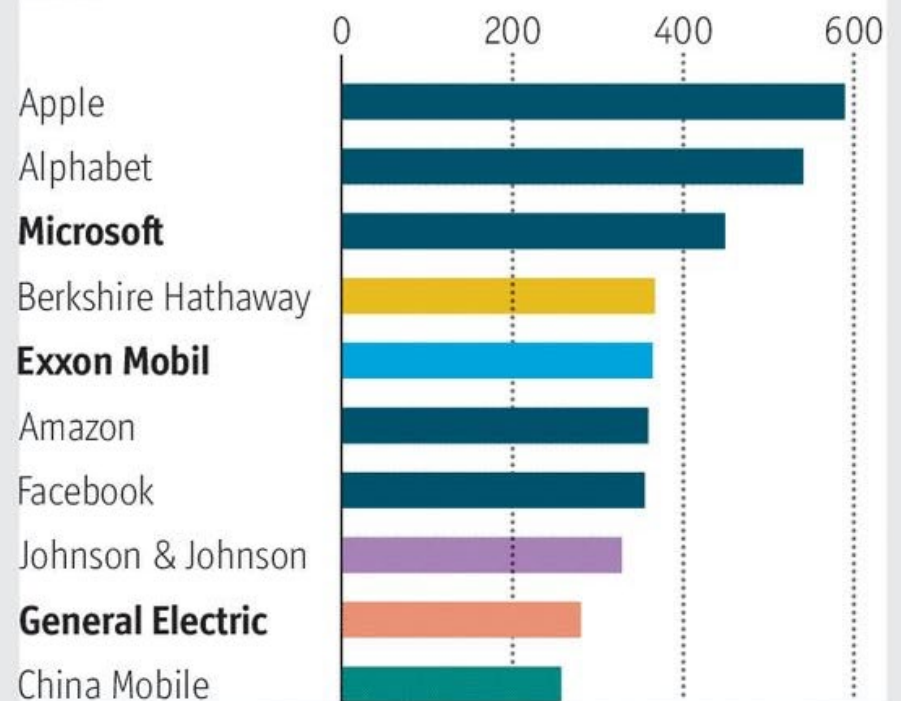
World, largest listed companies by market capitalisation, \$bn

Sector: ■ Energy ■ Financials ■ Health care ■ Industrials ■ IT ■ Telecoms

End 2006



2016*



Source: Bloomberg

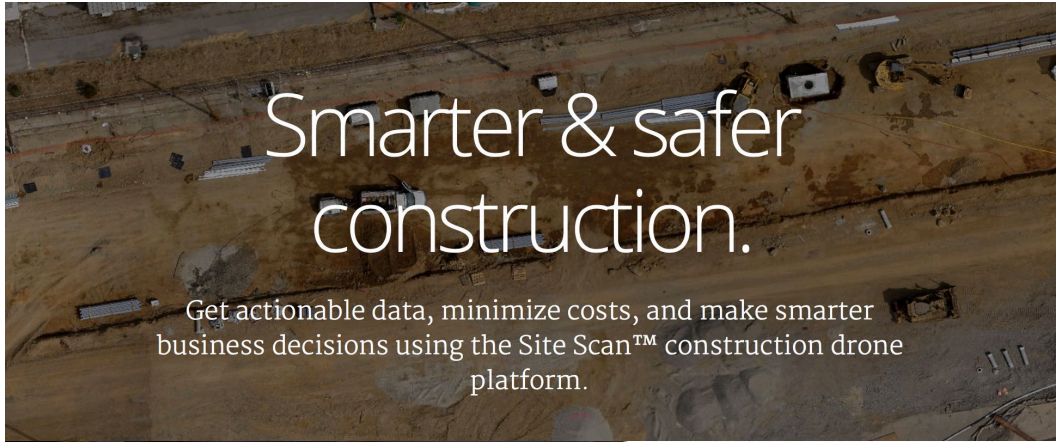
*At August 24th 2016



- Software to transform standard industry robots into autonomous 3D printers
- Multi-disciplinary team collaborating with several industry players

“
The first step was to make everybody want this project.
”





3DR

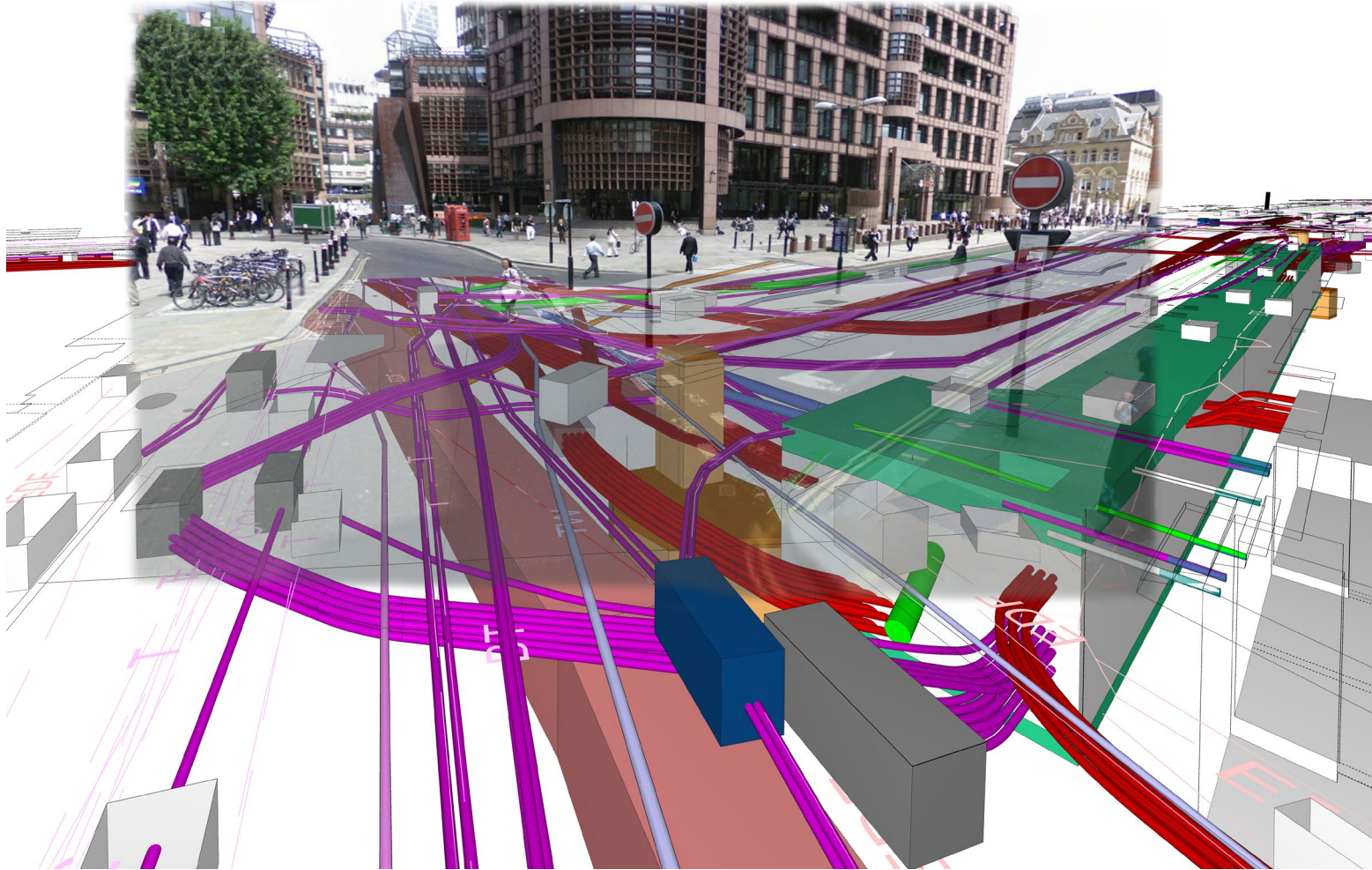


A stylized blue icon composed of several parallel lines forming a shape reminiscent of a checkmark or a downward-pointing arrow.

DAQRI



The DAQRI Smart Helmet concept proved professional-grade augmented reality can change how people work

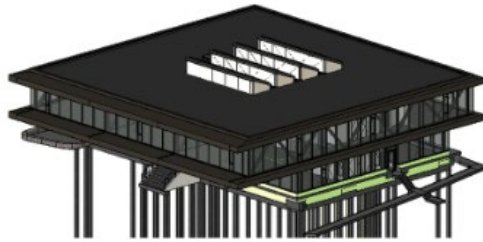


Liverpool Street - How Crossrail interfaces with the City, via BIM

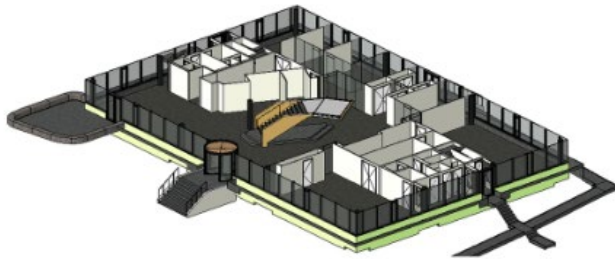
BIM potentiates energy efficiency

Table 1
Streamlined and Complete LCA/LCC analysis results.

Modules	ADPE (MJ)	ADPM (kg Sb eq)	AP (kg SO ₂ eq)	EP (Kg PO ₄ ³⁻ eq)	GWP (kg CO ₂ eq)	ODP (kg R-11 eq)	POCP (kg C ₂ H ₄)	PE-NRe (MJ)	PE-Re (MJ)	Cost (euro)
A1-AS (Streamlined)	4.93E+7	1.77E+4	2.03E+4	1.10E+4	4.72E+6	2.56E-01	2.37E+3	5.56E+7	4.62E+6	1.78E+6
A4	4.97E+5	1.41E-03	1.63E+2	3.74E+1	3.56E+4	7.17E-05	1.19E+1	5.00E+5	5.65E+2	0.00E+0
A5	3.18E+06	3.34E+02	1.11E+03	6.74E+02	2.93E+05	1.58E-02	1.23E+02	3.68E+06	3.18E+05	1.05E+05
B	3.55E+7	3.34E+3	4.95E+3	4.09E+3	2.80E+6	1.45E-01	2.53E+2	4.46E+7	4.37E+6	5.57E+5
C	-2.72E+7	9.01E-01	-1.13E+4	-3.77E+3	-2.74E+6	-1.30E-01	-2.06E+3	-2.90E+7	-4.75E+5	7.50E+4
D	-	-	-	-	-	-	-	-	-	-9.72E+4
Complete	6.13E+07	2.24E+04	1.52E+04	1.20E+04	5.11E+06	2.07E-01	6.98E+02	7.54E+07	8.03E+06	2.42E+06



(a)



(b)



(c)

Fig. 1. BIM model of the project in the Netherlands: (a) office building; (b) ground floor; and (c) first floor.

LCA/LCC Analysis results

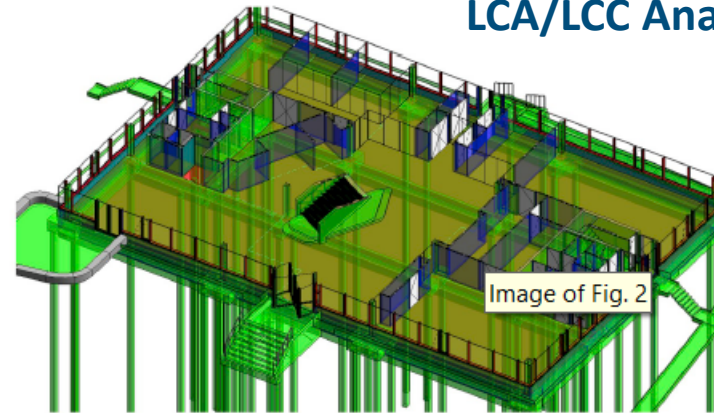
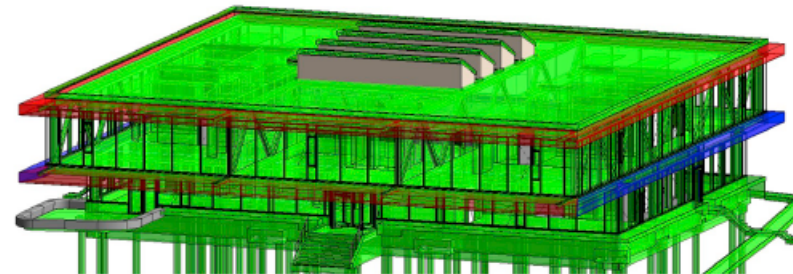
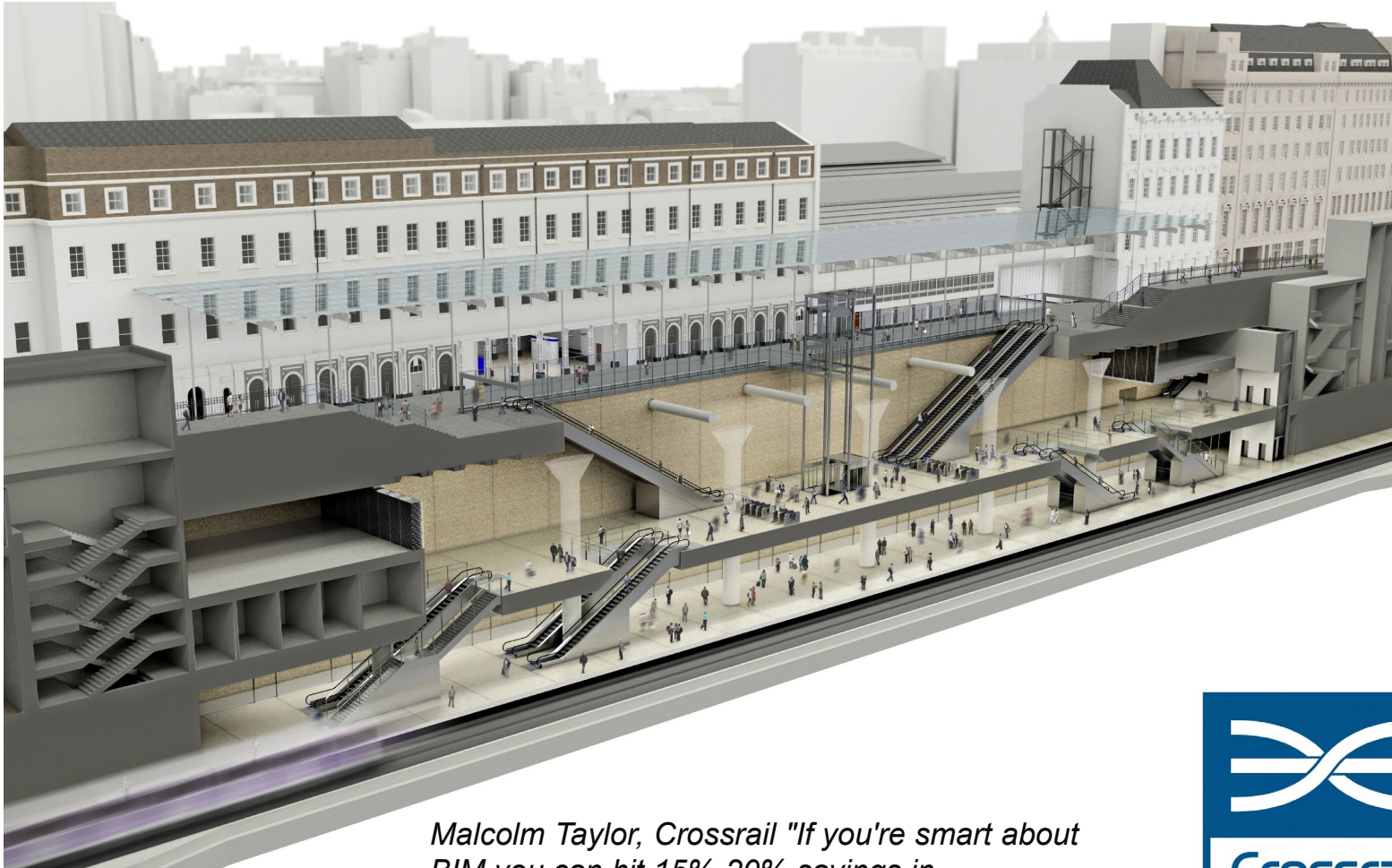


Image of Fig. 2

(a)



(b)



Malcolm Taylor, Crossrail "If you're smart about BIM you can hit 15%-20% savings in infrastructure and efficiency in the longer term"



A graphic of a network of white nodes connected by thin white lines, set against a dark blue background. The network forms a wave-like pattern that tapers off to the right.

**By 2025, “full-scale digitalization...
will lead to annual global cost savings
of 13% to 21% in the design, engineering
and construction phases and 10%
to 17% in the operations phase”**

BCG (The Boston Consulting Group)

'Digital in Engineering and Construction:
The Transformative Power of Building
Information Modeling' 2016

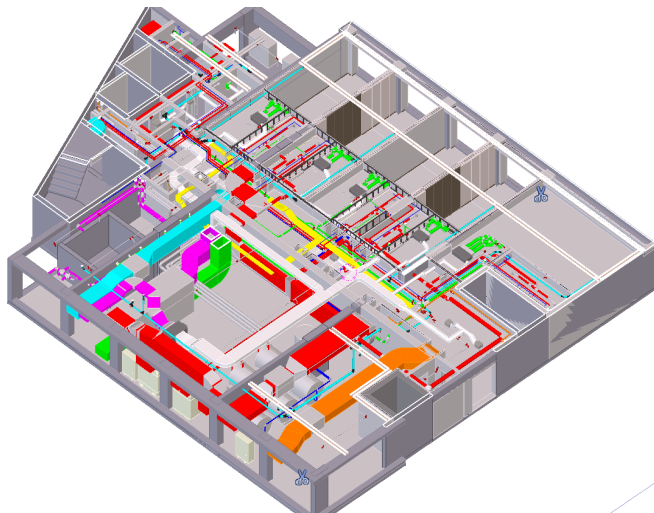
A lot of challenges...

- We need a **SMART approach** to BIM and Digital construction
- We need an integrated approach (**project lifecycle integration and supply chain integration**)
- We need to understand that Digital Construction is very much focused on “**information tools**” but the real change will come from the **methodological and management approach (EN ISO 19650)**
- We need to look at BIM/Digital Construction as the first step of the **DIGITAL TWIN** (the bridge between the physical and digital world)
- We need better **informed Clients** and **Government leadership**
- We need to **engage all people** within the entire design and construction sector and developing digital skills **appropriate** to their role
- We need to leverage **Digital transition motivation** focusing on critical subjects such as sustainability

BIMCERT wants to incentivize digital transition for a more sustainable world, in a smart way and engaging all people



Case Study in Portugal



BIMCERT major challenge:

→ Digital Competencies for all!





UNITED NATIONS
Geneva, 2019



Category	Levels	Skills
Digital skills for all	Adoption	Basic education and literacy Familiarity with technology devices and services
	Basic or generic use	Basic understanding of technologies, software and applications Knowledge of digital rights, privacy, security and permanence of data ^a Ability to make use of information and data, including basic issues of data storage, management and organization to construct calculations and answer questions ^a Ability to use digital technologies to collaborate, communicate and create ^a

Type of soft skills	Description
Sense making	Ability to determine the deeper meaning or significance of what is being expressed
Social intelligence	Ability to connect with others deeply and directly, to sense and stimulate reactions and desired interactions
Computational thinking	Ability to translate vast amounts of data into abstract concepts and to understand data-based reasoning
Novel and adaptive thinking	Proficiency in thinking and coming up with solutions and responses beyond that which is rote or rule-based
Cross-cultural competency	Ability to operate in different cultural settings
New media literacy	Ability to critically assess and develop content that uses new media forms and to leverage these media for persuasive communication
Transdisciplinary	Ability to understand concepts across multiple disciplines
Design mindset	Ability to represent and develop tasks and work processes for desired outcomes
Cognitive load management	Ability to filter information for importance and to understand how to maximize cognitive functioning using a variety of tools and techniques
Virtual collaboration	Ability to work productively, drive engagement and demonstrate presence as a member of a virtual team

Information and data literacy



Browsing, searching and filtering data, information and digital content



Evaluating data, information and digital content



Managing data, information and digital content



Communication and collaboration



Interacting through digital technologies



Sharing through digital technologies



Engaging in citizenship through digital technologies



Collaborating through digital technologies



Netiquette



Managing digital identity



Digital content creation



Developing digital content



Integrating and re-elaborating digital content



Copyright and licenses



Programming



Digital Competencies for all



DIGCOMP 2.0

THE DIGITAL COMPETENCE FRAMEWORK FOR CITIZENS
WHY - WHAT - FOR WHOM

Safety



Protecting devices



Protecting personal data and privacy



Protecting health and well-being



Protecting the environment



Problem solving



Solving technical problems



Identifying needs and technological responses



Creatively using digital technologies



Identifying digital competence gaps





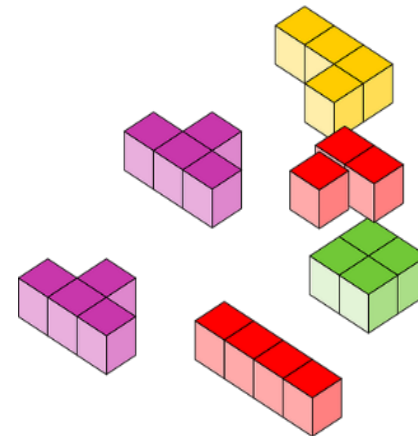
The BIMcert project will develop a blended, fully supported suite of Building Information Modelling training curriculum and tools, specially designed for the Blue Collars.

The project will have a particular focus on testing the BIM approaches to green and passive building design to contribute to the improvement of energy efficiency.

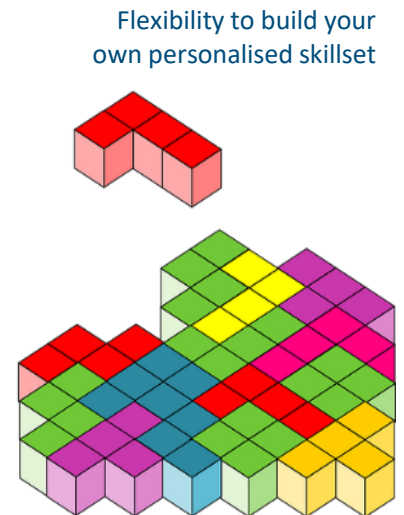
BIMcert approach

Encourage a more blended approach to self development:

- Encourage individuals to embrace digital learning as well as digital construction
- Easy entry level modules for those uncomfortable with technology
- Coaching and mentoring approach to progression into digital learning & working
- Develop desire to continue to develop using digital materials
- Develop appreciation of how digital construction (BIM) can improve long term performance of the Built Environment



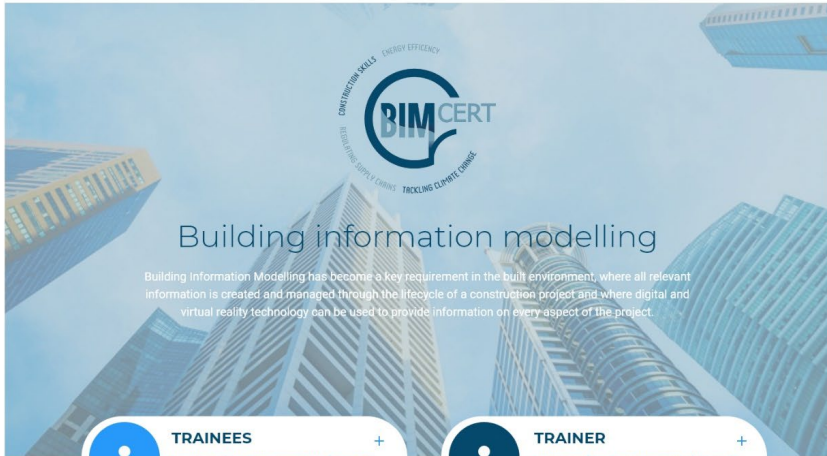
Several micro accreditations
(covering specific knowledge and skills)



Flexibility to build your own personalised skillset

BIMcert e- platform module	E-Platform module availability	OCN MODULE	OCN MODULE Assessment criteria (as presented in Canvas) content available in Canvas
WHAT IS BIM & DIGITAL CONSTRUCTION	AVAILABLE	BIM Principles	1.1 Explain key terms and definitions within BIM
BIM KEY TERMS	AVAILABLE	BIM Principles	1.1 Explain key terms and definitions within BIM
BIM MATURITY	AVAILABLE	BIM Principles	1.2 Summarise BIM maturity levels.
BIM DIMENSIONS	AVAILABLE	BIM Principles	1.1 Explain key terms and definitions within BIM
INTRO TO BIM IMPLEMENTATION IMPACTS IN PROJECT DELIVERY - OVERVIEW	COMING SOON (But covered in session 4 and reviewed in following ones & Canvas)	BIM Principles	1.3 Explain impact of BIM maturity Level 2 requirements for project delivery.
BIM & DIGITALISATION BENEFITS-OVERVIEW	AVAILABLE (Already covered in classes- session 3 & Canvas)	BIM Principles	1.4 illustrate the benefits of BIM to the construction sector.
BIM & DIGITALISATION BENEFITS-SUSTAINABILITY & ENERGY EFFICIENCY	COMING SOON (not mandatory)	BIM Principles	1.4 Illustrate the benefits of BIM to the construction sector.(partial)
INTRODUCTION TO STANDARDS - OVERVIEW	COMING SOON (covered previously in classes & Canvas)	BIM Principles	2.1 Summarise applicable Standards and industry guidance.
BIM LEVEL2 REQUIREMENTS-EIR	COMING SOON (covered previously in classes & Canvas)	BIM Principles	2.2 a) Explain BIM maturity Level 2 requirements for Employers Information Requirements (EIRs)
BIM LEVEL2 REQUIREMENTS-BEP	COMING SOON (covered previously in classes & Canvas)	BIM Principles	2.2 b) Explain BIM maturity Level 2 requirements for BIM Execution Plan (BEP)
BIM LEVEL2 REQUIREMENTS-PIP	COMING SOON (covered previously in classes & Canvas)	BIM Principles	2.2 c) Explain BIM maturity Level 2 requirements for Project Implementation Plan (PIP)
BIM STANDARDS -NAMING CONVENTIONS	COMING SOON (covered previously in classes & Canvas)	BIM Principles	2.3 Illustrate the use of file and layer naming conventions
BIM TECHNOLOGY- INTRO- SOFTWARE & HARDWARE	COMING SOON (covered previously in classes & Canvas)	BIM Principles	3.1 Summarise key technology requirements to enable BIM implementation.
DIGITAL SKILLS & COLLABORATION I- CDE & FILE STRUCTURE	AVAILABLE (covered previously in classes & Canvas)	BIM Principles	3.2 Explain the use of CDE, including arrangements collaborative working and communication
BIM SECURITY	COMING SOON (covered previously in classes 5 & Canvas)	BIM Principles	3.3 Summarise security-minded building information modelling, including key terms and definitions.

BIMcert e- platform module	E-Platform module availability	OCN MODULE	OCN MODULE Assessment criteria (as presented in Canvas)
BIM & DIGITALISATION BENEFITS- FOR PROJECT MANAGEMENT	COMING SOON (already covered in class 26th Nov.) PPT/PDF in Onedrive- partially address in MODULE: BIM & DIGITALISATION BENEFITS-OVERVIEW)	Digital Skills	1..1 Explain the use of digital skills and devices in the improvement of construction project management and delivery.
		Digital Skills	3.2 Analyse the use of BIM for construction project management.
DIGITAL SKILLS-BASIC FILE MANAGEMENT	COMING SOON (However covered in class 26th Nov and also available in BICERT MODULE: DIGITAL SKILLS & COLLABORATION I- CDE & FILE STRUCTURE)	Digital Skills	1.2 Demonstrate structured file management. 2.1 Demonstrate Information and Communication Technologies (ICT) file management.
DIGITAL SKILLS -H&S FOR BIM USERS I- SITE BASED	COMING SOON (will be Covered in pre recorded class 5th Dec)	Digital Skills	1.3 Summarise Health and Safety considerations for the use of digital devices in a site context.
DIGITAL SKILLS & COLLABORATION I- CDE & FILE STRUCTURE	AVAILABLE (covered in class 26th Nov and also available	Digital Skills	2.1 Demonstrate Information and Communication Technologies (ICT) file management.
	AVAILABLE (previously covered in class sessions 4 and 5-PPT/PDF in Onedrive)	BIM Principles	3.2 Explain the use of common data environments, including arrangements for collaborative working and communication
DIGITAL SKILLS- CLOUD & MOBILE DEVICES USAGE OR DIGITAL SKILLS- ACCESSING INFORMATION THROUGH THE CLOUD	AVAILABLE Was already Available /covered in session 5 & 6 follow up materials- videos in shared One drive) Reviewed on the class of the 19th Nov)	Digital Skills	2.2 Explain the use of cloud based storage and portable devices to access and exchange information.
BIM & DIGITALISATION BENEFITS- FOR SUPPLY CHAIN COORDINATION	COMING SOON (However covered in class 26th Nov_PPT/PDF in Onedrive))	Digital Skills	3.1. Explain the use of BIM and digital skills to improve coordination across the construction supply chain.
DIGITAL SKILLS / COLLABORATION II-ACCESS & VIEWING BIM MODELS	AVAILABLE (covered in class 19th Nov)	Digital Skills	4.1 Demonstrate the use of digital design review tools to access a BIM model.
DIGITAL SKILLS / COLLABORATION III- REVIEWING BIM MODELS	AVAILABLE (covered in class 19th Nov)	Digital Skills	4.1 Demonstrate the use of digital design review tools to evaluate a BIM model.



TRAINEES +

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TRAINER +

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BIMcert Training

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Culpa qui officia deserunt mollit anim id est laborum. Sed ut perspiciatis unde omnis iste natus error sit voluptatem accusantium doloremque laudantium, totam rem aperiam, eaque ipsa quae ab illo inventore veritatis et quasi repoplar architecto beatae vitae dicta sunt explicabo.



Module 1

Module 2

Module 3

Module 4

Module 5

XP 240, Star 51, Badges 3

LEARN MORE



Hello Paulo

Rank: **Serious Learner**
XP Level: **4**
Modules: **4**
Training plans: **2**

XP 4
240/400

36/41

2 badges

MY MODULES LIST

Single Module 1 (72% complete)

Single Module 2 (15% complete)

Single Module 3 (15% complete)

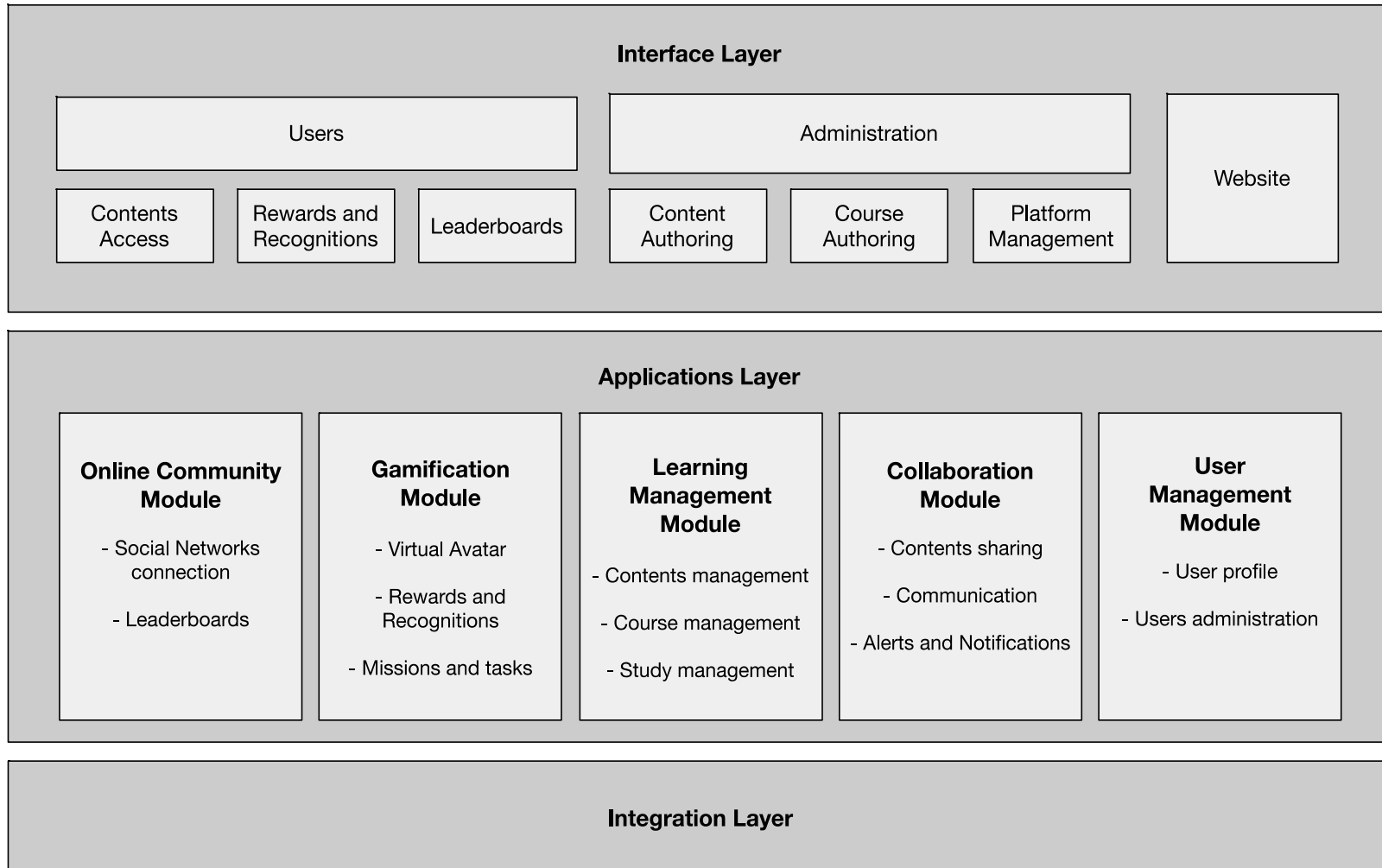
Single Module 4 (15% complete)

MY TRAINING PLANS

Training plan 1 (15% complete)

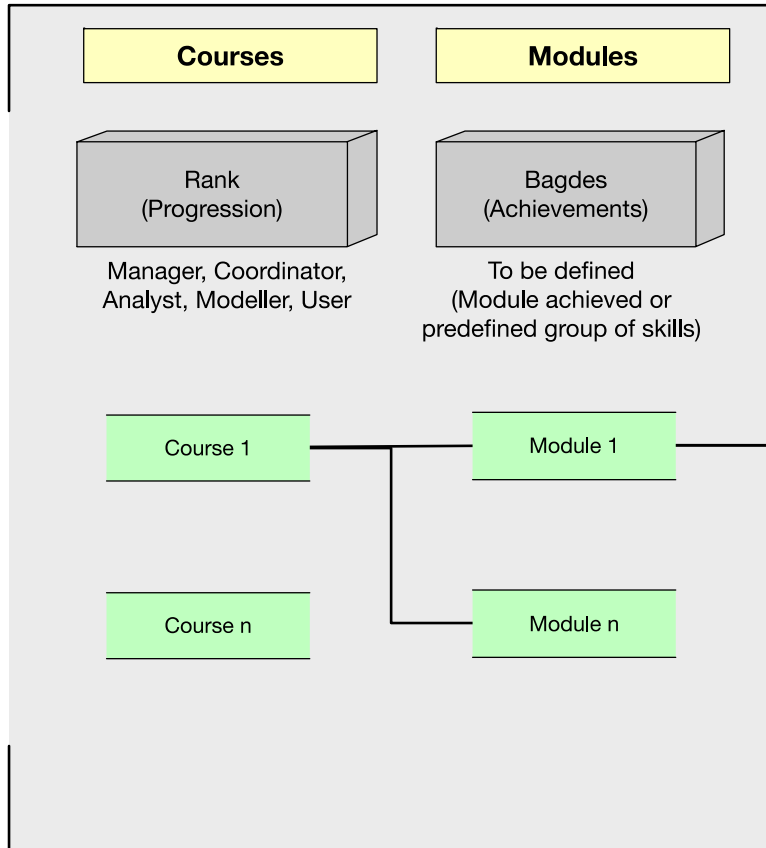
Training plan 2 (15% complete)

E-learning platform with gamification



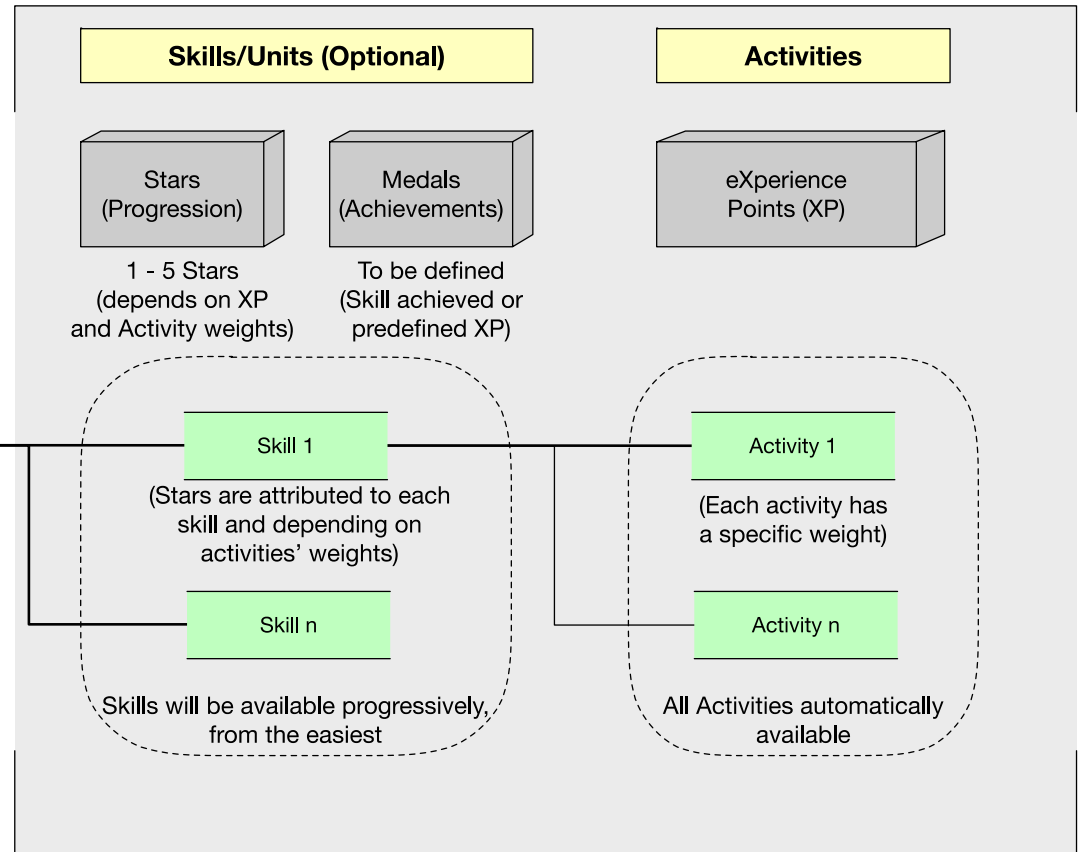
E-learning platform with gamification

Course Administrator



Accreditation

Module Administrator



Gamification



Digital Competencies for ALL...

- BIMCERT wants to incentivize digital transition for a more sustainable world, in a smart way and engaging all people
- We developed:
 - Small modules focusing digital competencies and emphasizing the energy efficiency problematic
 - Digital platform to disseminate the modules and engage trainees, using gamification features
 - A certification scheme that will push trainees throughout the learning path, while achieving badges and different certifications

Thank You very much!



aguiar.costa@tecnico.ulisboa.pt