

The construction industry and
print's role in the market today

THINK

BUILD

INTRODUCTION

The current
building design and
construction space

PERSPECTIVE

How legislation, sustainability and technology
are radically changing Architecture,
Engineering and Construction

INSIGHT

The opportunities opening
up for PSPs

Canon



Contents

01 **INTRODUCTION**

08 **THE MOVE TO DIGITAL**

Geographic information system (GIS)
Computer Aided Design (CAD)
3D laser scanning
Building Information Modelling (BIM)

12 **A SMARTER REVOLUTION**

14 **GLOBAL GROWTH**

16 **PRINT IN CONTEMPORARY
BUILDING DESIGN AND
CONSTRUCTION**

Volume
Colour
3D print
Management
During construction

24 **CONCLUSION**

General advice

26 **HOW CAN PSPs
GET STARTED**

The European Union estimated the population of the 28 member states on the 1st January 2015 at

508.2 million

up 1.3 million on the year before¹



Introduction

Climate change, population growth, increasing urbanisation, diminishing natural resources, ageing housing stock and a requirement to foster greater process efficiency are all factors spurring radical change in building and infrastructure design and construction.

The Architecture, Engineering and Construction (AEC) space is coping with rapidly changing international legislation to boost sustainable procedures for both building and infrastructure projects. These huge shifts are forcing AEC companies to become some of the most transformative on the face of the planet - embracing cutting-edge workflows and innovative technology.

The building industry as a whole is shaped by some of the world's biggest trends and movements. AEC companies have to mitigate the challenges posed by the world's rocketing population, changes in where people will live, ageing dwellings and diminishing natural resources, alongside changing international legislation around building and construction projects:

66%

By 2050 the United Nations forecasts that 66 per cent of the global population will reside in megacities²

1970

In Europe, where 50-60 per cent of houses in use now were built before 1970, there is a huge requirement to improve energy consumption³

1.5x

To complicate matters further, natural resources are being used-up 1.5 times faster than the world can replace them⁴ >

1. Population and population change statistics, European Union

2. World Urbanization Prospects 2014, United Nations

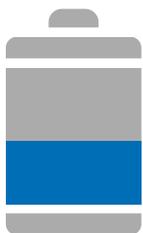
3. Mega trends' driving a major transformation in the building industry, Andrew Burgess, Chief Scientist, AkzoNobel

4. Living Planet Report 2014, World Wildlife Fund

> The global trend to introduce legislation to protect the environment is on the rise.



40%



For example, buildings represent a huge 40 per cent of the European Union's (EU) final energy consumption⁵. The EU has mandated a 20 per cent reduction in greenhouse gas emissions on 1990 levels by 2020 as part of comprehensive climate change targets⁶. This EU activity is part of a broad range of international regulations to implement sustainable and energy-efficient practices in both established and new buildings.

5. State of the Energy Union 2015, European Union

6. European Union 2020 Climate & Energy Package, January 2016



“

In large sites, such as industrial zones, office parks, shopping malls, airports or seaports, IoT can help reduce the cost of energy, spatial management and building maintenance by up to 30 per cent⁸.

”

Bettina Tratz-Ryan
Research Vice President, Gartner

Moreover, adoption of voluntary green building certifications, such as Leadership in Energy and Environmental Design (LEED) globally and the BRE Environmental Assessment Method in the UK, among others, are increasing the acceptance, use and development of new technologies and systems to meet sustainable building standards. These factors have sparked a huge demand for sustainable and low cost housing to cope with the rising urban population. The need to provide housing to the booming European population alone will see total construction output in the region register a two per cent growth in 2018⁷.

Alongside social and environmental concerns, great strides in technology are also accelerating change in building construction and design. The Internet

of Things (IoT) – an increasing network of physical objects that are connected to the Internet, which communicate with other Internet-enabled devices and systems – is developing rapidly in the market. Commercial real estate in particular, can derive significant benefits from IoT with an integrated view of facilities management and advanced service operations via the collection of data from sensors around the building. There are many IoT applications and closer to home, for example, the IoT can enable someone to control their heating or oven from their mobile; or their fridge to identify when food is low and conduct an online weekly shop. >

7. 80th Euroconstruct Conference

8. European Union 2020 Climate & Energy Package, January 2016



> **There will be over one billion connected 'things' in commercial buildings by 2018, according to Gartner⁹.**

The AEC community is increasingly focused on how they can deliver 'smart' buildings that can integrate into the IoT ecosystem. 'Smart' commercial buildings will be responsible for almost a third (32 per cent) of the total market in 2016; on the back of growing sales of commercial security cameras, webcams and indoor LEDs, according to Gartner. The growth of cloud-based and mobile technology has also contributed to change in the way AECs work. This technology has ensured improved collaboration, sharing and management of project data among AECs. With some projects now generating terabytes of data, managing all of this means that technology is now at the heart of building construction and design.

As technology supports the rise of smart buildings across the world's skylines, traditional building and infrastructure design and construction offers a process which is not so smart. The AEC space has suffered from crippling project inefficiencies, with schedules for buildings, roads and bridges often overrunning, costs spiralling and materials going to waste. Currently, construction and demolition make up 32 per cent of landfill in the UK alone¹⁰. Moreover, 13 per cent of products delivered to construction sites are sent directly to landfill without being used¹¹. There is mostly consensus in the industry that it must boost building project ROI; but also push for more sustainable construction practices for the sake of the environment and to spare the earth's rapidly vanishing natural resources.

The push for sustainability is but just one trend that is changing the AEC space; but the changes in this sector unlock considerable opportunities for Print Service Providers (PSPs). This is an industry that has offered a great deal of opportunity to PSPs over the years with its need for precise, detailed and large format technical documents. Print has remained essential in the design and construction process - whether it is delivered through an in-house print room or a PSP.

9. Forecast: Internet of Things — Endpoints and Associated Services, Worldwide, 2015, Gartner, December 2015

10. Sustainability in building design and construction, Institute of Civil Engineers, December 2015

11. Sustainability in building design and construction, Institute of Civil Engineers, December 2015



Currently, construction
and demolition
makes up

32%



of landfill in the UK alone

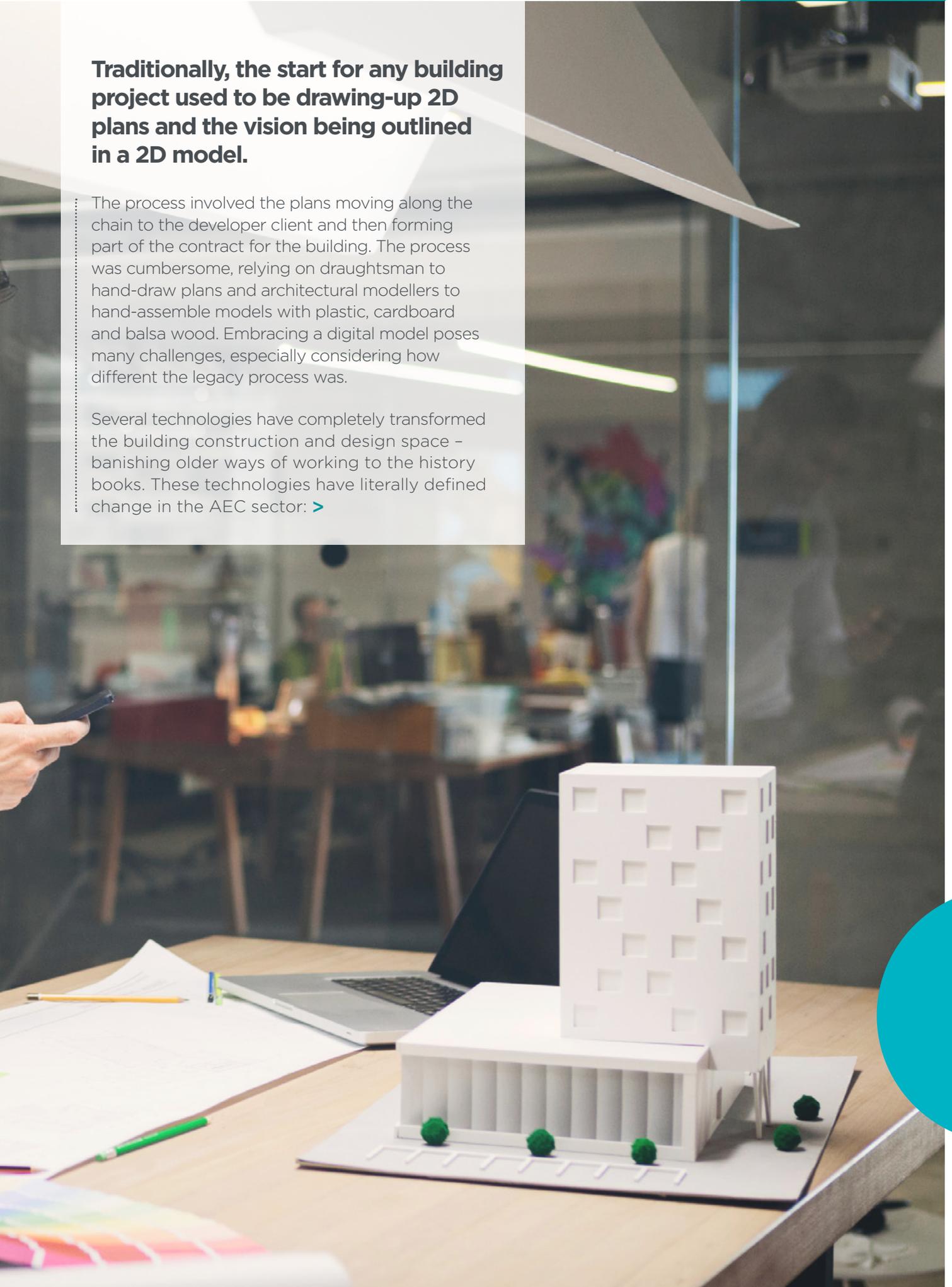


The move to digital

Traditionally, the start for any building project used to be drawing-up 2D plans and the vision being outlined in a 2D model.

The process involved the plans moving along the chain to the developer client and then forming part of the contract for the building. The process was cumbersome, relying on draughtsman to hand-draw plans and architectural modellers to hand-assemble models with plastic, cardboard and balsa wood. Embracing a digital model poses many challenges, especially considering how different the legacy process was.

Several technologies have completely transformed the building construction and design space - banishing older ways of working to the history books. These technologies have literally defined change in the AEC sector: >





GIS

> A geographic information system (GIS) is a computer system that is able to scan, store, check and display data relating to positions on the Earth's surface on one map. It can be leveraged to improve the mechanics and management for building new infrastructure through the combination of site and building design data. All those involved in the project, such as surveyors, engineers, building owners and construction contractors can rely on a centralised database for open communication and visualisation, analysis, management, re-using and sharing of project data.



CAD

The term Computer Aided Design (CAD) refers to the use of computers to generate graphical representations of buildings and highways, for example, to support the design process. CAD can be used to create both 2D and 3D representations and allows for the addition of some supplementary information such as dimensions, descriptions of components, references to specifications and so on. A wide range of CAD software has been developed for use in the design and construction of buildings and infrastructure.



3D laser scanning

3D laser scanning is a way of collecting data about surfaces, either topographic or infrastructures, using a laser scanner to capture the precise distance of densely-scanned points over a given object at rapid speed. This process can be used to generate 3D imagery that can be converted for use in 3D CAD and Building Information Modelling (BIM)



AAVO architect - Belgium



BIM

BIM is a technology-driven workflow which is at the forefront of this radical change in design and construction. BIM is a cutting-edge workflow which involves the creation and management of a digital model of a building, road, or bridge - etc. This process of generating and managing building data over its lifecycle can accommodate a huge range of data and influences on building construction and management:

- 3D BIM displays the building's visual characteristics
- 4D BIM integrates time into the model
- 5D BIM includes cost
- 6D BIM covers any other relevant building information
- 7D BIM leverages facility management applications

BIM is being used by architects, engineering companies, building firms and facilities managers, among others. Its adoption in the AEC sector is unprecedented, because it can underpin a truly efficient, sustainable and cost effective design and production process for building projects. ○

A smarter revolution





BIM is symbolic of the way that the AEC industry is changing and will change in the coming years – placing information and digitisation at the heart of the design and construction process.

The BIM model comprises a huge array of data, which can include aerial imagery of the site, GIS data, 3D laser scans of the area, neighbouring buildings, existing water and electricity infrastructure and many more aspects. BIM's inherent simulation tools enable the accurate visualisation of all of this data; from sunlight on the building in differing seasons, through to the exact number and size of windows and how energy efficient it will be. This staggering level of detail means that BIM can support in the identification of construction problems (clash detection) before the build is initialised. For example, BIM can detect problems such as electrical conduits running into a beam – which helps to reduce potential building problems and re-working costs on-site.

As well as lowering issues on the site, BIM can also boost collaboration, coordination and communication between AEC companies working on building projects. This has always been an area which is challenging for companies working together in the AEC space as the process is complex and has many moving

parts. However, BIM, by its very nature is a shared mode into which all disciplines feed into. As the project progresses, review and mark-up steps are auto-saved in the BIM model. Anyone working on the project can view the model's evolution via BIM's cloud-based project management tools and dedicated database. These features boost clarity and leave no room for confusion on what work has, and has not, been completed.

The rich layers of data included by BIM mean that each phase of the project is a more coordinated and predictable sequence of steps. This supports improved analysis, decision-making and more accurate projections around project design and construction. This superior decision-making process results in reduced costs on building materials and labour, less waste and buildings which are constructed efficiently and sustainably, with peak performance in mind. In an industry that has become synonymous with a wasteful, ill-informed and cumbersome process, BIM is at the forefront of a revolution in project-efficiency and productivity. ○

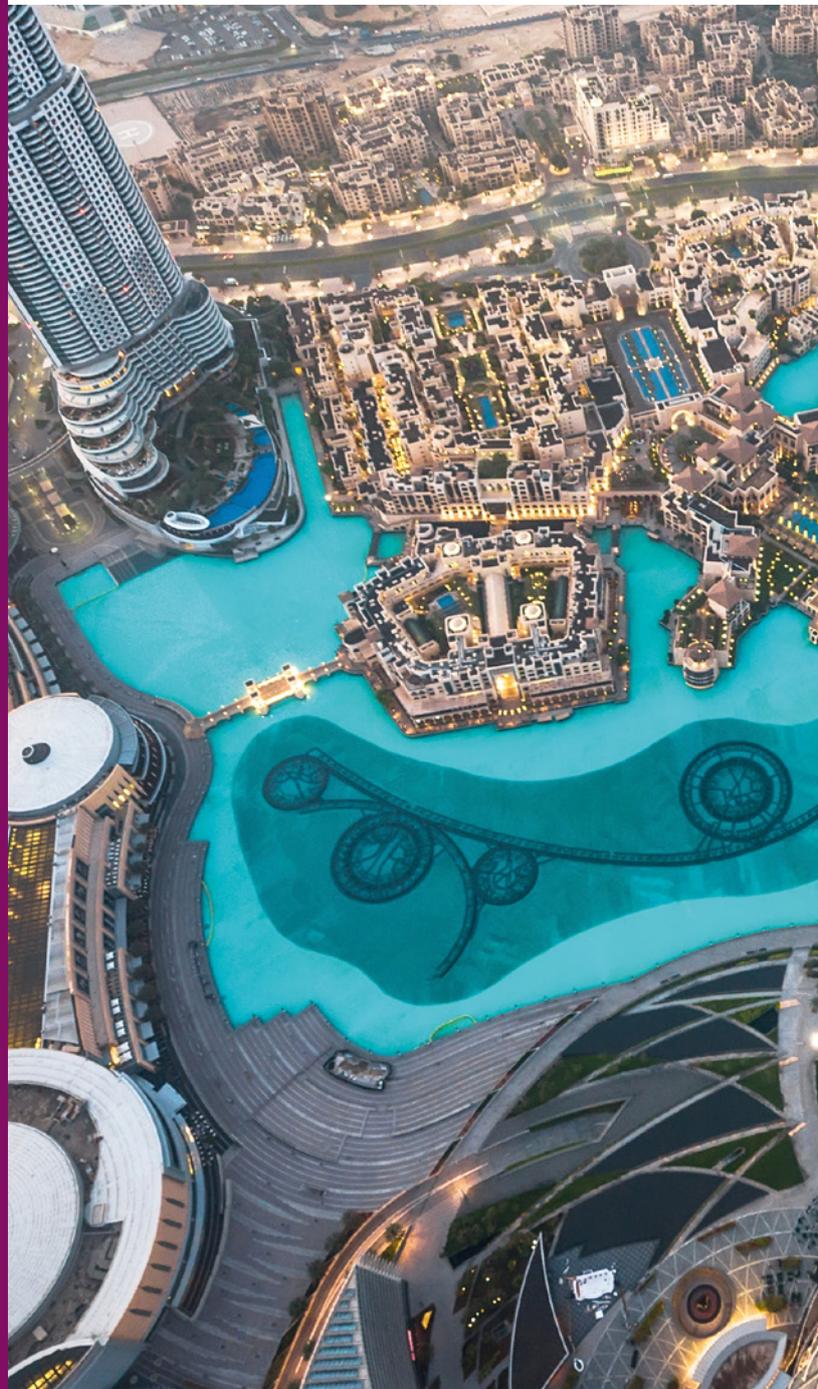


Global growth

Although BIM is at varying stages of adoption around the world, the Nordic countries were trailblazers in embracing it. In particular, Norway and Finland have been leaders in the BIM space. In 2000, following collaborations on digital e-submissions with the Map Authority of Norway, the Norwegian Building Authority advocated BIM as a tool for providing drawing information; with Industry Foundation Classes (IFC) open standards playing a crucial role in supporting the information exchange.¹²

Finland began to adopt BIM in 1997, when the Finnish funding agency for technology and innovation, Tekes, asked Professor Arto Kiviniemi to lead the national BIM R&D programme. Between 1997 and 2002, Kiviniemi headed this programme, which built Finland's position as one of the leading BIM adopters.

Finland, Norway, Denmark, South Korea, the UK and Singapore are countries that all have national mandates for BIM.¹³ However, there are many countries pushing BIM, with adoption at differing stages:



Canada: The Institute for BIM in Canada is collaborating with the buildingSMART alliance to adapt the UK National BIM standard as a basis for a Canadian standard.¹⁴

Japan: The Japan Institute of Architects created BIM guidelines in 2012. Currently, private owners in Japan have taken the lead in requiring BIM on projects in Japan.¹⁵

UK: The UK's front running position in the BIM space has been underlined by the fact that 48 per cent¹⁶ of UK AECs were actively using it on building construction and design projects in 2014. In 2010, just 13 per cent of the UK's AECs knew what BIM was. There is continued expectation that BIM will

12. - 15. The Business Value of BIM for Owners, McGraw Hill Construction, 2014
16. NBS National BIM Report, 2015



become the 'de facto' standard for building design in the UK.¹⁷ Ninety two per cent of AECs expect to be using BIM within three years and 95 per cent within five years.¹⁸

U.A.E. - The United Arab Emirates does not have a national mandate for BIM. However, in 2014, the Dubai Municipality mandated BIM for use on buildings over 40 stories high that are 300,000 square feet or larger, all hospitals, universities and other specialised buildings on campuses, and buildings delivered by and/or through an international party.¹⁹

While the mandating of BIM by governments around the world has had a clear impact on its

growth; there are also efforts being made by the international private sector, either on their own or in collaboration with government, to boost the usage of BIM. However, the intensity of the private sector push varies greatly on several factors including region, budgets and project size and scale.

Around two thirds of private sector building owners in the UK (70 per cent) say they will require BIM on new projects they will be starting. However, just 11 per cent of US private sector building owners felt BIM was required on their new projects. Successful government projects will serve as further proof of the value of smarter working processes and could lead to more widespread adoption.²⁰ ○

17 - 18. NBS National BIM Report, 2015

19 - 20. The Business Value of BIM for Owners, McGraw Hill Construction, 2014

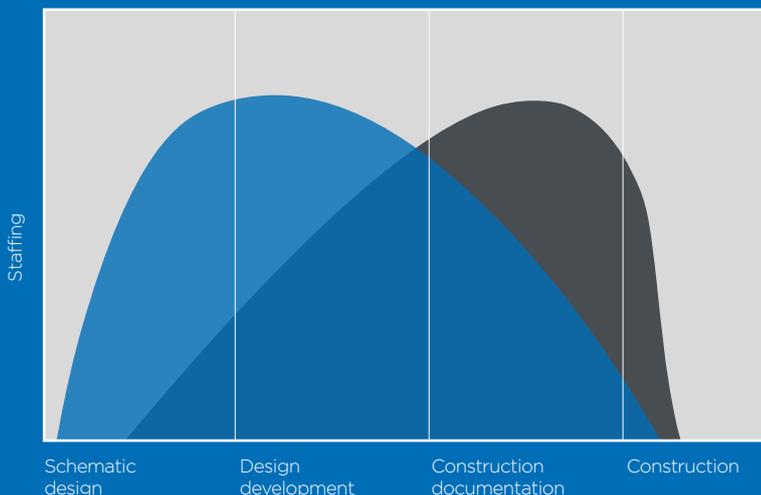
Print in contemporary building design and construction

Innovations such as BIM, 3D CAD and 3D laser scanning will impact printing volume and behaviour positively. Many other industries have turned to digital models, which leverage 3D, such as manufacturing and automotive, which resulted in changes to printing patterns, but not an overall demise in print volumes.

The digital and technological transformation taking place in the AEC space is great news for PSPs. The move towards AECs using more innovative technology and smarter working in the design and construction process simply shifts where PSPs can support. With more information available in the design phase – it is at this point that designs are finalised now – PSPs have the best chance to support AECs. Especially since this is the point where there is the greatest need for extensive collaboration and communications, as opposed to later in the cycle.

The diagram below demonstrates that the volume of drawing activities is moving to the earlier stages of construction projects. This trend means the time at which PSPs can provide support to the AECs in the process is changing.

- 2D CAD workflow
- BIM workflow





> The main opportunities for PSPs fall into five areas:



1

Volume

> Some in the AEC space feel that the increasing adoption of digital technologies will actually result in greater print volumes. Traditionally, final changes to a building project took place on-site, during construction. Therefore, PSP's could support by providing revised plans. However, with the digital transformation the AEC space is going through, more issues in building projects are identified and altered in the design stage. New ideas and concepts can also easily be added to the digital model and simulated.

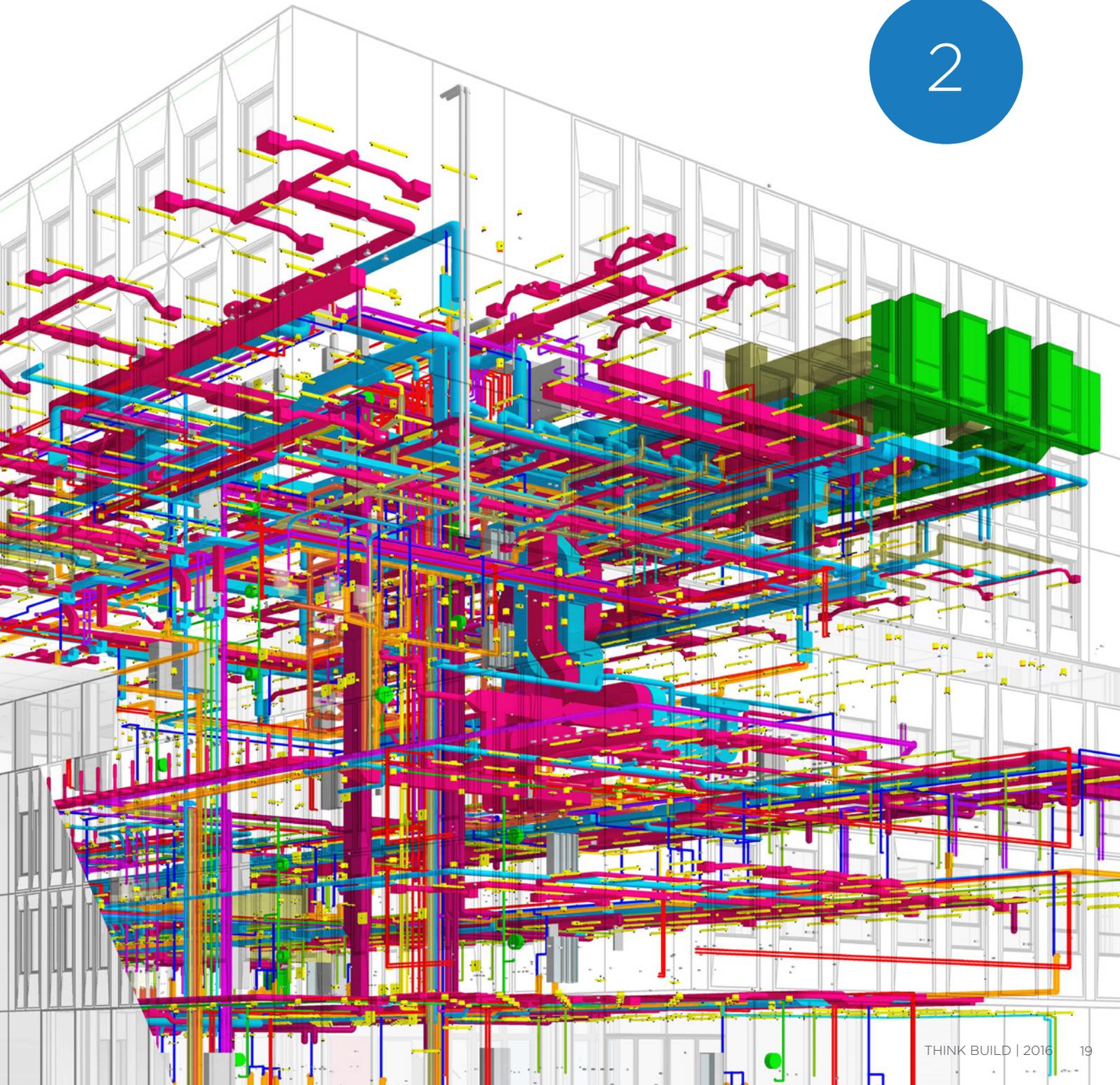
Even so, any and every change will need to be reviewed by all affected disciplines in detail. That means that detailed and extremely precise technical documents will need to be created in large format at the design stage. The accurate visualisation of design scenarios in the earlier stages simply means the opportunity for PSP's has shifted to an earlier stage in the project timeline.

Colour

Greater access to information leads to more alterations and actually impacts the volume of colour prints necessary in the building design and construction process. The numerous changes that occur in the design phase of a building project need to be clearly communicated to all partners. Moreover, for the sake of efficiency, this needs to be done with impact. Renderings, shading and textures, among other things, are

all communicated better in high-quality colour. Moreover, certain colours can promote an emotional response which can help in getting the message across. Never underestimate the power a single sheet of colour can have in communicating a project's vision. It's important that PSP's consider their own colour printing offering and how it can be tweaked to support AECs.>

2



“

The speed at which fast, 3D-generated models can hone the design both at concept stage and at the production stage means that architecture practices' use of 3D printing technology will increase.

Sheppard Robson

(leading architects practice)

”

3

3D print

> Before the advent of digital technology, manually constructed models were leveraged by architects, property developers and other stakeholders to convey urban development ideas.

However, the advances in 3D printing technology, mean that designers can now rapidly combine building concepts in 3D CAD and simply print it out. This dramatically reduces cost, but also claws back valuable project time spent on hand-crafting a model. It used to take weeks to hand-build a model, but printing a 3D model of a building can be achieved in a day.

Indeed, many reprographers working with UK architects are enjoying increased business due to offering 3D printing services.

“3D printing represents a huge opportunity, enabling us to expand our offering, provide a new type of service, and achieve a faster time to market for our clients. We already have an exciting pipeline made up of existing and new clients excited to see how the technology can add an extra dimension to their brand marketing and customer interaction, proposition.”

Tom Gurd

Managing Director FT Solutions

The growth of 3D printing over the last several years, spanning multiple industries, has been stellar and is poised to increase. The global 3D printing market is predicted to expand from \$4.98 billion in 2015 to \$30.19 billion in 2022, at a CAGR of 28.5 per cent between 2016 and 2022.²¹ 3D printing has become a viable, convenient, cost-effective and quick method to deliver improved design concepts and prototypes. 3D printing has been integrated into industries such as manufacturing and automotive seamlessly, as designs are functional. However, in architecture, designs are made to form and that makes it a completely different prospect for 3D printing. Many architects have found it challenging to successfully deliver 3D printed models. A common challenge is that when a building is scaled down to be 3D printed, the walls scale too and can become too thin to carry weight. This can happen regularly because architects design to form; and can overlook the need to scale their ratios accordingly when generating a 3D model. When the files are prepared, the building elements must be scaled and correctly accommodated so they print out correctly in 3D. >

21. 3D Printing Market by Printer Type, Material Type (Metals, Plastics, Ceramics & Others), Material Form (Powder, Liquid, Filament), Process, Technology, Software, Service, Application, Vertical and Geography - Global Forecast to 2022. Research and Markets, 2016

“

A PSP can launch a consultancy practice to offer workshops on scaling for 3D printing. Moreover, they could consider a file fixing offering – in which in-house specialists could prepare BIM and 3D CAD files so that any resulting 3D models are scaled correctly and print out in the desired fashion.

”

- › This represents one of the biggest opportunities for PSPs, whose role is to communicate the detail of the designs and plans as effectively as possible. That can be done by offering 3D printing services to architects. However, there are also a number of layered services that can be delivered on top of 3D printing. A PSP can launch a consultancy practice to offer workshops on scaling for 3D printing. Moreover, they could consider a file fixing offering – in which in-house specialists could prepare BIM and 3D CAD files so that any resulting 3D models are scaled correctly and print out in the desired fashion. They could even sell 3D printed components to existing architectural model makers. There are many business opportunities to be explored.

Management

Alongside fixing files for 3D printing, there is also an opportunity for PSPs to help companies in the AEC space manage information on a wider basis. The building design and construction process has always generated a lot of information. The advent of newer technologies simply means that it now sits in different places. Rather than a ring binder of documents in a filing cabinet - plans can now also be stored in the cloud, on mobile devices, USB sticks and in shared databases; among others. While digital technology and the cloud

makes it easier for information to be shared and tracked, the nature of the AEC business is fragmented - with companies using different BIM standards, software and varying processes. It can get complicated with this much data moving around differing partners, using various systems. PSPs can support in the process by offering document and file management services. This could involve a service in which documents are tagged, given access privileges and managed from a central, secure storage location.



During construction

Although digital technology has shifted the opportunities for PSPs from the construction phase of the building, this doesn't mean that chances in this phase of the process have disappeared. On-site signage, marketing materials, window graphics and print room services are all still required for a construction site. This presents a series of openings for PSPs to support AECs working on projects - from designing, printing and consulting on the necessary materials to outsourced print room

services. There are specialist applications that a PSP can offer to companies specifically in this space, such as robust water-fast print technology, which can be used on-site without fear of water damage to deliver real value for AECs. ○



Conclusion

The way that buildings are designed and constructed is changing radically. The methods and processes that are used by the AEC sector are being redefined by digital transformation and changes in available technologies.

While the pace of development is somewhat less certain – with an industry made up of smaller companies with fragmented processes and workflows – the direction of travel is very clear. Now governments are increasingly mandating the use of more intelligent workflows to satisfy both sustainable building and ROI considerations, it's obvious that the winds of change in the AEC space are unstoppable.

As this landmark step-change continues, the opportunities that continue to open for PSPs are there for the taking. In particular, the role of 3D printing and colour output in supporting AEC companies in the journey to construct cost-effective, sustainable, attractive and functional buildings and infrastructure.

There will, of course, be challenges in supporting AECs in this radically changing market. But for PSPs that are brave, creative and ambitious – the rewards are there to be seized.



General advice

The way companies in the AEC space collaborate is changing. The volume of work is growing, but is becoming more localised to the earlier stages of the building design cycle. The use of technology is also ensuring much greater collaboration between AEC businesses and the level of interactions is increasing rapidly.

Any PSPs working with businesses in the AEC space will need to be responsive to these changes. The first step is understanding this shifting process and how building design works generally. With this clarity, a PSP is able to identify where support is required in building design and investigate if it is meeting the need. It's important to be responsive and flexible. It's a prudent idea to take stock of the equipment the business owns and if the

devices can best fulfill the requests for print jobs from AEC businesses. Perhaps there are areas in which investment is required to best support that endeavour. For example, investment in a Multi Function Device (MFD) to process the wide format printing necessary for blueprints and plans or cloud storage or information management to mitigate for the high-level of information moving around the building design process.

Another option, depending on the business, is to form partnerships with other local PSPs that could provide support services for specialised AEC print jobs. ○

How can PSPs get started

1

Start with research

- It is crucial to understand the transformation taking place in the AEC space and how the building, design and construction procedure works – from project bidding all the way through to completion. A PSP in this sector must transform to support the changing process
- Are there any particular pressure points that you can help with, from technology to delivery times, accessibility or 24 hour support?
- Where is the highest amount of demand and how can you best meet the AEC's requirements there?
- What applications dovetail to the specific needs of the industry? Is there anything you could add?
- Understand where the demand for print and digital services is going to come into the process and how your business could serve the customer
- What print and capture applications meet the AEC need? What do you think you need to add?

2

Look at your current capabilities

- Conduct an audit of current business capabilities, such as 3D printing or document management, among others, to understand what services you could currently provide the AEC community and what you'd like to focus on. Perhaps there is an opportunity to provide 3D printing for models or high-quality colour for design blueprints?
- Perhaps you already support customers in this or a related space – are there any connections you could take advantage of?
- With the research you have completed, and Canon's support, what do you think you could provide and how much integration would be required?

3

Think creatively

- What sorts of innovative and new consultancy, services and insight can you provide AECs?
- Can you deliver a multi service offering, providing an on-site print room and industrial display services perhaps?
- What ideas, concepts and innovations could you share?
- How can you best demonstrate the new applications and services you want to deliver?
- What showcase materials or samples do you need in your portfolio to highlight what you can do for AECs?
- It's important to offer value, but crucial to differentiate yourself in the market, how could you achieve that?

4

Bring in people with the right skills

- Considering the technologies and specific requirements in the AEC space, what sort of skills do you require to better serve these types of clients?
- Are there existing staff members that you can nurture?
- Identify where the skills gaps are and invest in training or application development

5

What can I do now?

Talk to Canon. As the market leader in this space for over 30 years, Canon can help you to develop the skills to unlock the opportunity that print and materials can create – resulting in an outstanding offer for both your existing customers and new business wins ○



For more industry insights, why not
subscribe to our magazine for the
print community, Think Digital, at
www.canon-europe.com/thinkdigital

You can also follow our conversation
on Twitter @CanonProPrintUK

Canon