

BIM EDUCATION - GLOBAL – 2019 UPDATE REPORT

ISSUE VERSION: V6.0

ISSUE DATE: May 2019

COMPILER: Kevin Rooney (NATSPEC)

CONTRIBUTORS: See list at end of report

EXECUTIVE SUMMARY

In January 2014 NATSPEC issued the first version of a report summarising the status of BIM education in a number of countries across the globe. The report has been updated and reissued each year since, with this report being version 6.0 of what is now an annual update to the original report.

Each year the countries included in previous versions of the report are given the opportunity to update their section to reflect the current status of BIM education in their respective countries. In the updated versions since the original 2014 report, additional countries have provided input, expanding the scope of the original report. This sixth edition of the report includes information for 17 countries.

Most countries are reporting BIM education being provided to Architecture Engineering Construction (AEC) students by their higher education and technical training institutions. However, this year it would appear that, in general, the number of courses being offered compared to last year has not increased significantly, with countries such as Chile and Hong Kong being the exception. This may indicate that the number of courses offering some form of BIM education may be reaching saturation in many countries. Many countries do however note that the content of the material being delivered in such courses can be expanded upon to cover more detailed aspects of BIM and its potential applications.

Studies carried out by some of the countries report that there are many challenges being faced by educators in regards to incorporating

BIM into the curricula, such as the knowledge base/skills of educators, resources available and a simple resistance to change.

Most countries' higher education institutions are including structured BIM education within the syllabus of their AEC courses, at both an undergraduate and postgraduate level. Countries such as Australia, Chile, Finland, Netherlands, Singapore, Sweden, UK and USA are reporting a significant volume of courses and subjects available. Many vocational education institutions are also providing BIM education to the industry's workforce.

Whilst the majority of BIM education being provided still tends to focus on the use of particular BIM software packages. It continues to be reported that training for both graduates and professionals in openBIM concepts, BIM management, Sustainable BIM, BIM for FM and Life Cycle Costing and working in collaborative BIM environments, appears to be increasing.

Countries including Australia, Canada, Finland, Hong Kong, Japan, Norway, Singapore, Sweden, Switzerland and UK have reported training and education being available in these topics.

As previously reported, certification schemes to validate the BIM knowledge of professionals in industry continue to be provided. Countries such as Australia, Canada, South Africa, UK and USA have all reported the existence or development of such schemes in their respective countries.

INTRODUCTION

Question

In October 2013 Richard Choy (NATSPEC) sent an email to a global group of parties with an interest in BIM, asking for a brief paragraph outlining the current status of BIM education in each of their respective countries.

This question was interpreted in two ways, with the respondents either describing the current level of BIM awareness/use in their country or the current level of training/higher education available. Some respondents also provided a much more detailed response than a brief paragraph.

Original report

A report summarising the responses received was compiled by NATSPEC and issued in January 2014. The report only included countries from which a response was received and was based purely on the responses provided. It did not attempt (or claim) to fully research and document the status of BIM education/awareness in each country.

Updated report

The report has been updated and reissued each year since, with this report being version 6.0 of what is now an annual update to the original report.

In the updated versions since the original 2014 report, additional countries have provided input, expanding the scope of the original report. This sixth edition of the report includes information for 17 countries.

Early in 2019 NATSPEC again contacted the respondents who had contributed to the previous versions of the report, offering them the opportunity to update their information to reflect the current status of BIM education in their respective countries.

This report again summarises the responses received. As per previous versions, this report is based purely on the responses provided; it does not attempt to fully research and document the status of BIM education/awareness in each country.

Two countries that have previously contributed, did not provide an update this year. Where no response was received from a previous contributor, it was assumed that the status of BIM education in their country has remained unchanged.

BIM EDUCATION - BY COUNTRY

AUSTRALIA

Education/Training

There are 30 Universities that are accredited to provide undergraduate programs in AEC disciplines. Of these, 11 provide programmes in all three discipline streams.

These 11 institutions have shown the greatest uptake of BIM in their undergraduate programs. However, this has mostly been at a basic level of information, simply covering the concepts of BIM or the basics of using a particular piece of BIM software. At this stage these courses are not yet looking at collaborative BIM across all three disciplines.

Many TAFE (technical) colleges are providing courses where BIM is incorporated into the syllabus. However, this is usually related to the use of specific BIM software packages.

The topic of BIM management or the procedures for working in a collaborative environment are not generally covered in these courses.

The University of Canberra (UC) has incorporated BIM into several different subject areas in its Building and Construction Management Degree program as well as introducing a specific new compulsory unit of study in BIM. Students are introduced to 3D modelling tools, complemented with scheduling and costing tools. In their final year, students complete a dedicated unit in BIM where they apply their knowledge in a real case study in 3D, to integrate the model with the time dimension to generate 4D, grasp 5DBIM via cost integrated modelling and run technical clash detection. UC is also planning the introduction of new subjects and programs, such as a Graduate Certificate of BIM and a Master's Degree of BIM in the near future.

In Western Australia, the North Metropolitan TAFE runs a short 3-day course titled 'Introduction to BIM'. The University of Western Australia offers a BIM Masters course.

NATSPEC has been providing an *Introduction to BIM* presentation to undergraduate students at Universities across Australia for the past 8 years.

NATSPEC also provides industry seminars on the use of the NATSPEC BIM Project Inception Guide, NATSPEC National BIM Guide, NATSPEC BIM Management Plan, the NATSPEC BIM Object Properties Generator and the recently released Open BIM Object Standard (OBOS).

Initiatives/Organisations

The ongoing development of the digital built environment in Australia is demonstrated with the recent release of the *Digital Engineering Framework* by TfNSW, the *Victorian Digital Asset Strategy (VDAS)*, and *Principles for BIM Implementation* in Queensland. These documents highlight the need to visit BIM concepts from various perspectives.

In September 2018, representative Australian universities attending the 42nd Australian Universities and Building Education Association (AUBEA) Conference announced the formation of the Australian BIM Academic Forum (ABAF), in order to promote the academic aspects of BIM. It was unanimously agreed that the work of ABAF be driven by the needs of industry. The objective of the group is to gain higher and consistent levels of student competence in BIM in tertiary education in Australia. This objective will be achieved by raising BIM-related curricula standards and promoting research-informed BIM education.

ABAF therefore recognises that the standard curricula for Australian universities must support the need for BIM-ready graduates across wider generic fields, covering the whole lifecycle of assets. The prime targets are the built environment-related courses, yet it is recognised that BIM issues may appeal to academic disciplines outside simply the built environment. The mission of ABAF is to:

- Foster integrated collaborative efforts for enhancing the quality and consistency of BIM-related curricula.
- Create a dynamic collaborative group to enhance and promote teaching, education, learning and research, linking the research and teaching aspects of BIM.
- Develop minimum requirements for BIM-related curricula, with the objective of bridging the gap between BIM university education outcomes and workplace performance requirements.
- Provide a collective voice to contribute to policy issues, funding priorities and agenda setting.
- Establish an open medium for communication across tertiary education in

Australia, thus, facilitating the sharing of knowledge; experience; case studies; views, etc.

- Collaborate for joint learning-based activities, competitions, games and research projects, both in Australia and internationally.

Three Universities (University of South Australia - UniSA, University of Newcastle - UoN and University of Technology, Sydney - UTS) were involved in a project supported by the Australian Government Office for Learning and Teaching called CodeBIM (Collaborative Building Design Education using BIM).

The project aimed to examine whether collaborative design education could be improved using BIM technologies; how best to adapt these technologies to existing AEC courses; and to develop new curricula for collaborative building design courses in a variety of delivery modes (traditional face to face, distance and block/intensive mode, for example).

A framework to help academics implement BIM (the IMAC framework), was developed and published. It aimed to help identify existing courses that could be modified to incorporate BIM and collaborative working practices, rather than having to create entirely new courses.

Outcomes from the CodeBIM project resulted in the development of new undergraduate courses. For example, an 'IPD studio' class was developed at UTS which involved multi-disciplinary students working over a semester on a project using BIM tools and processes, learning how to work in a collaborative team and to consider the information needs of their partner disciplines. At UniSA, similar collaborative BIM courses were developed.

Curtin University collaborated with Huazhong University of Science and Technology (HUST), Wuhan, China, to establish the Australian Joint Research Centre for BIM.

The centre focuses on developing leading research that integrates BIM with other advanced concepts and technologies and acts as an allied international platform for creating and sharing knowledge among researchers, engineers and innovators to improve the performance and productivity of building projects in the energy, mineral and construction industries across Australia and China.

The Australian Institute of Architects (AIA) and Consult Australia established a BIM education

working group of industry and academia members back in 2011. This group produced a series of documents, which were published in August 2012.

buildingSMART's National BIM Initiative report to Federal Government (2012) identified 6 key areas needing attention to drive the construction industry forward. One of the key areas identified was multi-disciplinary BIM education.

A working group was set up, and details can be found at buildingsmart.org.au.

The Australasian Procurement and Construction Council (APCC) and the Australian Construction Industry Forum (ACIF) jointly published their *Framework for the Adoption of Project Team Integration (PTI) and BIM* at the end of 2014. Education and training in PTI and BIM is a key theme of this framework.

As a result, APCC and ACIF established a BIM education working group to develop a framework and objectives for training providers. This was released early in 2017 and titled *BIM Education and Skills Framework*. A corresponding BIMcreds knowledge testing tool has been developed by buildingSMART to compliment the APCC/ACIF framework.

The Australasian BIM Advisory Board (ABAB) was founded in 2016 by APCC and ACIF, together with the key standard-setting bodies, NATSPEC, buildingSMART and Standards Australia, to promote best practice and consistent approaches to BIM standards, requirements and methodologies. The Board links industry leaders and expertise from government, industry and academia. ABAB published two documents during 2018; *BIM Process Consistency: Towards a Common Framework for Digital design, Construction and Operation*; and *Asset Information Requirements Guide – Information required for the operation and maintenance of an asset*.

Awareness/Uptake

BIM is being widely used on projects in Australia and by Australian consultants working on overseas projects. The use of BIM for FM/Operations/Maintenance is occurring on more and more projects across Australia. BIM is also trickling down to smaller consultants and smaller projects. BIM is becoming the norm. Some projects such as the Opera House and Pyrmont Bridge in Sydney are using BIM

retrospectively to create a working model for FM.

The NATSPEC National BIM Guide and BIM Management Plan are being increasingly adopted across industry and government both as a framework for building projects as well as within education programs. The recently released Open BIM Object Standard (OBOS) is also being adopted.

The NATSPEC BIM website, accessed by clicking on the BIM logo on the NATSPEC homepage (www.natspec.com.au), is a useful resource for general information on BIM, BIM R&D projects and the numerous BIM guidelines that are available.

CANADA

Education/Training

The goal of the buildingSMART Canada (bSC) and Canada BIM Council (CanBIM) Education Committee is to support and aid the development of BIM educational initiatives in Canada, to ensure that a consistent and relevant BIM education and training landscape responds to, meets, and is relevant to the realities of an ever-evolving industry.

In a focussed effort to enrich the Canadian BIM-ecosystem, the *CanBIM Professional Certification Program* was launched in 2014, with the intention of understanding BIM-related skills and knowledge as well as professional competencies and capabilities in the AECOO industry, in order to provide a point-of-reference and benchmarking to inform educational and training objectives. This program spawned the emergence of the *CanBIM Foundations Certification Program* which, through the establishing of course and program outcomes, assists educational institutions in aligning curriculum in response to industry needs and expectations. To date, the *CanBIM Foundations Certification Program* has certified upwards of 30 national and international BIM-related courses or programs.

A further goal of the bSC/CanBIM Education Committee is to provide a national and international benchmark for openBIM training.

The committee continue to be an active participant in the development of the buildingSMART International 'Individual Qualification' program, under which individuals receive foundational BIM training through an accredited training provider and then are

eligible to complete an on-line exam to confirm their fundamental understanding of openBIM.

The bSC/CanBIM Education Committee also continues to explore opportunities to develop reciprocity between the *CanBIM Foundations Certification Program* and the *bSI Individual Qualification Program* for the Canadian BIM community.

Initiatives/Organisations

Practice Manual

The *Canadian Practice Manual for BIM* was launched in 2017 and continues to provide direction on the application of BIM practices and processes in Canada. It is being used to develop Module 6 of the Learning Outcome Framework. The practice manual is multi-disciplinary, multi-volume and is a comprehensive guide that reflects both international best practice as well as the use of BIM in Canada. It builds on the Roadmap to deliver value to industry.

bSI Individual Qualification Program

The program exists to support training organisations to deliver internationally standardised and recognised training content. bSC/CanBIM will not be delivering training itself, but will define the learning outcomes and manage the approval of training providers and the testing and qualification of individuals. A Canadian module is currently being developed which will be incorporated into the bSI Individual Qualification Learning Outcome Framework, with the intention to launch the program by the end of 2019.

The program goals are:

- To standardise and promote openBIM training content.
- To support and accredit training organisations.
- To test and certify individuals.

CanBIM Certification

The *CanBIM Certification Program* continues to be well supported. It was launched in 2014 with the objective of bridging BIM education and the AECOO industry's implementation and use of BIM through the pursuit of excellence in certification. The pillars of the *CanBIM Certification Program* are:

- Professional Certification: A tiered, four-level certification program for BIM Professionals assessing knowledge, skill and professional workplace experience.

- Foundations Certification: Assessment and certification of courses and/or programs offered by:
 - . Educational Institutions both private and public.
 - . AEC industry training providers for industry professionals.
- Company/Organisation Certification: Assessment and certification of BIM-enabled companies and organisations.
- Provision of guidelines for a Continued Professional Development framework for certified individuals.

Satellite Sessions

These sessions are a joint event where CanBIM/bSC, Industry partners and Academia present on relevant topics within the host region. These events are intended to bridge the gap and unite the interests between Academia and Industry. The host Academic Institution has the opportunity to highlight its BIM related programs, a student from the host school is invited to present a BIM-relevant topic and the remainder of the agenda is filled out with Industry leaders from the host region. It's an opportunity to educate and connect all stakeholders over the course of an evening, while also showcasing the latest developments of the educational institutions across Canada. CanBIM/bSC have planned for three Satellite Sessions in 2019, Ottawa (March 6), New Brunswick (September 25) Saskatchewan (October 17-18), with others currently being evaluated.

Student Affiliate Memberships

CanBIM/bSC now have 20 Post-Secondary Education Institutions in its Membership. As a CanBIM/bSC Member, Educational Institutions have the ability to offer FREE Student Affiliate Membership to all of their students. The Student Affiliate Membership opens up opportunities for Students to engage with industry leaders across Canada and globally. Students have the opportunity to participate on and engage with one of the following nine CanBIM/bSC Committees:

- Technology Committee.
- General Contractors Committee.
- Trades Committee.
- Designers Committee.
- Owners Committee.
- Education, Research & Certification Committee.

- International Committee.
- Legal Committee.
- Marketing Committee.

Students are asked to participate in a monthly call to help keep the Committees organised through meeting minutes and agenda creation and dissemination. Students are also asked to participate in working on various industry-based tasks giving them direct exposure to the challenges facing our discipline-based Committees. Further to the CanBIM/bSC Committees, students are continuing to engage as volunteers at the CanBIM/bSC Regional and Satellite Sessions. This is a great networking opportunity to be at an event meeting the industry leaders and learning from the many presentations and panel discussions about the most relevant subject matter.

Student Connect: An Online Networking Platform

Student Connect is an online portal to be hosted on the NEW CanBIM/bSC Website in the spring of 2019. This portal will allow students to login and explore industry-based research opportunities made available by CanBIM/bSC Members. These research opportunities would be posted within the portal by CanBIM/bSC Member companies looking to investigate the value proposition for market ready technologies. Students would volunteer or apply to be hired, as research interns, to help deliver on the research goals around the technology or project.

Additionally, CanBIM/bSC will offer functionality within the same portal for Students to upload a profile and store information and documents relating to their background and experience. This is a place where students and employers can connect for the purpose of research and or potential employment opportunities. CanBIM/bSC are working to create opportunities to deliver significant value for Students, Educational Institutions and its Industry Members.

CHILE

Education/Training

At a university level, Chile's strategy has shown good progress for massifying BIM training in the 42 universities that give AEC-related degrees, with an increase of 81% across the whole country. Moreover, 84% of the 106 programs existing in 2018 have included BIM content in mandatory courses on their curricula.

This increase is partially due to the dissemination work of different academic, public, and private institutions, as well as software vendors, through the development of seminars, workshops and the creation of 25 new continuing education courses, aligned with the *Matrix of BIM Roles* (Planbim 2017). Also, CORFO has granted 870 scholarships for BIM training courses across the whole country, through its program www.becascapitalhumano.cl.

At a school level, a task force was formed with the support of the Ministry of Education, to lead the 'e+bim' project, aiming at training teachers and students of technical schools, and coordinating internships in important architecture, engineering and construction firms, promoting active learning, based on real experiences and 'learning by doing' methodologies.

As for dissemination activities related to BIM education in Chile, in January 2018, CORFO's Planbim developed the *Seminario Internacional de Formación de Capital Humano en BIM* [International Seminar on BIM Human Capital], with the participation of renowned national and international speakers, who presented the new challenges for human capital formation, promoting collaborative training models and interdisciplinary learning.

In this context, the *Matrix of BIM Roles* was presented, a document providing guidance to academic institutions on the different BIM capabilities the work force needs to acquire.

All these initiatives will help reduce the gap of human capital with BIM education, estimated for 2020 to be approximately 105,000 professionals and technicians.

Initiatives/Organisations

Since 2016, Chile has been promoting BIM in public institutions by creating Planbim, an initiative part of the Digital Transformation Committee of CORFO (Economic Development Agency), depending on the Ministry of Economy. This initiative, using the procurement capacity of the State as a driving force, is articulating the process of implementing BIM in public institutions, being a requirement of most public tenders as of 2020.

Simultaneously, progress has been made in the definition of a BIM standard for industry. During 2018, through multisectoral work, Planbim developed the *BIM standard for Public*

Projects. Based on international standards, it defines and guides the information exchange process between contracting public and private companies that take part in public tenders. This document will be made available in June 2019.

This year a public-private agreement was reached between BIM software companies and CORFO's Planbim. This initiative is pioneering competition and aims at disseminating the benefits of BIM interoperability, while also promoting the mass use of these technologies. Companies that are part of this agreement are: Sonda, Geocom, Microgeo, Construsoft, Datco, Soluciones BIM, Archisoft and Planbim.

Representatives from several industrial sectors and Planbim kicked off the development of a *BIM Maturity Matrix*, allowing to guide different institutions and companies in the step-by-step process needed to successfully implement this methodology. It is based on four elements: strategy, processes, human capital and technology. Because of this work, during 2019 a web platform will be available for self-assessment and comparison of maturity levels with their industrial peers.

In Latin America, Chile organized, in May, the first meeting for the development of a BIM network of Latin American countries, aiming at building a shared vision of government programs promoting BIM in the region, and allowing countries to exchange information and experiences, and explore potential common goals and collaboration efforts.

Representatives from five countries participated in the first meeting: Argentina, Brazil, Chile, Mexico and Uruguay. In the second meeting, held in Brazil in November, Colombia and Costa Rica joined.

Awareness/Uptake

More and more companies in the private sector are either implementing or interested in implementing this technology by 2020, as reported by 81% of the surveyed companies developing housing projects for the Ministry of Housing and Urban Development. This was also shown by the high attendance of the seminar *Por qué implementar BIM al 2020: Casos de éxito de empresas internacionales* [Why implementing BIM by 2020: Success cases of international companies], which aimed at providing information on BIM implementation processes in public entities, on

how the new BIM requirements will be included in future tenders, and showing BIM use cases.

The international seminar *Trabajo Colaborativo y Flujo de Información en BIM* [Collaborative work and information flow in BIM], organized by software companies in Chile and Planbim, was a pioneer in the area. The main target of this event was to develop a BIM interoperability demo (IFC and BCF), that allowed to show, live and in real-time, the data and file transfer between nine different software and players of the different areas of a project, who shared information regarding the design stage/phase of a building.

This year, the Faculty of Architecture and Urbanism of Universidad de Chile finished a research project titled *Estudio de costos relacionados con la implementación de metodologías BIM* [Research on the costs related to the implementation of BIM methodologies], developing a benchmarking tool for the BIM maturity of Chilean and international companies, allowing users to identify the financial aspects that make its adoption easier or more difficult.

Regarding public entities, the surveying of tender process and requirement mapping for BIM (EIR) has been completed for nine different project types. Based on this, the first experimental public projects will be carried out in 2019.

CHINA

Education/Training

The 1st Advanced Training event on BIM Application & Industry Collaborative Innovation, by the China BIM Union, was hosted in September 2015. Training events have been held every six months since, with seven sessions successfully completed. The training events last for 6 days, and the course content includes the following 5 research topics:

- Overview of BIM application and research progress.
- BIM technology research and achievement display.
- BIM applications development and project practice.
- Collaborative innovation platform of digital BIM industry.
- Completion result report.

The main programs of the course, included keynote speeches, thematic studies, academic interflows, discussions with experts and site tours, with full online live broadcasting. Students only need to bear the cost of accommodation and transportation.

The seven sessions of Advanced Training have trained 560 BIM professional technical personnel and senior management personnel. The training provides important talent support for the sustainable innovation and development of the AEC/FM industry, and plays a positive demonstration effect in leading the creation of a new pattern of talent education and training in China.

Initiatives/Organisations

As a public welfare organisation, the China BIM Union, composed of 16 union members, was founded in January 2012.

In 2017, 13 practice-based BIM mode (P-BIM) standards have been issued, jointly by the China Association for Engineering Construction Standardization (CECS) and the China BIM Union. Another 9 P-BIM standards are planned.

The objective of China's P-BIM standard system is application compatibility. In 1993, ISO/TR 14177 technical report titled *Classification of Information in the Construction Industry* embarked the construction industry on the journey of information classification.

26 years later, the China BIM Union has published a technical report titled *Breakdown and Coding of Construction Industry Information: A&bCode*. The A&bCode construction information breakdown coding system is a coding system for the construction industry, aiming to satisfy the informatisation developments of the construction industry.

Awareness/Uptake

In the object-oriented method, concept of essential characteristics of things, abstracted from entities with common attributes, is 'Class'.

In the systems engineering-oriented method, elements in the system are regarded as 'alive' subjects with their own purpose, initiative and enthusiasm, and it is called 'Code'.

We can restructure the function of construction industry application systems by means of A&bCode, so as to modularize the AEC industry application tools and generate AEC industry applications in a smaller, simpler, more professional and more delicate way.

Establish the AEC industry information network exchange system based on A&bCode in order

to further develop and facilitate the AEC industry internet network system towards four primary objectives of minimal network architecture, minimal internet trade pattern, maximum network security and privacy protection follows GDPR.

Similar to internet network architecture, several rules are suggested when it comes to establishing AEC industry internet network structure:

- The ACE industry network, equipment, and system data exchange interface code, A&bCode, should be the equivalent of the fixed IP address of internet public network.
- The A&bCode series of standards for P-BIM applications function and information exchange should be the equivalent of the TCP/IP of Internet Protocol Suite.
- The HIM network operating system of A&bCode-based AEC Industry internet should be the equivalent of the Internet Domain Name System (DNS).

CZECH REPUBLIC

Education/Training

In the Czech Republic there is a lot of BIM education and training through BIM seminars, workshops and presentations led by CzBIM (Czech BIM Council), CAS (Czech standardisation agency), Universities, companies, software vendors, technical chambers etc.

Leading Czech Technical Universities gradually implement BIM into their curriculum, mainly as standalone subjects or as innovations of the regular ones.

There were only voluntary subjects focused on using particular BIM software in the past but now, they are aiming to implement compulsory subjects focused on basic information of BIM at the undergraduate level, which would be developed further to more details during the next level of the studies.

The content of the subjects would vary depending on the branch of study at both undergraduate and graduate levels. BIM becomes focused more on interconnection of Construction Management, Project Management and teams' cooperation.

BIM starts to be a part of research and development projects on a regular basis. Universities also connect more with professionals in both research and educational areas.

BIM is also being implemented in secondary education (especially at technical high schools) mainly in CAD based subjects. There is no dedicated BIM study branch or programme.

Initiatives/Organisations

CzBIM – Czech BIM Council is a non-profit organisation which is focused on support of BIM implementation in the Czech Republic. It assembles professionals from both companies and individuals active in the BIM area. The main goals are popularization, education, standardisation and implementation of BIM. CzBIM hosts an annual conference titled ‘BIM DAY’. There were several documents published and many others have been prepared under its wings. It also plays a key role in the negotiation with ministries and standard bodies.

It resulted in success in 2017 when the Czech government approved a BIM implementation document which covers a strategic plan for the next 4 years. The main goal is to prepare the Czech construction environment for BIM - aiming to the beginning of 2022 when big public projects should use BIM (this document is called *BIM Policy 2022*).

CAS – Czech standardisation agency is a funded organization of the Czech Office for Standards, Metrology and Testing (ÚNMZ). At the end of 2017 CAS established a new department to execute the tasks of the *BIM Policy 2022*. In 2018, there were 6 workgroups established, from which one is focused on education and public relations. This group, in cooperation with 3 Czech Technical Universities, faculties of Civil Engineering (from cities of Prague, Brno, Ostrava) and with the Ministry of Industry and Trade, have initiated lifelong learning BIM courses. These courses are designed for architects, engineers, contractors, public clients, project managers and facility managers. The first participants are expected in 2019. However, detailed programs of these courses are still in development and will follow other outputs of the *BIM Policy 2022*, where there are big tasks like standardization and classification now.

Awareness/Uptake

There are a few BIM projects currently running (big projects) but 2D is still used for the majority of projects. Some of the big contractors are running their own pilot projects.

Designers are still a bit sceptical of BIM, primarily due to the cost of software and education/training. But some of them are starting to see the possibility of market advantage if they provide this service and knowledge.

Quite a new impulse came from clients who finally start to see the benefits of BIM. Usage of BIM in the operational phase is a big topic now but there are no practical impacts.

Rising awareness of BIM in the Czech Republic is also supported by the need of society to search for modern technologies and their use.

FINLAND

Education/Training

Universities, Universities of Applied Sciences (UAS) as well as Vocational Education Institutes provide BIM education for their students. All current construction and architecture students study BIM to some extent included in their professional courses.

Some UAS also provide whole bachelor's degree for Architectural education where the key areas are modeling (BIM) and model utilization: visualization, renovation, maintenance of buildings, lifecycle thinking and energy efficiency. Different courses are also integrated in various AEC programs e.g. BIM for Building Production; BIM for Structural Engineering; Simulation Tools for Building Services, BIM in Housebuilding Projects (integration of BIM holistically to building process).

Some Vocational Education Institutes provide continuing education related to BIM e.g. CAD-BIM utilization for HVAC on construction sites. A new curriculum for a degree program for design assistants has been updated with inclusive BIM covered in every module of the study (implementation started in August 2018).

For graduate, postgraduate and further education students, there are several options and possibilities offered:

- Special Courses and Further Education is provided by some UAS:
 - . BIM for Vocational Education Teachers, 15 ECTS.
 - . BIM Basics Online, 5 ECTS.
 - . BIM Coordinator, 15 ECTS.

- . BIM Manager, 5 ECTS.
- . <http://metropolia.fi/bim>
- Software companies:
 - . All vendors (Solibri, Autodesk, ArchiCAD, Trimble, Novatron, Symetri, Civil Point, Magicad, etc.) are providing BIM training for their own software solutions.
 - . Various courses provided by a variety of players:
 - . www.symetri.fi/koulutus/
 - . www.magicad.com/fi/koulutus/
 - . <https://mad.fi/tapahtumat/archicad>
 - . www.tekla.com/fi/palvelut/koulutukset
 - . <http://novatron.fi/tapahtumat-2018/>
- Large companies such as Skanska, YIT, NCC, Lehto Group (construction) and Senaatti (state client office) arrange focused in-house training as required in co-operation with Universities and UAS's.
 - . <https://lehto.fi/lehto-vastaa-tietomalliosaajapulaan-kaynnistaa-oman-leka-akatemia/>

Initiatives/Organisations

There are a number of initiatives taking place in Finland, including the following:

- buildingSMART Finland has over 140 company members and user groups for Education, Building, City planning, Dictionary and Infra are all up and running. <https://buildingsmart.fi/en/home/>
- KIRA-digi, a Government's key project, involves ministries, municipalities and the KIRA forum. The aim is to create an open and interoperable information management ecosystem and harmonized practices for the built environment. <http://www.kiradigi.fi/en/front-page.html>
<https://kirahub.org/>
- COBIM, the national common BIM requirements, was published in March 2012 and it is now in widespread use. English, German, Estonian and Spanish translations of the requirements have also been completed and four Annex for building owners were published. Updating the COBIM guidelines is currently ongoing.
- Guidelines similar to COBIM, but for Infrastructure (Common InfraBIM Requirements), have also been developed.
- The Finnish XML based data format for neutral BIM data exchange for infrastructure is now a buildingSMART project.

- The first Finnish textbook for BIM education: 'BIM on a construction site' was published in 2016 by Building Information Ltd.
- ROTI 2019 is a report and an expert assessment (published every second year) on the condition of the built environment. It offers impartial information and viewpoints for experts, decision-makers and citizens alike. The ROTI report raises the issues of architecture, planning, design, and art in the built environment. The section 'Digital Solutions' is a part of the 2019 ROTI. ROTI gives recommendations like: improving the digital capacity and skills of both individuals and organisations, standardizing the electronic system interfaces to be open and machine-readable, determining common goals for RDI activities in the real estate and construction industry, significantly boosting construction companies' own research and development investments etc. www.ril.fi/fi/alan-kehitys-2/roti-2019

Awareness/Uptake

BIM is now in everyday use in Finland. Large firms such as Skanska, NCC, YIT use BIM for 100% of their own production. Furthermore, BIM sessions (training) relative to specific uses depending upon the profession and activities are organised on a regular manner.

Public sector clients are using BIM on some of their projects.

In Finland BIM always means using open standards: IFC for buildings and LandXML for infrastructure.

BIM education and training was carried out for Vocational Education Teachers and interested UAS teachers as a project to promote BIM education integration on all education levels through Ministry of Education research.

The first draft for the skills and learning outcomes matrices related to BIM and energy-efficiency have been published in BIMEET, a project funded by the EU Horizon2020 research program. BIMEET project participants include LIST Luxembourg, Cardiff University UK, CSTB France, BRE UK, HOT Luxembourg, CRES Greece, VTT Finland and Metropolia UAS Finland.

Different levels of BIM courses/trainings will be planned and executed based on the learning outcomes. Collaboration with other EU projects and buildingSMART International, focusing on

education and professional certification systems, is an ongoing effort to develop EU wide course content and delivery methods.

HONG KONG

Education/Training

The Construction Industry Council (CIC) continues to develop itself as a Centre of Excellence for BIM, formulating strategies for market transformation and promoting cross-discipline collaboration and wider adoption of BIM.

CIC have expanded the spectrum of BIM training courses at the BIM Innovation and Development Centre. Apart from the BIM basic modelling, advanced modelling and data management, CIC offers additional day and night courses, covering BIM modelling for civil engineering, BIM object development and BIM Management in the areas of information management at different stages of construction projects. To cope with the strategic goals and development of CIC, The Hong Kong Institute of Construction (HKIC) was established and has been responsible for BIM related courses since January 2019.

Free and open 'BIM Awareness Seminars and Workshop' are organised to promote the awareness and understanding of BIM while 'BIM Talks' are organised to accelerate BIM adoption in Hong Kong by inviting local BIM experts to share their experience of implementing BIM in real life projects. Online versions of both events have been broadcast over CIC's YouTube channel.

To foster the collaboration with higher education institutions on the development of BIM teaching courses and to introduce BIM knowledge into higher education, CIC have signed Memoranda of Understanding (MoU) with seven faculties in six local higher education institutions including The University of Hong Kong, The Hong Kong University of Science and Technology, The Hong Kong Polytechnic University, City University of Hong Kong, Chu Hai College of Higher Education and The Chinese University of Hong Kong.

Initiatives/Organisations

In April 2018, an online CIC's BIM Portal was launched to provide a centralised and convenient platform to access and share information about BIM, including information on CIC's BIM training, local events, BIM

showcases, and local and overseas BIM standards and guidelines, etc.

A 'Production of BIM Object Guide - General Requirements' was published in June 2018 to standardise the minimum requirement of BIM object production for BIM object creators, which is a pre-requisite to the compilation of a comprehensive and usable BIM object library.

The Inaugural Asia Pacific Regional BIM Group Meeting and Forum was held in Hong Kong in September 2018 to provide a platform for practitioners from around the region to share their insights and experiences on how BIM improves construction productivity. The Chairperson of Committee on BIM, Ms. Ada FUNG representing Hong Kong, has been appointed as the chairperson for the first term of the Group with members from Singapore, Vietnam, China, UK/EU, etc.

JAPAN

Initiatives/Organisations

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) established *BIM guidelines for government buildings* in 2014.

The focus is on the use of BIM, from the schematic programming phase to post-project maintenance.

In the construction field, BIM utilization for public works is advanced, but CIM (Civil Information Modelling and Maintenance), which is BIM of the civil engineering field, has begun in earnest. A draft version of the *CIM Guidelines* was created in 2018. CIM aims at new construction linked with robot introduction ICT, IoT, AI, and is redefined as 'i-Construction' with the goal of increasing the productivity of the construction sector by 20% by 2025.

Technology development for i-Construction, research and development investment is being carried out by the Public / Private R & D Investment Strategic Expansion Program (PRISM), and a budget of 2 billion yen has been spent on R & D investment for the 2018 financial year. Of this, for architectural building-related matters, 40 million yen for building a BIM object library and 20 million yen for developing a BIM building verification examination, were allocated under the supervision of the Building Research Institute (BRI). As part of this R & D, a BIM object library, providing an environment and a draft code of practice for BIM building confirmation have been developed. PRISM plans to

continue until 2021, and by that time the goal is to develop a common BIM usage environment for building production.

Awareness/Uptake

The role of the consortium is growing with respect to PRISM R & D investment. The BIM Library Consortium was established for the creation of the BIM object library before the PRISM investment began, and a research committee was established for the BIM building confirmation for PRISM investment, and the related construction related organizations, private companies involved in design, construction and parts production, and software vendors cooperated with these consortium and committee. They are working to develop a common BIM usage environment.

In response to such movements of private enterprises, a system to support the building administration side has been put in place, and the BIM Promotion Council has been established under the Ministry of Land, Infrastructure, Transport and Tourism, Housing Bureau Building Guidance Division in April 2019.

NETHERLANDS

Education/Training

BIM is taught in all three technical Universities of the Netherlands at both Bachelor and Master levels.

All 14 Universities of applied science with a built environment department are organised in the BIM Education Network by the national Building Information Council (BIR). The network is supported by school-management but populated with mainly lecturers.

The Netherlands has approximately 50 institutions for intermediate vocational education. BIM adoption by these 50 institutions is also rising.

Initiatives/Organisations

The Building Information Council (BIR) is very active in the development of strategic policies for BIM in the construction and civil works industry.

The BIR's BIM Education Network was created in 2013 to raise BIM awareness among lecturers. In 2017 the network presented its first version of the minimum BIM level for BIM knowledge graduates of all 14 Universities of applied science.

In 2018 a similar BIM network for intermediate vocational education has been established aiming for experience exchange among

teachers of the various institutions. At the end of 2018 a first version of their minimum BIM level for graduates will be presented.

In all before mentioned networks and activities, companies throughout the whole construction chain are involved and represented.

In 2017 The BIM Education Network organised its first annual BIM education conference (www.bimonderwijsdag.nl). Over 500 people visited this event where students, lecturers, and BIM experts shared knowledge and learned about new BIM developments. Among others, the highest-ranking government official of the Ministry of Education was present to show his support to the initiative.

In advance, 8 Student-teams battled for two days to earn the title 'Best Student BIM team of 2017'. The assignment was to redesign an old industrial building into a desirable place for young people to live. Not only the building had to be designed, but also the connection to public transportation. The winning team visited Autodesk University 2017 in Las Vegas.

The CB-NL (Concept Library) was initiated and agreement was reached with buildingSMART International on collaboration with buildingSMART Data Dictionary (bsDD).

The Netherlands construction industry as a whole is involved in the project, over 200 people. It covers construction, civil works and geospatial environment, with new technology and new content being developed.

Awareness/Uptake

There is strong growth in the diversity of educational offerings. In particular the essential 'soft skills' and organizational change are increasingly being discussed.

There is also a strong undercurrent in the development of BIM-based quality assurance.

The development of knowledge leaflets by the BIR is helping to create greater awareness in the industry about opportunities and possibilities created by using BIM.

At this moment 5 knowledge cards have been developed and translated into English. They can be accessed at www.bouwinformatieraad.nl/main.php?mode=download_cat&cat_id=9

NEW ZEALAND

Education/Training

BIM is being taught by most tertiary institutions offering construction courses with new programmes being developed and BIM being integrated into existing content. Most universities have BIM based research projects underway.

Software vendors continue to provide specific training and regularly promote new BIM products or versions.

Initiatives/Organisations

Construction Information Ltd collaborated with NATSPEC in Australia to develop the Open BIM Object standard (the OBOS) which was released to the market at the end of 2018, to a positive response.

BIMinNZ are a nationwide industry and government alliance established in Feb 2014 to coordinate efforts to increase the use of BIM in New Zealand.

They have organised the BIMinNZ Conference in Wellington in May 2019, with the view to “provide relevant and inspiring local and international examples of where BIM sits within the project environment. Our aim is for delegates to engage with both the content and their fellow attendees; for them to be inspired, leaving the forum to play a role in transforming our industry”.

BIMinNZ’s main communication platform are the networking groups in Auckland (BIMak), Wellington (BIM.well) and in Christchurch (BIMsiNZ), which meet quarterly and are well attended (80 plus people). The aim of these groups is to look to involve a wider audience beyond the usual BIM practitioners to engage building owners, developers, and the construction sector in BIM.

BIMinNZ are currently undertaking a review of the NZ BIM Handbook, conducting workshops around the country to garner feedback. It is not a major rewrite but a refinement of what is there with expansions in a few areas, in particular early contractor involvement and asset metadata requirements. The work will also look to ensure that the handbook is aligned with the OBOS.

Construction Information Ltd worked with government departments to restructure the NZ Asset Metadata Schema to align with IFC and

BIM based content. The schema covers residential and light commercial buildings, potable water, storm water, and sewers. The intent of this schema is to provide a framework for parties across the BIM value chain to use to build their metadata requirements on to ultimately enable a complete digital dataflow. A National Technical Standards committee has been formed to oversee the development and introduction of this.

A consortium of universities and industry partners have won a government research grant under the title of Building Innovation Partnerships Projects which has BIM and metadata as a key enabler to a number of the research projects. The main themes are:

- Better investment decisions.
- Enabling integrated design, construction, and operation.
- Fit for purpose building components.

Awareness/Uptake

BIM has become business as usual for larger practices and on larger projects but has been slow to expand outside of this.

There are some developments around the use of BIM into the operating phase of buildings but this is at an early stage.

NORWAY

Education/Training

There are at least seven faculties that are running openBIM courses and several colleges that have special BIM studies.

There is no central government requirement for BIM education at a tertiary level. A few engaged teachers are driving openBIM education in colleges and Universities and buildingSMART Norway (bSN) has initiated a programme to support the teachers who are using BIM in their classes.

The collaboration will support, coordinate and raise awareness of digitalisation of the industry.

In June 2014 bSN released an educational program. The program focused on quality assurance of content and output of courses. Three teaching plans (Basic, AEC and Client) have been released by bSN, specifying the minimum requirement for BIM training at two basic levels.

Several private companies have developed courses based on these teaching plans. The teaching plans do not include specific software training but focus instead on how to behave in a multi-discipline openBIM environment. The plans are free to use for bSN member organisations.

In addition, bSN has established a web-based multiple-choice user certification system, allowing users to get a diploma for their openBIM knowledge.

Initiatives/Organisations

In March 2015 bSN released the BIM Guideline database. The bSN guide allows clients to specify requirements for BIM deliveries without having specialised BIM expertise in the organisation.

The client can configure the requirements with an intuitive wizard, according to the intended BIM usage.

Several Norwegian organisations are involved in the development and revision of National and International standards for digitalisation of business processes.

bSN has 80+ member organisations, representing 25% of the total AEC industry turn-over. bSN coordinates most industry initiatives and BIM User Groups for all disciplines, in a series of arenas.

Awareness/Uptake

Government for Municipalities and Modernisation and its legislative body the Norwegian Building Authority are fully aware of the need for digitalisation.

The Building Authority runs and supports several initiatives in collaboration with the industry.

The projects using and making benefit of openBIM can be counted in the hundreds, from the large openBIM award winning project "New Østfold Hospital", to small residential refurbishments.

The next frontier is to digitalise construction product information and FM/operational documentation.

SINGAPORE

Education/Training

There are 11 Institutes of Higher Learning (IHLs) providing full-time and part-time

programmes with BIM/VDC (Virtual Design & Construction)/IDD (Integrated Digital Delivery) curriculum. Third-party BIM software educational vendors were also crucial in training, especially for professionals. To date, close to 12,000 students and professionals have been trained in BIM/VDC/IDD.

The Institute of Technical Education (technical college) have integrated BIM, mainly on software capabilities, into their skill qualification programmes for architectural space design, civil & structural engineering design and facility systems design.

Four out of five polytechnics provide BIM modules in the three discipline streams and beyond, such as in sustainability-related programmes.

Five out of six Universities offer BIM modules in their bachelor and master programmes. Nanyang Technological University and the National University of Singapore have also launched Centres of Excellence in BIM to focus on nurturing BIM R&D capabilities.

The Building and Construction Authority's education and research arm, the BCA Academy, takes the lead, going beyond BIM and Virtual Design and Construction methodologies into Integrated Digital Delivery concepts for its curriculum.

BIM/VDC/IDD contents are incorporated into BCAA's full-time diploma programmes covering all disciplines across the construction value chain, joint degree programmes between BCAA and Universities, such as Singapore University of Social Sciences and the University of Newcastle (Australia), as well as Master programme partnering with the University of Florida.

Currently, BCAA offers three specialist diplomas in BIM, VDC and Computational BIM, and six certification courses on BIM Modelling (for Architecture, Structural and MEP), Management, Planning for Owners and Facility Managers, and MEP Coordination.

BCAA also organizes seminars, workshops and short courses on BIM/VDC/IDD such as in the areas of BIM Quantity Take-Off, BIM Scheduling and Process Management, Computational BIM, BIM for Building Lifecycle

and Facility Management as well as Data Analytics.

To support the development of leadership capability in Design for Manufacture and Assembly (DfMA) and IDD, BCAA partners with Imperial College, London to organize an Executive Development Programme on DfMA and IDD Leadership.

More than 2,900 full-time students and 9,000 professionals have been trained through the BCAA's BIM/VDC/IDD-related programmes.

The BCAA also launched the Centre for Lean and Virtual Construction (CLVC) at the end of 2015 as a first-of-its-kind immersive and experiential facility for BIM, VDC and Lean Construction, to encourage IHLs and industry firms to utilise the Centre for training and experiential learning purposes.

The Singapore Contractors Association Limited (SCAL) Academy has also trained more than 200 students from its member firms in BIM software. The Singapore Institute of Architects also holds programmes engaging their members in BIM management and implementation.

Initiatives/Organisations

The Building and Construction Authority formulated the 1st BIM Roadmap in 2011 to drive the adoption of BIM under 5 areas:

- Public sector taking the lead.
- Promoting success stories.
- Removing impediments.
- Building BIM capability and capacity.
- Incentives for BIM adopters.

By 2015, the 1st BIM Roadmap achieved BIM adoption in most of the larger consultants and contractor firms in the industry. The 1st BIM Roadmap also saw the adoption of BIM in 102 public projects, 181 projects meeting mandatory BIM electronic submission requirements, SGD20 million committed to more than 700 firms who achieved an average of 21.5% efficiency gain, launch of the Singapore BIM Guide, Essential BIM Guides, BIM e-Submission guidelines and software-specific template guidelines.

The 2nd BIM Roadmap was launched in 2015, to advance the use of BIM in an integrated

manner over the building life-cycle under 4 areas:

- Focus on VDC:
 - . Driving BIM collaboration throughout value chain.
 - . Building BIM capability of specialist contractors.
 - . New training programmes and facilities (such as the Centre for Lean and Virtual Construction) at all levels.
- BIM for Design for Manufacturing and Assembly (DfMA).
- BIM for Facilities Management and Smart Buildings.
- Research & Development.

As part of Singapore's Construction Industry Transformation Map (ITM) launched in October 2017, Integrated Digital Delivery (IDD) is one key area identified to transform the built environment sector. Enabled by BIM, IDD aims to fully integrate processes and stakeholders along the value chain from design, fabrication, to assembly-on-site and operations and maintenance of buildings through advanced info-communication (ICT) and smart technologies.

The IDD Implementation Plan was launched in November 2018 to encourage more built environment sector firms to go digital.

The three focus areas under the Plan include:

- Raising awareness on the benefits of IDD through demonstration projects.
- Developing the IDD ecosystem, with enabling solutions, platforms and standards.
- Strengthening the industry's competency in IDD.

The Building and Construction Authority also engages industry leaders through the new IDD Steering Committee and subgroups, as well as practising BIM/VDC/IDD experts from various disciplines both upstream and downstream through the BIM/VDC/IDD Managers Forum.

To help the industry go digital with IDD, the BCA Academy is offering IDD related training programmes at various levels. These training programmes include the application of data analytics (e.g. analysis of data to identify bottlenecks), and artificial intelligence in construction (e.g. multiple design options – optimised based on the developer's requirements – can be quickly generated based on machine learning of previous designs). These courses will help equip

building professionals in Singapore with the necessary skills and expertise to execute IDD projects.

Awareness/Uptake

Continuing the success of Singapore Green Building Week (SGBW) and Singapore Construction Productivity Week (SCPW), BCA will partner with all the 12 Trade Associations & Chambers (TACs) to organize a new flagship event, International Built Environment Week (IBEW) in September 2019.

The event aims to provide a platform for industry leaders and renowned professionals from the global built environment industry to exchange ideas and experiences on policies, business solutions and technologies, as well as explore business opportunities.

As part of the event, an international design competition targeted at full-time local and international students from tertiary institutions in the respective countries will also be held to raise awareness and build digital competencies in Green, Design for Manufacturing and Assembly (DfMA) and IDD concepts.

SOUTH AFRICA

Education/Training

The BIM Academy Africa has engaged with 16 tertiary universities and colleges including supplying a handful with different curricula BIM courses at university level.

Changing South African (RSA) university curricula is a fraught and time-consuming activity and thus the introduction into the mainstream coursework will still take many years to action. However, some universities have introduced BIM from a software perspective in the form of REVIT or ARCHICAD courses. The majority of these are stand-alone or short courses, completely divorced from the university's core curriculum.

RSA lecturers and university staff generally lack knowledge of and exposure to BIM, so to comprehend (much less lecture) the nuance and complexity of BIM processes is a challenge, and as such, the topic is therefore glossed over or ignored completely. This is further exacerbated by traditional educator's reluctance (or out and out refusal) to share information across departments within the AEC educational spaces and therefore stunt the development of collaborative courses.

Upskilling within the workplace is looking better though. The end of 2018 saw the BIM Academy Africa (in partnership with UK Whitefrog) establish the first African strategic implementation of BIM for the Ethiopian Government Ministries under the Ethiopian Construction Project Management Institute (ECPMI). The BIM Academy Africa also trained and internationally accredited 478 professionals in various BIM courses, while simultaneously providing hundreds of SA students (Wits, TUT, UCT and DUT) online learning access to NavBIM.com (Africa's largest learning portal for BIM education).

Initiatives/Organisations

Despite a lack of any private or public funding, the BIM Institute has been drafting the South African National BIM Guide for designers and operators in a bid to align itself with international standards. There is still a battle with certain technology vendors hell-bent on creating a monopoly in BIM software solutions.

A new local online book, *BIM - It's your move* by Vaughan Harris, has been published. The book gives the reader a "no holds barred" view of the current state of BIM in Africa. It encourages professionals to reinvent themselves, and the sector that they work in, through an honest and insightful guiding hand (and sometimes a kick) in the right direction.

In 2018, and in collaboration with the South African Quantity Surveyor Association (ASAQS), the BIM Institute challenged Quantity Surveyors in the [5D BIM Estimating Competition 2018](#). The results were announced at the 4th ASAQS Conference. The winners were selected from an impressive 48 entries. The competition sparked new concepts and communication solutions for estimating professionals. It focussed not just on quantifying the models provided, it tested the candidate's understanding of the principles of the Common Data Environment (CDE) and ability to identify and correct some errors within the architect's model geometry.

Entrants stated their chosen estimating software used to produce an elemental estimate (using the newly released [estimating classification](#) system developed by the BIM Institute). It showcased the innovators embracing the digital tools at hand – the future leaders of the RSA construction sector and the potential stars that will lead the country in its digitisation push.

Awareness/Uptake

The tipping point for BIM adoption in RSA requires a fundamental shift in building standards and education at the tertiary and institutional level.

Many traditional architects and engineers are caught up in the details (the fee structure changes that require clients to invest more to develop a “digital twin”), losing sight of the bigger picture related to the improved efficiencies the technology will bring to their daily operations.

This has created an inertia that spills over to the architect and engineering associations, leaving them unwilling to promote BIM within their ranks.

Construction professionals have not embraced the technology as a means to better deliver their projects, with government tenders in particular reinforcing manual processes as part of a wider policy on increasing jobs growth.

Design professionals within the RSA AEC industry still largely consider BIM solely as a software tool, failing to fully understand the often overlooked improvement in productivity a more holistic implementation would facilitate.

However, BIM adoption is gaining momentum within the African market. The BIM Institute and the BIM Academy Africa have led the charge in skills and resource development. African countries are increasingly using BIM (often to meet international investors requirements) and the demand for this skill set will keep increasing. Graduates and professionals that lack these skills are starting to feel their disadvantage already and will be marginalised more and more both locally and internationally.

RSA businesses continue to battle with slow economic growth, a diminishing pool of construction professionals leaving the African shores, a lack of foreign investment and pressure by the South African government to transform the sector faster and more drastically. With these pressures, we see the motivation of South African companies to keep pace with first world countries diminish directly proportionately to the stress that “business as usual” in this environment places on the sector.

The billions of Rands proposed for investment into the infrastructure development pipeline is great news, unless you factor in the aging RSA workforce. An inability to replenish this pool of professionals with young, skilled workers with digital skills is putting at risk the country’s ability to ensure these projects are completed

on time and within budget. This despite sporting one of the worst youth unemployment rates in the world and with Industry 4.0 having become a government focused initiative. This risk is also becoming clearer to foreign investors looking for opportunities in the country.

As a reaction to some of governments other policy decisions, we see RSA companies failing to invest the necessary time and resources to ensure their skills pools are future-proofed and skilled enough in current and future technologies designed specifically to ensure their own success. This short sightedness is lessening RSA’s lead on competing African countries – some of whom have already started the digital standardisation process that RSA still fails to address.

This conservative thinking (and naivety) leaves many local companies with undelivered value. The greatest failure sits with central government (or influential agencies) that have yet to put their metaphorical foot down and prescribe digital adoption as a catalyst for growth. A case in point is the National Building Regulations which still require submitted drawings for council planning approval to be a 2D Paper submission only (under SANS10400 Part A).

SWEDEN

Education/Training

Construction related University teaching programs in Sweden have, with only few exceptions, adopted BIM in their respective curricula. Engineering Bachelor programs at University colleges have the highest general representation of BIM subjects in the curricula. The adoption of BIM in architectural schools is, however, significantly limited.

The degree of BIM adoption differs significantly between the respective teaching programs. Only a few Universities have adopted BIM as an integrated subject in courses that deal with general construction related issues. The predominant approach is however to implement BIM subjects as discrete teaching modules, i.e. stand-alone courses, in which BIM is regarded as a technical tool rather than a facilitator for process integration and organisational development.

There are about 50 national institutions of higher education in Sweden, of which 10 Universities and 8 University colleges provide

construction related teaching programs, offering 135 courses.

In Sweden these 18 University institutions are currently offering BIM education in:

- 8 Master programs.
- 21 Bachelor programs.
- 11 Two-year programs.

A Masters program (in Jönköping) has been developed specialising in Sustainable BIM as a topic. Many courses on advanced level BIM focus on BIM coordination or BIM strategies.

There has been a small increase in the number of courses being developed by Universities in the field of BIM in recent years. However, there has been a significant increase in the number of practical education schools that have started two-year programs that focus on BIM-applications for entrepreneurs, consultants and clients.

Initiatives/Organisations

Since 2013 there has been national investment for digitalization for research and development in construction. The governmental program of Smart Built Environment has started which has a number of knowledge packages to develop education with digitalization.

BIM Academy, a network of the 18 Swedish University institutions, was started in 2016 as a part of the BIM Alliance, for the purpose of knowledge transfer between Universities.

In 2018 the BIM Academy started a project of defining BIM Basics for Sweden. This project is still being developed with the aim of defining BIM basics for sharing and contributing knowledge, educational assignments, lectures and software experiences.

Awareness/Uptake

There is a considerable discrepancy between the technically oriented BIM curricula at the Universities and the more process and change oriented approach to BIM represented by the industry.

Besides, the industry emphasises the importance of BIM implementation in urban planning and real estate management, which currently is more or less neglected in curricula at Swedish Universities.

The large consultancies and contractors drive the Swedish BIM movement and are ahead of

the Universities concerning BIM awareness, maturity and competences.

SWITZERLAND

Education/Training

Several partners provide this part in Switzerland: Focussing mainly on open BIM, technical universities and universities of advanced sciences offer a wide range of courses on undergraduate and postgraduate level.

ETH Zurich (University of Science and Technology) and EPFL (Ecole polytechnique fédérale de Lausanne / Swiss Federal Institute of Technology) both push BIM forward by offering CAS, DAS and MAS programmes.

This is true also for universities of advanced sciences like FHNW (University of Applied Sciences and Arts Northwestern Switzerland) with its Institute for Digital Construction that focuses on changes triggered by digitalisation.

The Institute of Facility Management at ZHAW (Zurich University of Applied Sciences) provides the module BIM for FM. At ZHAW the continuing education concentrates on the field of Facility Management and Life Cycle Costs including BIM.

The BFH (Berne University of Applied Sciences) offers a CAS Digital networking in timber construction.

At the Lucerne University of Applied Sciences and Arts, the continuing education offers courses in Simulations with BIM as well as developing competencies for the ordering process.

The program of continuing education at the HES-SO Fribourg (University of Applied Sciences and Arts – Western Switzerland) includes a CAS in BIM Coordination.

The HSR University of Applied Sciences Rapperswil joins in with the module, BIM for Infrastructure.

Software providers are also involved in education and training, mainly, and not surprisingly, more on the closed BIM side. Private training institutions take over a major role in this part.

Non-academic professionals that plan to grow into the BIM area do still have no offering in Switzerland for their specific needs and requirements. Low-barrier training and educations are not yet available.

Initiatives/Organisations

Since January 2018 the Swiss chapter of buildingSMART has started to take action. It is closely connected to Bauen digital Schweiz, an initiative of SIA (Swiss Society of Engineers and Architects), CRB (Swiss Centre for Construction Rationalization), KBOB (Coordination conference of the building and real estate bodies of public clients), and IPB (Association of private, professional builders), being the legal entity for the chapter.

In 2019, the Swiss chapter went public all over Switzerland taking also into account the French-speaking regions. Concurrently the committee in charge of the Professional Certification Program pushed forward to be able to release the Qualification Platform by Q4 of 2019.

Another driver is Netzwerk digital, the coordination unit for the digital transformation of the planning, construction and real estate sectors.

Awareness/Uptake

Professionals are increasingly aware of the fact that continuing education becomes important especially as far as BIM is concerned. Over the years, an increasing number of events and courses on this topic have popped up all over the country.

Additionally, the Swiss BIM Congress came into life in 2016 and is implemented on a yearly basis.

A new platform is an openBIM Forum that took part the first time at the beginning of 2019. A congress driven by the major BIM software providers with over-average content delivered by first movers in the BIM market (architects, planners, contractors, owners).

UNITED KINGDOM

Education/Training

The BIM Academic Forum (BAF – discussed later) published [Embedding building information modelling \(BIM\) within taught curriculum](#) in 2013 and “Current position and associated challenges of BIM education in UK higher education” in 2015. The latter report indicated that BIM is now becoming widespread across the various levels of higher education, albeit ad hoc and without

consistency. In the main, this tends to be driven by individual academics or schools/departments that have a particular interest in the area of BIM and recognise its importance in the education of professionals.

Over the last few years, a number of BIM specific programmes at Masters level have emerged. A number of BIM specific BTEC level programmes have also now begun to emerge. Apart from architecture and construction related disciplines, there are overall low levels of interest in BIM incorporation in teaching across built environment related disciplines. At the cutting edge where BIM is fully embedded into programmes/modules, architecture maintains a significant edge over all other built environment disciplines.

BAF held its first international conference at Glasgow Caledonian University, 13th-15th September 2016. This brought together delegates from both industry and academia to discuss aspects around Education & Training, Process & Standards, Strategy & Implementation, Knowledge Management & Decision Support, BIM Maturity & Assessment, Asset Handover & Operational Management, Technology. The programme also included a workshop to explore establishing a European BIM Academic Network to bring together the European national BIM academic forums. BAF are currently focusing on taking the first report of embedding BIM within the taught curriculum forward by drilling down to disciplinary perspectives at the undergraduate level. BAF are also aligning their activities in support of the UK BIM Alliance, and the Upskilling work stream, in particular.

Within the UK, Secondary, Further (FE) and Higher Education (HE) are devolved matters and in Scotland these fall within the Scottish Government’s remit. Scotland has 26 FE and 18 HE Institutions. Although the Scottish Government acts as the funding agency for HE built environment programmes, accreditation is normally undertaken by professional bodies. The Scottish Qualifications Authority (SQA) is the executive non-departmental public body of the Scottish Government responsible for accrediting educational awards at secondary and FE levels.

The SQA also publishes the Scottish Credit and Qualifications (SCQF) framework which offers a structured and incremental pathway (Levels 1-12) for education and training which spans between secondary and tertiary level qualifications and maps equivalences between

FE/HE provision and workplace-based learning programmes.

SQA have developed a Professional Development Award (PDA) in Building Information Modelling (BIM) at SCQF level 8. The PDA aims to address the UK Government and industry drive to modernise the built environment sector with the adoption of BIM technologies, processes and collaboration.

BIM is also embedded in Higher National named awards including the HND in Architectural Technology offered by several of Scotland's FE Colleges. Looking ahead, the key challenge continues to be engagement with interdisciplinary activities, most significantly hands-on exercises such as developing collaborative BIM projects in classroom and/or studio environments.

Within the HE sector in Scotland, a number of universities have engaged with BIM, either through the provision of named awards and/or by embedding BIM in undergraduate teaching. The University of Strathclyde, one of the pioneers of built environment inter-disciplinary education in Scotland, provides a postgraduate pathway to masters-level study in Advanced Construction Technologies and BIM. The Robert Gordon University offers a postgraduate programme leading to an MSc in Building Information Modelling Management and the University of the West of Scotland has partnered with Loughborough and Westminster Universities in The B1M's Higher Education teaching initiative, which shares a free video platform across B1M's partner network and is sponsored by industry. Glasgow Caledonian University offers a module in BIM for Management of Construction at SHE Level 5.

At a pan-European level, the Robert Gordon University's Scott Sutherland School of Architecture and Built Environment participates in inter-disciplinary built environment projects through the ERASMUS and International Congress for Architectural Technology (ICAT) networks. Typically, these undergraduate exercises are structured to simulate real-world BIM projects which students can develop from remote locations and engage in real-time dialogue using digital media.

Since 2015, the [BIM Regions](#) have been actively seeking partnerships with local Higher Education Institutions. The London and SE BIM Region formed a partnership with the University of Westminster and ran a [series of free BIM Events](#) aligned to its Masters programme. [thinkBIM](#) is run by the Centre for Knowledge Exchange at Leeds Beckett University in partnership with the Yorkshire

and Humber BIM Region. The South West BIM Region is run in partnership with University of West England. The [BIM Academy](#) is partnered with Northumbria University.

[Design, Engineer and Construct](#) (DEC), run by Class of Your Own, is an accredited learning programme for secondary-school age students and has been expertly developed to create and inspire the next generation of Built Environment professionals. Class of Your Own are leading the [BIM4Education](#) initiative. This initiative has recently been awarded [CITB](#) funding to get teachers and students excited about BIM and construction. One recently published report has shown how the DEC program has worked well in Manchester as a partnership between the University of Salford and St Ambrose Barlow RC High School.

There are now many providers of BIM training within the UK. As identified above, the BIM Regions have partnered with local Universities to provide free events. Other providers of paid for content include:

- Professional Institutions:
 - . Royal Institution of Chartered Surveyors (RICS).
 - . Chartered Institute of Architectural Technologists (CIAT).
 - . Chartered Institute of Building (CIOB).
 - . Institution of Civil Engineers (ICE).
 - . Building Services Research and Information Association (BSRIA).
 - . Building Research Establishment (BRE).
 - . Construction Industry Training Board (CITB).
 - . National Federation of Builders (NFB).
 - . British Standards Institute (BSI).
- The [BIM Campus](#) provides a six-week intensive course.
- The B1M is an online video resource which includes a [BIM for Beginners](#) programme.

Many of the AEC companies have run their own in-house training programmes which are compulsory to attend and require a certain level of attainment.

There is significant body of research being undertaken into BIM. Each Higher Education Institution has its own research programme and there are also numerous Knowledge Transfer Partnerships (KTPs) being undertaken. [KT4BIM](#) involves BIM4SME acting as a client to a virtual project with numerous

KTPs; the objective is to achieve a Level 2 compliant project.

Initiatives/Organisations

The UK Government influenced a significant movement within the UK AEC industry by requiring the use of BIM on public sector projects in its [2011 Government Construction Strategy](#). The primary objective of the strategy was to sustainably reduce the construction costs incurred by the public sector. BIM was identified as one of the principal initiatives to achieve the objective and was supported by the creation the [BIM Task Group. Training and Education](#) was one of the Task Group's four work-streams and a key output was the [BIM Learning Outcomes Framework](#). As a consequence, there has been a significant increase in the provision of formal academic qualifications, training, accreditation and research.

The subsequent [Government Construction Strategy 2016-2020](#) maintained the emphasis on developing digital and data capability in construction, although the BIM Task Group was no longer funded to support the wider adoption of BIM. The formation of the [UK BIM Alliance](#) has taken on the mantle from the BIM Task Group and there is a work-stream dedicated to upskilling the industry. The Alliance was formed in late-2016 and is in the process of consulting on its proposed plans.

The BIM Task Group instigated a community of special interest groups with the aim of raising "awareness of BIM and promoting a shared understanding of the value proposition and issues affecting the implementation of BIM" as stated in the [BIM4 Community Charter](#). Each group determines their own approach and certain groups are seen to be significantly more active e.g. [BIM4SME](#) and the [BIM Regions](#).

The BAF is the BIM4 Community special interest group representing Higher Education. Formed in 2011, BAF consists of a group of representatives from a large number of UK Universities, with the aim of creating a dynamic collaborative group to enhance and promote teaching and learning together with the research aspects of BIM, therefore serving as a conduit between industry demands and BIM education in higher education institutions.

Scotland's BIM Delivery Group is acting on Government's requirement to implement the

majority of recommendations to encouraging the adoption of BIM across Scotland's public sector by April 2017. It recognises the diverse range of interests which pose significant questions for Scotland's built environment educators and training providers in developing appropriate pedagogies. Research is being undertaken to investigate the potential of the Scottish Qualifications Framework (SCQF) to act as an overarching paradigm for education/training in addressing the many challenges raised by aspirations to digitise Scotland's construction sector.

A number of initiatives have emerged to help industry with upskilling for digital working. For example, BCTG Construct hosted by Glasgow College is a consortium of educators, industrialists, and designers, which has created a blended learning resource to help Scotland's construction sector close technical skills gaps by offering site supervisors access to online learning resources including an introductory module in BIM.

The Scottish Futures Trust (SFT) is an agency the Scottish Government established in September 2008 to improve public sector infrastructure investment. The SFT has developed a BIM Portal which offers guidance on the implementation of BIM within public sector procurement. In 2018, the SFT published research developed by a consortium of stakeholders including the UK BIM Alliance and the Construction Industry Training Board (CITB) to investigate the benefits, challenges and proposed structure for a BIM Competency Framework. Based on the data gathered, the research team mapped out key principles which could underpin a competency framework if it was developed. Feedback from stakeholders suggested that the lack of an overarching approach to competency management for BIM resulted in highly variable content in education and training delivery.

Although several worthwhile initiatives are contributing to the development of BIM education across FE and HE sectors, the overall picture looks quite patchy. At this point in time, Scotland would benefit from some collective academic/industry vision going forward, a more cohesive approach to BIM education and a roadmap which sets out strategic aims/objectives with a timescale for implementation.

Awareness/Uptake

The government's BIM requirements and the subsequent activity of the BIM Task Group and the wider BIM community has significantly

influenced the awareness and take up on BIM within the UK. This is evidenced above by the broad range of support and resources available to via the UK BIM Task Group Website, the BIM Regions and BIM4 groups such as BIM4M2 and BIM4SME. This is supported by a frequent programme of conferences run by amongst others the professional institutions and in 2016, the second [Digital Construction Week](#).

In addition, institutions and industry related journals have sections on their websites specifically focused on BIM, which together with the plethora of BIM-specific resources such as [BIM Plus](#), support the growing awareness of BIM within the UK.

The proposed programme of the UK BIM Alliance includes a work-stream focused on Awareness and being the champion for BIM Level 2.

The [Government Construction Strategy 2016-2020](#) indicates that progress has been made in “developing digital capability in design and construction, with all departments on target to procure assets using Building Information Modelling (BIM) Level 2 by 2016”. The strategic objective within this strategy is “increasing BIM Level 2 maturity across government will enable departments to gradually move to BIM Level 3, which would support a fully integrated and collaborative process” (point 25). Further guidance is set out in [BIM-Level2.org](#).

The Government in conjunction with industry will develop the next generation of digital standards to enable BIM Level 3 adoption under the remit of the [Digital Built Britain Strategy](#).

UNITED STATES

Education/Training

Currently there are 68 public and 39 private Universities offering formal Architectural and Engineering programs. The majority of these Universities are accredited by the National Council of Architectural Registration Boards (NCARB) to provide undergraduate programs in all three of the AEC disciplines and all of which offer some ‘BIM courses’ as part of the syllabus. However, a select few lead the field for BIM specific courses and initiatives including Purdue University, Brigham Young University, Pennsylvania State University, Georgia Southern University, University of Oklahoma, University of California - Irvine, and Georgia Tech University.

The American Institute of Architecture (AIA) sponsors the AIA Academic Engagement which fosters academic research focusing on the advancement of educational programs and initiatives including a joint venture symposium between the AIA and the Association of Collegiate Schools of Architecture (ACSAA) geared toward bridging the gap between academia, practice and Architectural industry.

The Associated General Contractors of America (AGC) has developed - in conjunction with leading BIM practitioners, technology firms and educators - a BIM Education Program designed to prepare construction professionals at all experience levels to successfully implement BIM on a construction project.

The program comprises the following four units:

- Unit 1 | An Introduction to Building Information Modeling - Revised Edition
- Unit 2 | BIM Technology-Revised Edition
- Unit 3 | BIM Contract Negotiation and Risk Allocation
- Unit 4 | BIM Process, Adoption, and Integration

The highly interactive program provides 32-hours of instruction and training to get construction industry professionals at all levels ready to take advantage of the benefits of BIM.

After participants complete all four units in the program they become eligible to sit for an exam to earn the Certificate of Management—Building Information Modeling (CM-BIM). Successful candidates will carry the CM-BIM designation.

Initiatives/Organisations

The Academic Interoperability Coalition (AIC), founded by the buildingSMART alliance and the BIMForum incorporates 53 Universities from the U.S. and abroad with the common mission of coming to a consensus about BIM education. Their 9th BIM Academic Symposium presented papers in the following areas: A Case Study on Hybrid BIM Course Development, BIM Estimating in the Classroom, and many others.

Awareness/Uptake

Research published by McGraw-Hill Construction (now Dodge Data & Analytics) in

2012 showed a rapid increase of BIM usage by architects, engineers, contractors and clients in North America. The percentage of companies using BIM was recorded at 71%, a jump from the 49% recorded in 2009 and the 28% recorded in 2007.

The 2015 SmartMarket report by Dodge Data & Analytics, titled *Measuring the Impact of BIM on Complex Buildings*, indicates that 40% of owners report an accelerated project completion due to the use of BIM. 41% of contractors report that BIM reduces final construction costs by at least 5% and 67% of contractors report improved productivity by using BIM.

CONCLUSION

As reported in previous years it is clear from the responses received that BIM education and BIM awareness/uptake is still at different levels of implementation across the globe.

Most countries are reporting BIM education being provided to Architecture Engineering Construction (AEC) students by their higher education and technical training institutions. However, this year it would appear that, in general, the number of courses being offered compared to last year has not increased significantly, with countries such as Chile and Hong Kong being the exception. This may indicate that the number of courses offering some form of BIM education may be reaching saturation in many countries. Many countries do however note that the content of the material being delivered in such courses can be expanded upon to cover more detailed aspects of BIM and its potential applications.

Studies carried out by some of the countries report that there are many challenges being faced by educators in regards to incorporating BIM into the curricula, such as the knowledge base/skills of educators, resources available, fitting additional material into an already crowded curriculum, converting lecture-based courses into smaller multidisciplinary teamwork-based courses and a simple resistance to change.

Most countries' higher education institutions are including structured BIM education within the syllabus of their AEC courses, at both an undergraduate and postgraduate level. Countries such as Australia, Chile, Finland, Netherlands, Singapore, Sweden, UK and USA are reporting a significant volume of courses and subjects available. Many vocational education institutions are also providing BIM education to the industry's workforce.

Whilst the majority of BIM education being provided still tends to focus on the use of particular BIM software packages. It continues to be reported that training for both graduates and professionals in openBIM concepts, BIM management, Sustainable BIM, BIM for FM and Life Cycle Costing and working in collaborative BIM environments, appears to be increasing.

Countries including Australia, Canada, Finland, Hong Kong, Japan, Norway, Singapore, Sweden, Switzerland and UK have reported training and education being available in these topics.

BIM awareness and BIM uptake appear to still be on the rise. However, this is not strictly a consistent global trend, with BIM reported as being widely adopted in countries such as Finland and Australia, and even required by government, in some countries, such as Singapore and UK, whilst still only being considered in others.

As reported in previous years, certification schemes to validate the BIM knowledge of professionals in industry continue to be provided. Countries such as Australia, Canada, South Africa, UK and USA have all reported the existence or development of such schemes in their respective countries.

It is clear that the provision of BIM education is growing globally and in many countries it would appear to have maybe reached saturation. As observed in previous years, liaison and partnership between education providers and industry is also improving in many countries, to coordinate the training provided with the needs of industry, the aim being to provide a graduate workforce with the collaborative BIM skills required for the future industry of which they will be part.

CONTRIBUTORS

NATSPEC and ICIS would like to thank contributors, past and present, who have provided input to this report for their respective countries. Note: Where more than one individual from any particular organisation has provided input, the name of the organisation has simply been listed once.

Current contributors

- Dr. Ronald Webber – Central Queensland University (Australia)
- Dr. Saeed Banihashemi – University of Canberra (Australia)
- Linda Newton – buildingSMART Canada (Canada)
- Canada BIM Council (Canada)
- Planbim (Chile)
- China BIM Union (China)
- URS (Czech Republic)
- Päivi Jäväjä – Metropolia University of Applied Sciences (Finland)
- Construction Industry Council (Hong Kong)
- Masaki Muto – Building Research Institute (Japan)
- Radboud Baayen – Stabu (Netherlands)
- Masterspec (New Zealand)
- BCA Academy – Building and Construction Authority – BCA (Singapore)
- Digitalisation, Built Environment Research and Innovation Institute – Building and Construction Authority - BCA (Singapore)
- Vaughan Harris – BIM Institute South Africa (South Africa)
- Chris Allen – Nelson Mandela University (South Africa)
- Gustav Jansson – Luleå University of Technology (Sweden)
- Swiss National Agency for Construction Nationalization – CRB (Switzerland)
- Graham Paterson – Letsbuildigital (United Kingdom)
- Jason Underwood – University of Salford (United Kingdom)

Past contributors

- Jennifer Macdonald – buildingSMART Australia (Australia)
- David Watson – Digicon Information Inc. (Canada)
- Susan Keenlside – buildingSMART Canada (Canada)
- Rakennustieto (Finland)
- Tomi Henttinen – buildingSMART Finland (Finland)
- Institute of International Harmonization for Building and Housing – iibh (Japan)
- Geir Johansen – Norconsult (Norway)
- Steen Sunesen – buildingSMART Norway (Norway)
- Mark Grant – Construction Communication Network (Pty) Limited (South Africa)
- Niclas Andersson – Malmö University (Sweden)
- BIM Academic Forum (United Kingdom)
- John Gelder – NBS (United Kingdom)
- Rob Garvey – University of Westminster (United Kingdom)
- Christopher Bushnell – Arcom (United States)
- Gilles Letourneau – Avitru (United States)
- James Robertson – Robertson Sherwood (United States)