

# FUTUREquipped

## Construction Sector

BIM in the design and construction of  
SMART Homes

UNIT

1

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Promoting further and higher education

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in collaboration by:

CONSTRUCTION  
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INNOVATION  
CENTRE



DIGITAL  
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# Learning outcome

Understand the principles of Building Information Modelling as it applies within the design and construction of a SMART Home.



# Introduction



## What is BIM?

**B**uilding Information Modelling is a standardised process for creating and managing information on a construction project from planning, design and construction to the management of a finished building and beyond. BIM offers a means for coordination of multiparty collaboration on a single project. Every detail of a building is modeled on BIM, which creates 3D visualisations of the different aspects of the project. When one element in the design is altered, all components of the design are updated. This helps with creating more efficient work flows, avoiding errors and conflicts, and making savings in terms of time, materials and effort. To date, BIM has mostly been used as part of larger construction projects.

## How might BIM benefit SMART Homes?

**S**MART Homes contain more technology than the average home, often designed to enhance the security, wellbeing and comfort of its occupants as well as the energy efficiency of the building. Several specialist designers are required to collaborate to ensure the different sensors and other technologies are installed in the most efficient locations. The 3D information model gives future specialists access to the information required for maintenance, monitoring etc. of the SMART Home. As with every construction project, BIM can reduce costs, errors and time etc. making SMART Homes more affordable housing solution. For individual bespoke SMART Homes, using BIM is likely to be prohibitively costly. However, for larger public sector SMART housing projects, BIM presents an opportunity to improve the design, construction, life-cycle maintenance and deconstruction process associated with house building.

This microlearning unit introduces main benefits of using BIM in construction work and how it might be applied in SMART housing.

### Watch a short introduction to BIM:

<https://youtu.be/ZYvQk78WITc>

### More resources:

Scottish Futures Trust video library on BIM

<https://bimportal.scottishfuturestrust.org.uk/page/video-library>

### CSIC BIM resources, including an e-learning unit

<http://www.cs-ic.org/innovationcentre/skills-training/bim-in-practice-programme/bim-resources/>

# Key drivers for the adoption of Building Information Modelling

**B**oth the UK (in May 2011) and the Scottish Governments (April 2017) have issued guidance on using BIM as part of construction project. Use of BIM at maturity level 2 was made mandatory for public projects costing over £2 million in the UK in April 2016 and in Scotland in 2018 to reduce time, costs and waste. For projects costing less than £2 million, its use is being recommended. BIM Level 3 is not fully defined yet. It will be underpinned by the adoption and integration of Internet of Things (IOT) technologies.

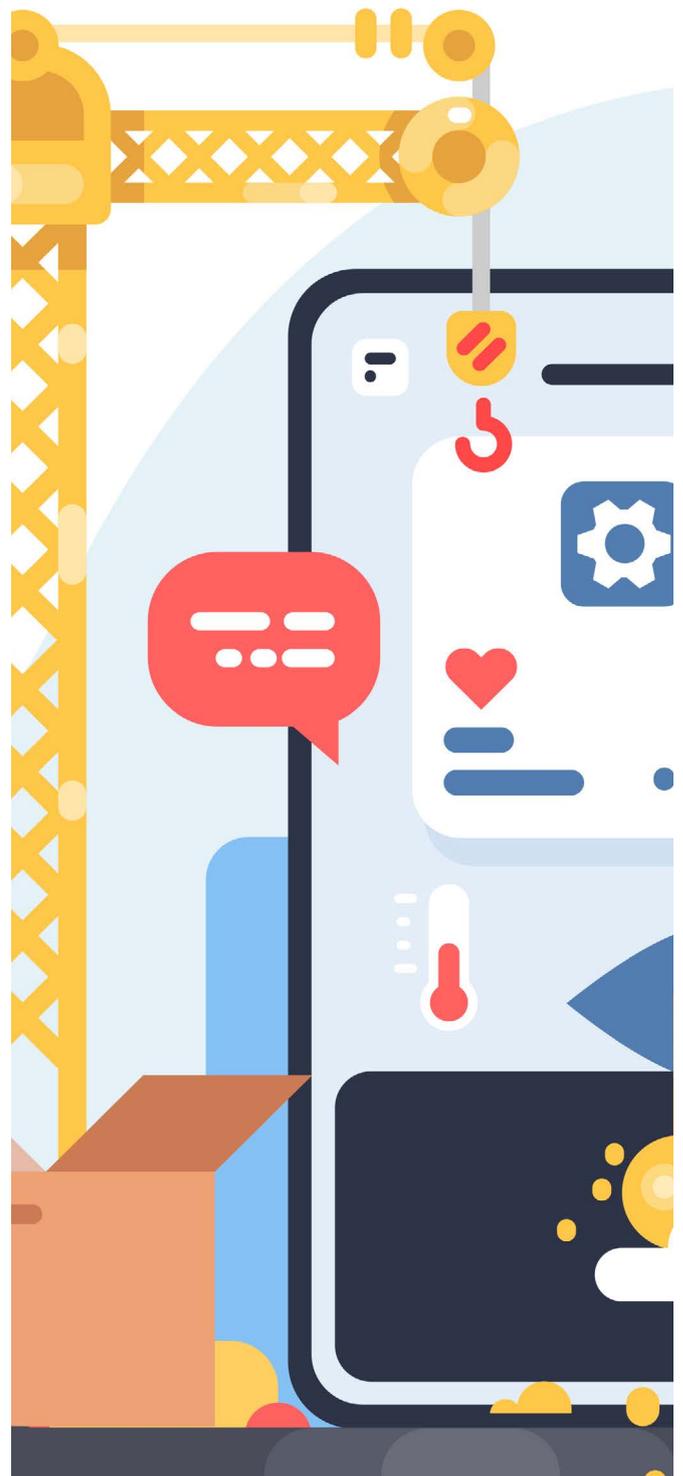
Learn here about the different levels of BIM maturity: <https://www.thenbs.com/knowledge/bim-levels-explained>.

Other drivers include:

- Developments in digital technologies (e.g. cloud computing, graphics, Internet of Things).
- Economic situation (efficiency drive; closing the productivity gap).
- Environmental factors: De-carbonising the construction process.
- Raising quality standards.
- Growing, ageing population.
- Building regulations underpinning use of BIM:
  - ISO standard BSENISO19650-2:2018 and PD19650-0:2019 (Previously BS 1192:2007 + A2:2016, now withdrawn).
- Shared Information governance protocols:
  - UK BIM Task Group has developed shared processes and work methods (e.g. file naming practices) to remove barriers for data sharing and storing between stakeholders. They have recommended developing Common Data Environment (CDE), a cloud-based, well-structured storage and data sharing platform accessible by all stakeholders.
- The growth in the SMART homes sector could see Scottish Government requiring a number of SMART Social Housing projects, that when grouped together may exceed the £2 million costs and therefore make Level 2 BIM a mandatory process.

# Who are the key players in BIM?

- UK Government (see above).
- Scottish Government (see above).
- Centre for Digital Built Britain - The Centre for Digital Built Britain is a partnership between the Department of Business, Energy & Industrial Strategy and the University of Cambridge to deliver a smart digital economy for infrastructure and construction for the future and transform the UK construction industry's approach to the way we plan, build, maintain and use our social and economic infrastructure. Considerable influence through the design of the British.
- Scottish Futures Trust (an independent company set up by SG to deliver value for money across public sector) has a portal for information on Building Information Modelling in Scotland.
- Construction Scotland Innovation Centre.
- Large construction and architectural companies; BIM software companies.



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## Scottish Innovation Centres most closely linked to BIM:



**Construction Scotland Innovation Centre (CSIC)** – Construction industry-led Innovation Centre for Scotland’s construction industry. Since opening in October 2014, CSIC has been linking together businesses, university and college experts and public sector providers to deliver transformational change in construction along with the provision of appropriate innovation support in areas where industry demand is currently not being met. CSIC has an innovation factory that has specialist equipment which can be utilised for product development; CSIC also provide business support and networking opportunities for emerging market players.

**CENSIS** - the innovation centre for sensor and imaging systems (SIS) and Internet of Things (IoT) technologies and their applications. Sensor technology and IoT applications are crucial for enabling and realising Domestic Building Management Systems for SMART Homes.

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# What are the key challenges and opportunities for the development / adoption / progress of BIM?

## Challenges:

- BIM at level 2 is not mandatory to projects costing less than £2 million.
- Adoption of BIM is slow (cost; lack of support for education of staff; resistance to changing traditional working practices within companies to be more collaborative).
- Interpretation and application of BIM standards in practice vary between organisations.
- Using BIM in building individual SMART Homes is rare but becomes more feasible a method in larger scale housing projects.
- With IoT, the growing availability of data generated by sensors, social media and smart devices raises concerns about privacy, data ownership and security.



## Opportunities:

- BIM for SMART Homes could open up new opportunities for linking together building performance data as well as the data collected by occupancy sensors etc.
- Real-time monitoring of the user as well as the environment would enable direct control of the Building Management System via Artificial Intelligence System.
- The global SMART homes market was valued at 76.62USD in 2018 and is expected to reach 151.38bn USD (Researchandmarkets, 2019). If this is to be mirrored in terms of construction effort, then the potential time and cost savings due to BIM collaboration and other benefits are obvious.
- The development of Internet of Things (IoT) enabling further development of SMART Homes. By 2022, there will be an estimated 50bn networked appliances and sensors worldwide as part of Internet of Things (Juniper research 2018). The same trend will apply to IoT linked to home usage.
- Developing new, more collaborative and cost-effective ways of working across different sectors.

Please, read a

# Case study

on using BIM to create a small-scale SMART home:

Dan Rossiter works for Building Research Established (BRE) and has a mission of using BIM to create his own SMART, IoT enhanced home.

After purchasing his own home, “two up, two down” terraced house, Dan learned that the information provided by the building survey was not correct, and the Energy Performance Certificate (EPC) was not accurate, something he wanted to improve. Because of his profession (Chartered Architectural Technologist) he had the skills to generate the relevant information himself. The best way he found for doing the project was to follow the BIM Level 2 process. It pointed him to certain standards and methods, on how to structure the information and generate good documents.

Dan has documented the whole journey in his blog “There’s no BIM like home”. In the blog he details every step of the way, including all the methods of using BIM on a small-scale building to create a SMART home, which embeds e.g. Google Home, Philips Hue bulbs and Nest Thermostat. His goal was to produce information which would make taking care of his house easy, and which would help him take the right decisions in maintaining it.

Dan’s Blog: <https://bimblog.house/>

Read more about using BIM as part of delivering small construction projects:

On NBS (2018) website: <https://www.thenbs.com/knowledge/can-bim-successfully-deliver-small-construction-projects>

A news article on the first BIM project on creating social housing (September 2017): <https://www.insidehousing.co.uk/insight/insight/how-the-first-bim-project-in-social-housing-could-provide-a-model-for-the-future-52464>

FUTUREquipped

7

STUDY ROOM

LIVING ROOM

DINING ROOM

DEPOSIT

LAUNDRY ROOM

KITCHEN

HOUSEKEEPING ROOM

FA



# Assessment 1

Multiple Choice Assessment (10 questions)

- 1. What does the acronym BIM stand for?**
    - a. Business Information Modelling.
    - b. Building Intelligent Modelling.
    - c. Building Information Modelling.
    - d. Building Information Moulding.
  
  - 2. When was BIM made mandatory to projects costing over £2 million in Scotland?**
    - a. 2016.
    - b. 2017.
    - c. 2018.
    - d. 2019.
  
  - 3. What does the acronym CDE stand for?**
    - a. Common Data Environment.
    - b. Centre for Data and Environment.
    - c. Central Data Environment.
    - d. Common Department for Education.
  
  - 4. What Level of BIM are companies working on publicly funded projects over £2 million currently required to work to?**
    - a. Level 2.
    - b. Level 3.
    - c. Level 4.
    - d. Level 5.
  
  - 5. What part of a construction project does BIM cover?**
    - a. Planning and design.
    - b. Construction.
    - c. Management of the finished building.
    - d. All of above.
  
  - 6. Which statement is correct?**
    - a. BIM helps reduce errors during construction.
    - b. BIM saves time in the duration of a construction project.
    - c. BIM lowers the cost of a construction project.
    - d. All above statements are correct.
-

**7. BIM is a cost-efficient tool for:**

- a. Designing and building bespoke SMART houses.
- b. Construction projects at value under £2million.
- c. Large-scale housing projects.
- d. All of the above.

**8. Which of the following is true?**

- a. Working from a single model removes the risk of duplicated of content.
- b. Working from a single model removes the risk of a hard clash.
- c. Working from a single model reduces time spent creating content.
- d. All of the above.

**9. The main barriers to the adoption of BIM include:**

- a. Cost of BIM software.
- b. Lack of skills in using the BIM software.
- c. Traditional working culture, where collaboration is rare.
- d. All of above.

**10. Level 3 BIM...**

- a. Is fully up and running.
- b. Requires better adoption and integration of IoT-technologies to become operational.
- c. Is not even heard of yet.
- d. Is fake news.

Answers on page 10

# Assessment 2

## Scenario / Project based Assessment

Please, identify at least three ways in which Building Information Modelling can improve the productivity of a construction project.



# Assessment 1 Answers

1. c. Building Information Modelling
2. c. 2018
3. a. Common Data Environment
4. a. Level 2
5. d. All of above
6. d. All above statements are correct.
7. c. Large-scale housing projects.
8. d. All of the above
9. d. All of above
10. b. Requires better adoption and integration of IoT-technologies to become operational.

These materials were produced by college lecturers as part of the FUTUREquipped project in 2018. The project was funded by the Scottish Funding Council and designed and delivered in collaboration by the Digital Health and Care Institute and the Construction Scotland Innovation Centre.

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