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AEC INSIGHT REPORT

Building back in a post-pandemic world: reconstructing skills

Summary

The world has changed immeasurably in the past two years. But even before the words "COVID-19 pandemic" were first uttered, the rise of automation and new technologies were transforming the world of work. The effects of climate change have brought the need for green solutions into clearer focus. In a battle to survive, many businesses have had to adapt and transform; responding to a range of challenges; the human impact of the pandemic, rising commodity prices, fragile supply chains and so much more.

The effects of technological progress, together with the continuing impact of the COVID-19 pandemic and the global climate crisis, have all contributed to a pressing challenge: how to equip people and businesses with the skills and knowledge they need to be productive and participate in this new look global economy?

The construction sector is buoyed by the continued drive towards urbanisation, with predictions suggesting 68% of the global population expected to reside in urban areas by 2051[1]. The construction market output is expected to reach $14.8 trillion in 2030[2]. The global Architecture, Engineering and Construction (AEC) solutions market is predicted to reach almost $16bn by 2028[3].

But the economic potential of the sector continues to be constrained by a lack of skilled workers, particularly in an increasingly digitised world.

This insight report highlights how skills gaps could derail the post-pandemic rebuilding of the construction sector.

This report is for policymakers, educational institutions, employers and training organisations. It outlines some of the challenges and opportunities facing the sector which have the potential to place further pressure on an already fragile skills ecosystem. Drawing on industry exemplars, we propose some practical steps for the sector, business and academia.

Framing the challenge

Construction is big business. It contributes a significant amount to the global economy; research from McKinsey suggests construction-related spending accounts for 13% of global GDP[4]. The construction sector continues to remain buoyant despite the challenges of the COVID-19 pandemic. Driven by population growth and trends towards urbanisation and need for infrastructure investment, estimates suggest that global construction output will increase from $11.6 trillion in 2020 to around $14.8 trillion in 2030[2].

The world continues to experience dramatic population growth, which will have implications for the construction and AEC sectors for years to come. By 2050, the United Nations predicts the world's population will increase from about 7.7bn today to nearly 10bn[1]. Urban areas, home to around 55% of the global population, will contain 68% of us by 2050[5]. Most of this increase will take place in Asia and Africa, primarily in India, China and Nigeria[5].

Globally, more than 3,600 non-residential buildings will need to be constructed daily, on average, to keep up with demand[5]. Around 43 million new homes will be required each year globally between 2020 and 2030; 11m in India, 7m in China, 2m in Nigeria and 1.5m in the US[2]. Upgraded or new roads, rail, airports, power and other vital infrastructure, will also be needed to accommodate this growing global population.

But the sector has reportedly experienced flat productivity for decades[6]. A variety of systemic factors reportedly contribute to poor productivity and cost outcomes, including:

- Poor organisation
- Inadequate communication
- Flawed performance management
- Contractual misunderstanding
- Missed connections
- Poor short-term planning
- Insufficient risk management
- Limited talent management

A role for digital construction

When faced with global demand of such a colossal scale, surely technology has to play its part? Many participants in the sector were already investing heavily in technology pre-pandemic, and just like other industries the pandemic have accelerated the shift to the use of digital tools and technologies.

McKinsey predicts that the continuing COVID-19 pandemic will drive a net acceleration in the use of technology and the construction industry will continue its transformation from a highly complex, fragmented, and project-based industry to a more standardised, consolidated, and integrated one[7]. This is being borne out in the growth in the global Architecture, Engineering & Construction (AEC) market, which was valued at around $7.2bn in 2020 and is projected to reach $15.8bn by 2028[3].

Government requirements for the use of AEC software has been shown to drive the market. Architects, construction firms, surveyors, engineers and project managers alike are also looking for ways to aid communication and ease project management. They need solutions which help in the planning of large and complex commercial, residential and industrial buildings, reducing investment costs and the time of construction.

Seemingly the pandemic has stimulated the adoption of technologies and digital construction solutions. According to recent research, the rising adoption of remote working due to COVID-19, rapid rise in urbanisation globally, wide-ranging benefits of building information modelling (BIM) realised by the AEC industry, and growing government initiatives for adoption of BIM are contributing to the growth of the market[8]. It has been predicted that the BIM market will be worth $10.7bn by 2026, with a CAGR of 12.5% between 2020 and 2026[8].

Population growth is driving urbanisation which has significant implications for the construction sector. But it is recognised that the global sector has faced a productivity challenge for many years. There's now a recognition that technology can address fragmentation and improve integration of the market. The global pandemic has accelerated the adoption of technology and digital construction solutions, and this growth is predicted to continue. What are the implications for the future of the sector?

> **The AEC industry must fundamentally rethink how it designs, constructs, and operates the built environment. Innovative firms around the world are doing this already by adopting new technologies that improve efficiency and productivity like building information modelling, prefabrication and modular construction, generative design, and robotics[5].**

Global population

7.7bn

today to nearly

10bn

in 2050[1]

Global AEC market size

$7.2bn

in 2020 to

$15.8bn

by 2028[3]

Global construction output

$11.6tn

in 2020 to

$14.8tn

in 2030[2]

BIM market

$5.4bn

in 2020 to

$10.7bn

by 2026[8]

Construction-related spending accounts for 13 percent of global GDP[4]

$ trillion

Global GDP
$85.2

- Construction spending, 11.5 — **13%**
- Other industries, 73.7 — **87%**

Construction industry spending

3% p.a.

2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
11.5	12.0	12.5	12.9	13.4	13.8	14.3	14.8	15.3	15.7	16.2	16.7	17.1	17.6	18.0	18.4	18.8	19.2

Note: Due to COVID-19, the amount of spending in 2020 and subsequent years is likely to change.
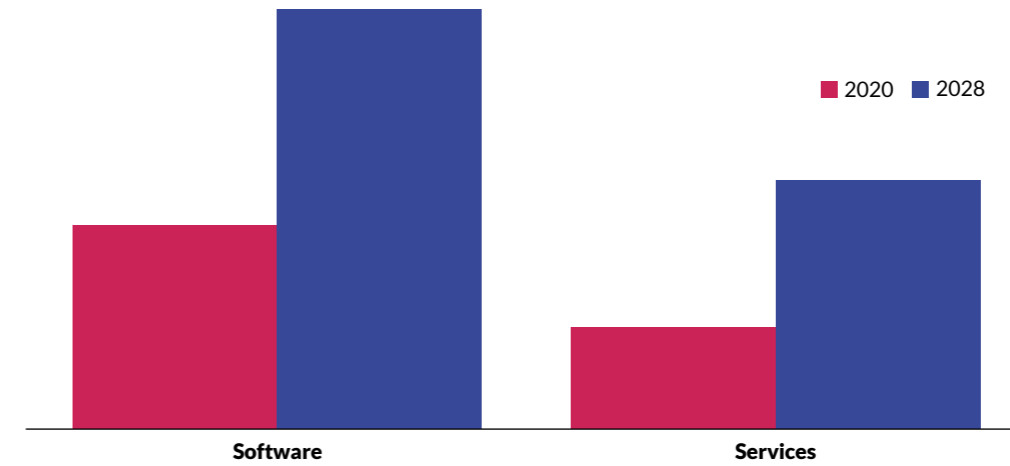**Source:** IHS Global Insight; ISSA – Infrastructure Stock & Spend Analyzer; World Bank; McKinsey Global Institute analysis

The use of Building Information Modeling (BIM) helps improve productivity as projects progress, because all information is contained in a single location. BIM tools are based on 3-D models, and they help planners avoid design clashes. Some companies are exploring adding dimensions, such as cost, time, and resources, in order to smooth project management in the execution phase and facilitate maintenance during operations[6].
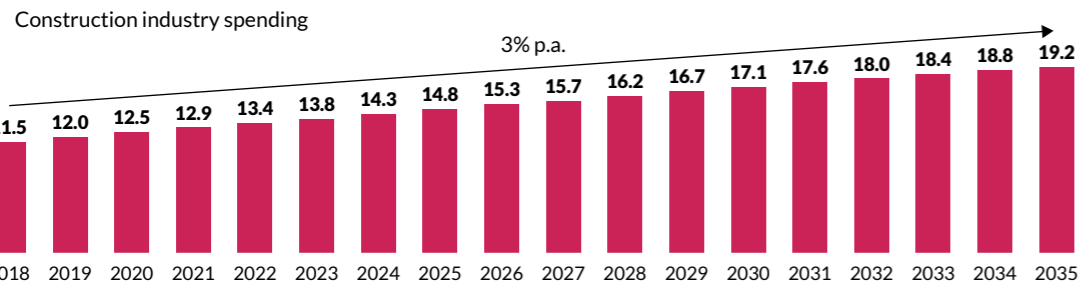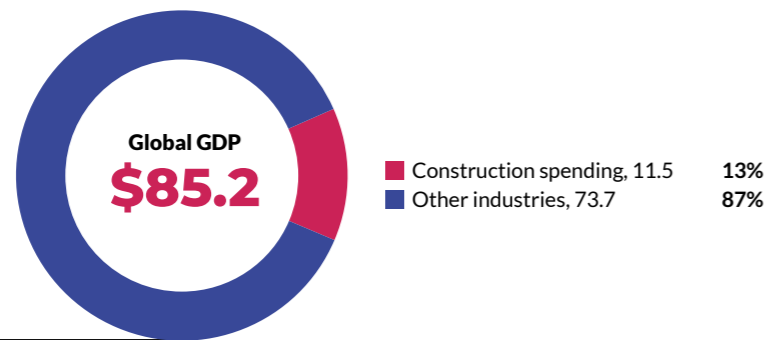
AEC market by component[3]

- 2020
- 2028

Software   Services

Note: Service segment is projected as one of the most lucrative segments

68%

of global population in urban areas by 2050[5]

43m

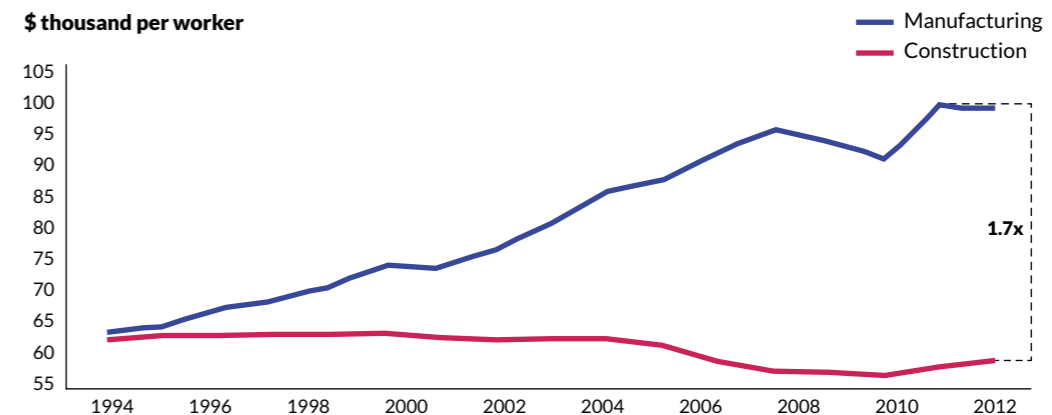new homes required each year between 2020 and 2030[2]

240,000km

of urban roads and 915,000km of road in rural areas[5]

Overview of productivity improvement over time[6]
Productivity (value added per worker), real, $ 2005

$ thousand per worker

- Manufacturing
- Construction

1.7x

Source: Expert interviews; IHS Global Insight (Belgium, France, Germany, Italy, Spain, United Kingdom, United States); World Input-Output Databases McKinsey&Company

The need for
green construction

Around the world, there's accelerating action towards the goals of the Paris Agreement and the UN Framework Convention on Climate Change. Governments are setting out net zero ambitions, and many of us are actively trying to manage our carbon footprint. We're turning to alternative fuels, such as solar and wind energy.

Climate change poses a challenge to infrastructure, with the potential for loss of homes, livelihoods and lives. However, the shift to more urban living means cities will need more housing and infrastructure.

How does the sector and AEC professionals square the circle? How do they meet the demand for housing and infrastructure on a planet with already-stressed resources?

The sector is responding by creating new materials and finding environmentally friendly ways to do things. Green construction techniques are designed to build energy efficient buildings and reduce construction costs. Its been estimated that 30 to 80% of building energy consumption can be reduced using proven and available technology[5].

There is increasing demand for sustainability to reduce the carbon footprint throughout every stage of the construction process (i.e., building, maintenance, demolition). Growing demand for environmentally-friendly and sustainable building materials is expected to propel the growth of the market. The global market for green construction is projected to reach $610.6bn by 2027[9].

New developments are the obvious target for adopting green construction techniques, optimising for green performance. Equally, the maintenance of existing developments and renovation of ageing buildings are candidates for green approaches. Evidence suggests that new construction as well as renovations will require more advanced remodelling than in the past.

Investments in renewable energy, energy-efficiency technologies and actions to mitigate against climate change are all likely to drive changes in the global workforce, the types of jobs required and the skills and knowledge needed. It has been suggested such actions could create up to 20 million new jobs[10].

Whilst green construction isn't a new concept, there's renewed focus on how the sector reduces its environmental impact on our planet. Is the sector equipped to implement the processes and workflows it needs to deliver the change required?

"Green construction often requires hundreds or even thousands of small adjustments to the building process to reach the goals of the finished structure. As a result, construction workers may need comprehensive training to become familiar with current techniques. Simply specifying the use of the new methods and not training the workers on them will only lead to low rates of adoption and a return to the familiar work processes. All the design improvements in the world can't make a structure green if the workers constructing it are failing to follow the specifications due to a lack of belief in its value[15]."

Green construction refers to the practice of using sustainable building materials and construction processes to create energy-efficient buildings with minimal environmental impact.

Building construction projects contribute
40%
of the waste in landfills[11]

Today's buildings produce
1/3
of the world's greenhouse gas emissions[12]

Global green construction market
$610.6bn
by 2027[9]

€3.9m
The planned investment that the average large AEC firm will make[13]

60%
of AEC firms are investing in improving workflows to use less energy and materials[13]

296 to 67,200
2006 vs 2018, the number of LEED-certified projects in the United States[14]

> The digital transformation is accelerating collaboration and innovation across industries, thereby enabling companies to deliver on our shared aspiration for a sustainable future[13].

**Lynelle Cameron,
Vice President, Sustainability
at Autodesk CEO, Autodesk Foundation**

A SPOTLIGHT ON SOUTH AFRICA:
IS GREEN THE KEY TO RECONSTRUCTION?

Pre-pandemic, in 2018, South Africans anticipated they would be doing a much higher level of green building activity in 2021, driven by the desire for lower operating costs and healthier buildings[16].

The South African construction industry was hit hard by the global COVID-19 pandemic. But signs of recovery are emerging; predictions suggest the industry is expected to grow by 6.1% in real terms in 2021 (up from a contraction of 16.5% in 2020)[17].

The government has announced a number of plans to help the economy recover from the crisis, including an ambitious ZAR1.1 trillion (US$60bn) Economic Reconstruction and Recovery Plan. This plan highlights aggressive infrastructure investment and green

economy interventions as priorities, with digital playing a key enabling role. It talks about retrofitting public and private buildings with measures to improve energy and water efficiency. Extending the programme to schools, human settlements, clinics and other public buildings "has a potential to build a local industry that is labour intensive and anchored on a sustainable value chain that supports SMME participation, income generation by households and skills development for unemployed youth."[18]
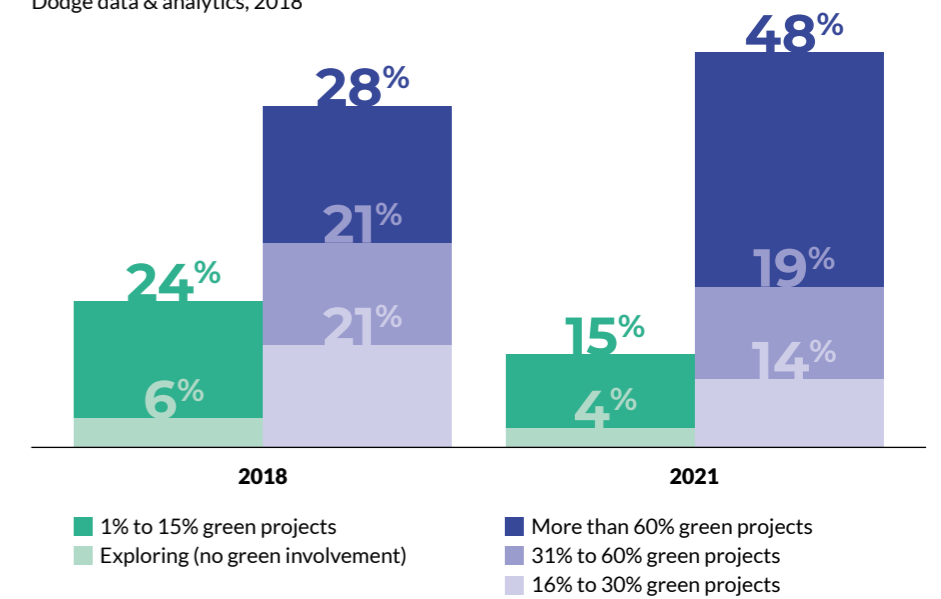
What about skills?

In 2015 research showed there was an urgent need for green-building and sustainability education to students studying towards built-environment professions such as architecture, quantity surveying, construction management, and urban planning[19]. The Department of Home Affairs has published its draft critical skills list for South Africa outlining the skills which are in short supply in the country, which included architect, draughtsperson and civil engineer.[20]

Should we conclude insufficient progress has been made in addressing the skills needs identified in 2015? What role should academia, training providers and companies play in improving awareness, knowledge and skills in green-building principles?

Levels of green building activity for respondents in South Africa (2018 and 2021 expected)[16]

Dodge data & analytics, 2018

- ■ 1% to 15% green projects
- ■ Exploring (no green involvement)
- ■ More than 60% green projects
- ■ 31% to 60% green projects
- ■ 16% to 30% green projects

Expected business benefits of green building in South Africa[16]

	New green building		Green retrofit	
	2015	2018	2015	2018
Decreased operating costs over one year	18%	8%	9%	8%
Decreased operating costs over five years	19%	23%	29%	22%
Payback time for green investments (years)	8	7	6	5

Building back after COVID-19

COVID-19 continues to affect communities globally. At the peak of the pandemic, construction sites across the world were shut down for extended periods. The sector has adjusted to the requirements of "social distancing" and remote ways of working. Fragile supply chains have compounded the challenges, organisations have had to source and manage scarce resources, and manage cash flow carefully.

However, estimates suggest the volume of global construction output declined by just two percent in 2020, less than half the rate of decline in the world economy. Construction was categorised as an essential industry in some countries, enabling it to continue working during lockdowns. Also "work at home" orders encouraged people to invest more in improvements to their own houses[2]. In the UK private investment was the driver to infrastructure growth in contrast to strong growth in public infrastructure in previous years[21].

Turner and Townsend research shows that 58.9 percent of surveyed construction markets anticipated being back at pre-pandemic levels of output within the next 12 months[22].

The volume of construction output is projected to increase by an average of 2.3% a year globally (2023 to 2030), with annual growth rates varying between a decline in Japan (-0.5% p.a.) to increases exceeding 8% a year in Tanzania (+8.4% p.a.), Ethiopia (+8.4% p.a.) and Bangladesh (+8% p.a.)2. Less developed regions are more likely to take longer to recover, given their fiscal support packages are smaller[23].

The AEC sector faced a lack of skilled labour before the crisis. The labour-intensive nature of the AEC industry makes it vulnerable to the COVID-19 pandemic, and the knowledge, attitudes, and practices (KPA) of the stakeholders play a vital role in controlling the impacts of this pandemic[24]. With rolling physical distancing measures as well as restrictions on cross-border movement, the shortage of skilled labour is expected to become even more acute[3].

The pandemic has created an unprecedented opportunity for the construction industry to reinvent itself. Some of the key trends emerge include an emphasis on supply chain resilience and diversification, an increased push for net zero carbon, a shift towards hybrid work patterns, and a growing use of digital and innovation in construction projects.

A recently published report emphasised the role COVID-19 played in catalysing innovation in construction by advancing technologies such as robotics and augmented reality[25]. McKinsey predicts further investments in technology or digitisation and innovation of building systems.

The case for digital tools that are proven to increase productivity, such as 4D simulation, digital workflow management, real-time progress tracking, and advanced schedule optimisation, will become even stronger[26]. Construction practitioners have also noted that adoption of technology by the industry could serve as a silver lining for the pandemic[27].

The World Economic Forum asserts COVID-19 has accelerated the need to implement an ambitious global upskilling agenda because it is forcing digitalisation and automation at a more rapid pace. Rising to this challenge could result in faster progress and even larger economic benefits by 2030[28].

15%

increase in construction volumes in Saudi Arabia in 2020 (compared with 2% decrease globally)[2]

> The mandate for change and technological adoption in construction has never been stronger, and financial and strategic investors continue to fuel a rapid expansion of the construction technology industry. The COVID-19 pandemic has only served to provide additional urgency to the pre-existing productivity and data-visibility issues facing construction companies[7].

Timeframes of recovery for construction industry to return to pre-pandemic levels of output — view across 90 global markets[22]

Percent
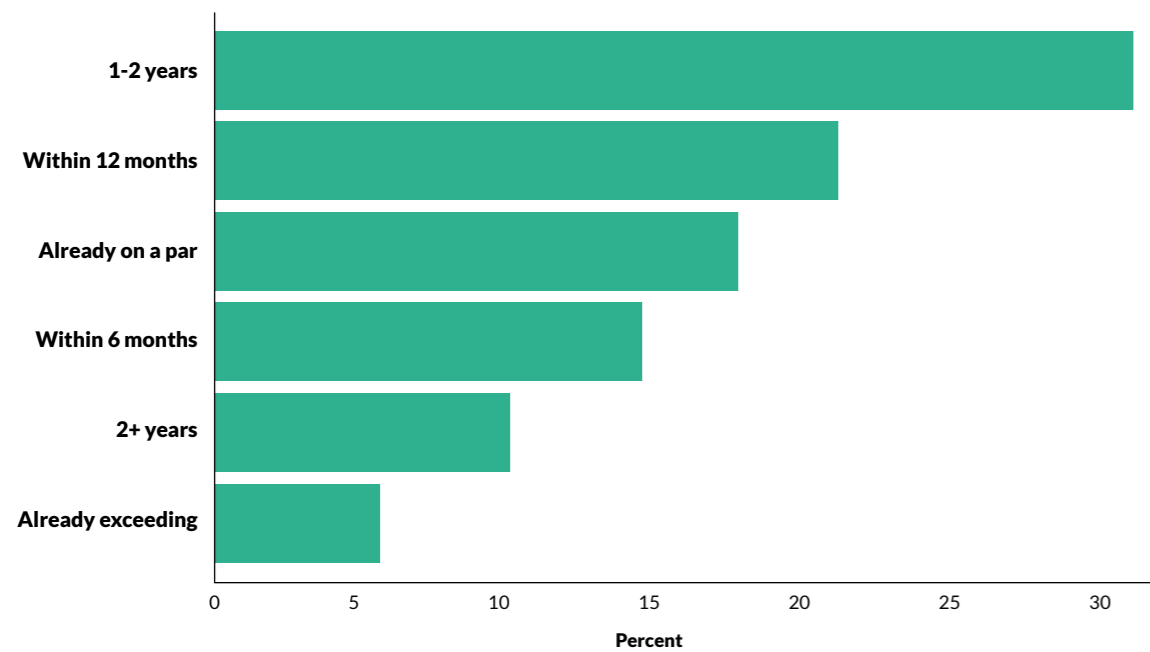
Source: Turner & Townsend International construction market survey 2021

What roles are you having trouble filling?[29]
From the Associated General Contractors & Autodesk workforce survey

Role	Percent
Project managers/supervisors	81%
Engineers	20%
Safety personnel	18%
Quality control personnel	15%
BIM personnel	8%
IT personnel	4%
Software/database personnel	4%
Lean construction professionals	4%
Environmental compliance professionals	2%
Architects	2%
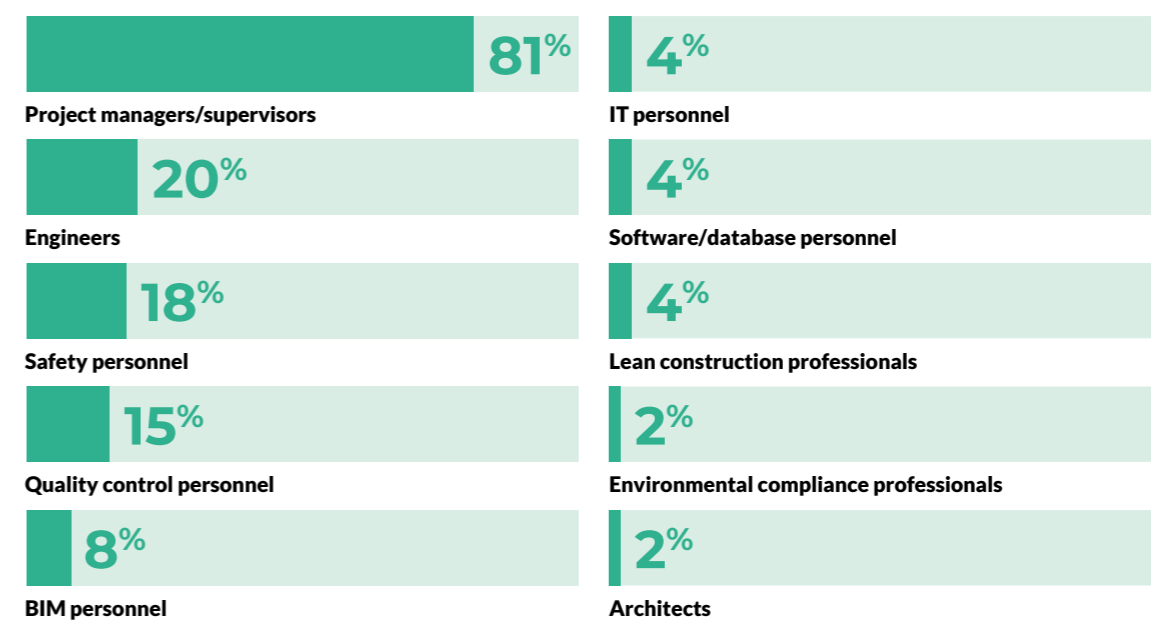
Defining technologies and skills

Tools designed to create immersive experiences that integrate virtual content with the physical environment that feel real to the user. The different technologies include:

The process of designing using immersive technologies and other digital design tools, including:

AUGMENTED REALITY

Augmented reality (AR) is a type of interactive, reality-based display environment that takes the capabilities of computer-generated display, sound, text, and effects to enhance the user's real-world experience. Augmented reality combines real and computer-based scenes and images to deliver a unified but enhanced view of the world. (techopedia)

MIXED REALITY

Mixed reality (MR) is the merging of real and virtual worlds to produce new environments and visualizations, where physical and digital objects co-exist and interact in real-time. Mixed reality does not exclusively take place in either the physical or virtual world but is a hybrid of reality and virtual reality. (Wikipedia)

VIRTUAL REALITY

Virtual reality (VR) refers to a computer-generated simulation in which a person can interact within an artificial three-dimensional environment using electronic devices, such as special goggles with a screen or gloves fitted with sensors. In this simulated artificial environment, the user is able to have a realistic-feeling experience. (Investopedia)

DIGITAL TWINS

A digital twin is a precise visualisation of a physical objective such as a product or infrastructure component. Typically used to display information about the physical object collected with systems and sensors. (Simplicable)

REAL-TIME 3D

Real-time 3D (RT3D) or real-time rendering is the sub-field of computer graphics focused on producing and analysing images in real-time. The term can refer to anything from rendering an application's graphical user interface (GUI) to real-time image analysis but is most often used in reference to interactive 3D computer graphics. (Wikipedia)

COMPUTER-AIDED DESIGN

Computer-aided design (CAD) is the use of computer-based software to aid in design processes. CAD software is frequently used by different types of engineers and designers. CAD software can be used to create two-dimensional (2-D) drawings or three-dimensional (3-D) models. (WhatIs.com)

BUILDING INFORMATION MODELLING

Building Information Modelling (BIM) is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct and manage buildings and infrastructure. (Autodesk)

GENERATIVE DESIGN

Generative design is an iterative design process that involves a program that will generate a certain number of outputs that meet certain constraints, and a designer that will fine-tune the feasible region by selecting specific output or changing input values, ranges and distribution (Wikipedia)

GREEN DESIGN

Green design is the creation of buildings which are energy-efficient healthy, comfortable, flexible in use and designed for long life (Foster + Partners, 1999)

New imperatives to address global skills gaps

We've been hearing about the skills gap for decades. With the impact of the global pandemic and demands of green economies, the gap isn't expected to narrow any time soon.

Research reveals that without sufficient investment in human capital, not enough qualified workers will enter the construction industry to keep pace with growth[30]. The World Economic Forum tells us there's a stark mismatch between people's current skills and the skills needed for jobs that will be created from and become more prevalent because of the changes brought about by the Fourth Industrial Revolution[28].

Digitalisation has extended the use of technologies in the construction sector. Adoption of 3D modelling, prefabrication, and virtual and augmented reality has increased the need for digital skills and the advent of new roles. There's significant demand for immersive skills in existing roles and new job postings; for example: a significant percentage of all job postings for engineers request solid modelling and 3D modelling technologies such as AutoCAD or Solidworks[31].

BIM: an in-demand skill

In recent years the application of BIM has become an in-demand digital skill which is transforming the construction sector, enabling the digital management and design of buildings and engineering processes. A recent report suggests construction must embrace a combination of all digital technologies including BIM, new visualisation tools, and big data analysis[32].

Governments across the globe are increasingly recognising the efficiencies that can be gained from adopting BIM; they view the use of BIM as a key to increasing innovation sector and addressing productivity declines[33,34].

Many governments are now making BIM mandatory for projects, defining targets for adoption. The United States adopted BIM as a requirement since 2008. In Australia, the reasons for adoption are defined as "to increase productivity and improved asset management in the built industry. Value for money, procurement transparency and emission reduction"[35].

Adoption of BIM is increasing. A BIM survey in 2020 revealed that in the past 10 years, the use of BIM made a substantial leap from 13 to 73% in the United Kingdom design and construction sectors[36]. However, in some markets – such as the UK – the lack of training is one of the main barriers to the adoption of BIM[37].

> The ongoing skills gap in the era of digital transformation in engineering and construction can create a mismatch between available employees and necessary skills. This situation could negatively affect E&C firms in various ways. As E&C firms seek approaches to mitigate these potential negative impacts, there are some practices that will likely increase in the coming year. Engaging with an external talent ecosystem, developing in-house training programs, and training a future workforce are some of the long-term strategies that most E&C companies should consider adopting[38].
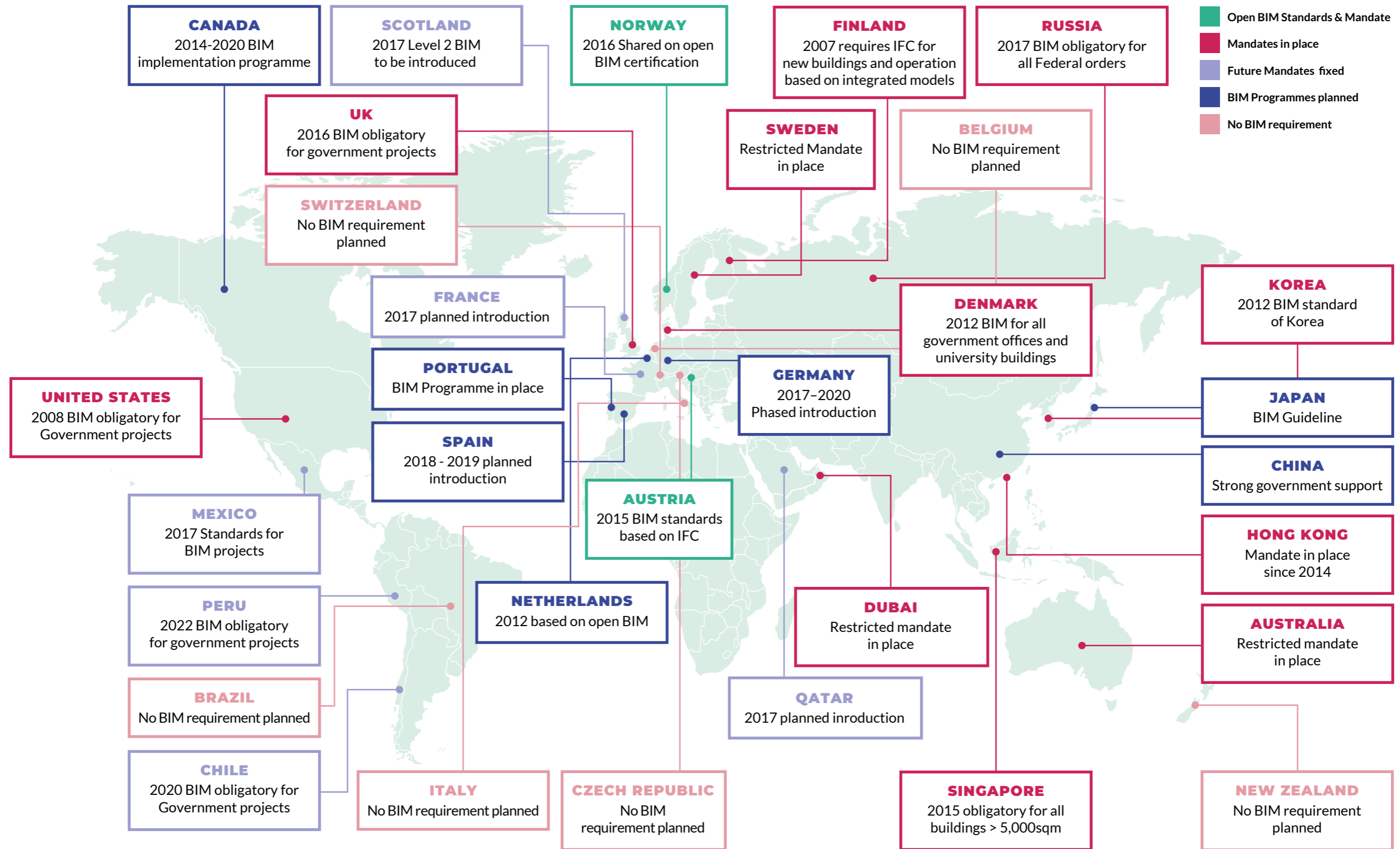
48%
of all demand for 3D graphics is in engineering[39]

1 in 5
job openings in engineering requests at least one CAD skill[39]

>50%
of jobs — draftsperson is the most common occupation to request 3D graphics skills in the EU[31]

Overview of global BIM adoption[40]

CANADA
2014-2020 BIM implementation programme

SCOTLAND
2017 Level 2 BIM to be introduced

NORWAY
2016 Shared on open BIM certification

FINLAND
2007 requires IFC for new buildings and operation based on integrated models

RUSSIA
2017 BIM obligatory for all Federal orders

UK
2016 BIM obligatory for government projects

SWEDEN
Restricted Mandate in place

BELGIUM
No BIM requirement planned

KOREA
2012 BIM standard of Korea

SWITZERLAND
No BIM requirement planned

FRANCE
2017 planned introduction

DENMARK
2012 BIM for all government offices and university buildings

UNITED STATES
2008 BIM obligatory for Government projects

PORTUGAL
BIM Programme in place

GERMANY
2017–2020 Phased introduction

JAPAN
BIM Guideline

SPAIN
2018 - 2019 planned introduction

CHINA
Strong government support

MEXICO
2017 Standards for BIM projects

AUSTRIA
2015 BIM standards based on IFC

HONG KONG
Mandate in place since 2014

PERU
2022 BIM obligatory for government projects

NETHERLANDS
2012 based on open BIM

DUBAI
Restricted mandate in place

AUSTRALIA
Restricted mandate in place

BRAZIL
No BIM requirement planned

QATAR
2017 planned inroduction

CHILE
2020 BIM obligatory for Government projects

ITALY
No BIM requirement planned

CZECH REPUBLIC
No BIM requirement planned

SINGAPORE
2015 obligatory for all buildings > 5,000sqm

NEW ZEALAND
No BIM requirement planned

Legend:
- Open BIM Standards & Mandate
- Mandates in place
- Future Mandates fixed
- BIM Programmes planned
- No BIM requirement

BIM awareness and 'use' 2011 vs 2020[36]

2011
just **13%** were using BIM

13%
43%
45%

■ Aware and using
■ Just aware
■ Unaware

2020
73% are now using BIM

1%
26%
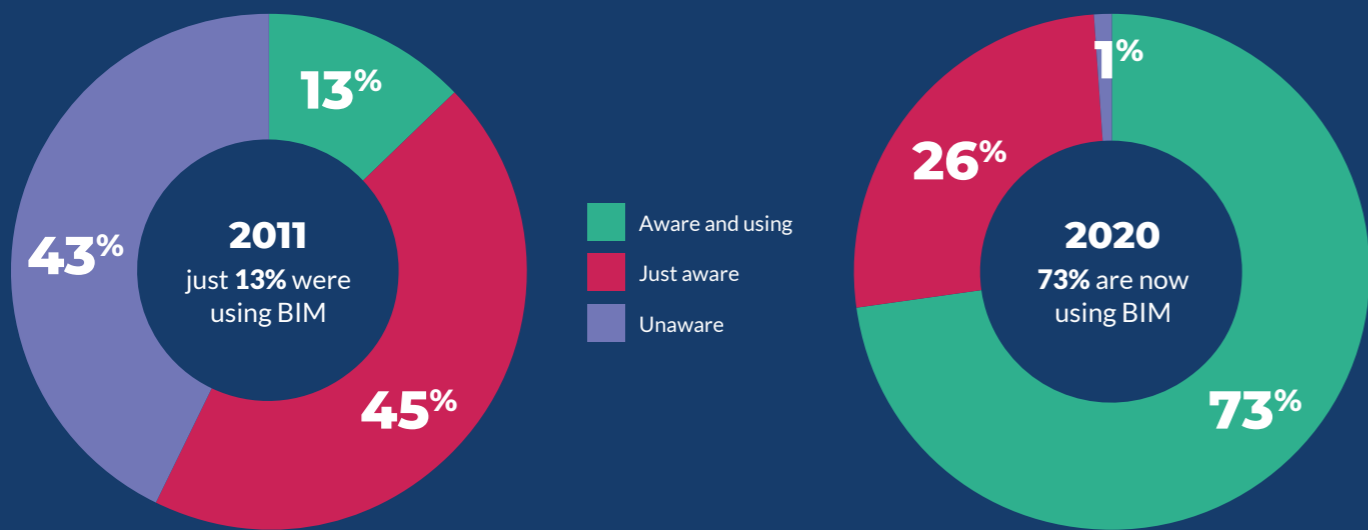73%

A shortage of BIM Managers was cited by **40% of built environment professionals**[41]

Digital Construction using Building Information Modelling (BIM) is a process for creating and managing information on a construction project across the project lifecycle. One of the key outputs of this process is the digital Building Information Model, the digital description of every aspect of the built asset. This digital model draws on information assembled collaboratively and updated at key stages of a project. Creating a digital Building Information Model enables those who interact with the building to optimise their actions, resulting in a more excellent whole life value for the asset[42].

worldskills

CHAMPIONING DIGITAL CONSTRUCTION SKILLS

Waterford Institute of Technology
INSTITIÚID TEICNEOLAÍOCHTA PHORT LÁIRGE

Ireland is the reigning champion for digital construction (formerly BIM) which was designated a "future skill" at WorldSkills Kazan 2019. Gordon Chisholm was the WorldSkills Ireland Chief Expert in Building Information Modelling at Kazan 2019.

We spoke to Gordon, a practicing architect, lecturer at Waterford Institute of Technology (WIT) and WorldSkills Ireland Chief Expert in Digital Construction for Shanghai 2022, about the role of digital construction, skills and WorldSkills.

**Gordon Chisholm
MCIAT, MRIAI**
Architect,
Lecturer & Tutor

Tell us a little about your course and how it has evolved

I lecture on the BSc (Hons) Architectural & BIM Technology course at Waterford Institute of Technology. In the 2008 depression there weren't any jobs in Ireland and in the EU. We saw that our students were going to North America, the Middle East, the Far East and Australia, and that jobs advertised for people with Revit and BIM skills. We thought "that's going to be coming here" and so we developed our architectural technology program, with Revit and BIM skills at its core. It has continued to evolve as digital construction has developed.

How do your students use digital technology to enable collaboration?

From first year we introduce the students and work with Autodesk BIM360. As the students progress we increase the complexity up to the final year construction collaboration technologies module, where we take the quantity, surveyors, architecture & BIM Technology and the construction management students and put them into teams. They run a project from post tender through to handover. They collaborate using BIM 360 technology and other digital tools. It gives them real-world experience. The feedback from the students is the projects set them up for the future, especially the opportunity to work as part of multi-disciplinary teams. I've heard it described as "many hands make light work".

How important are links between education and industry?

I'm always been industry focused. We're educating people to go into an industry; my view is if we're educating people and they're not getting a job out of it, then that's not right. I've always had good links from working in industry for a long time, and used these connections for CPD and for tech talks. It also helps with find industrial placements and graduate positions.

In around 2013, we recognised the industry around us needed to upskill and that our students needed to be upskilled. Through our BIM Collective Research Group We took advantage of the European-wide innovation voucher scheme, working with SMEs (architects, engineers, sub-contractors, manufacturers etc) on research and development projects. We've worked with around 100 companies and completed over 200 projects, looking at what might help them in their practices. In turn, that gives us a huge amount of insight and significant upskilling opportunities. Projects have uncovered a range of opportunities to test things out, including virtual reality and augmented reality.

We also have incorporated an industrial placement into our programme, which is going really well. We're getting some really good companies coming back each year looking for students for placement and graduate roles. We're seeing companies offering placement students graduate positions, which is great.

How's the skills and jobs landscape changing for your students?

Traditionally, an architectural technologist graduate would have gone in as a supporting role in an architectural practice. Probably less than half of our graduates now are going into architectural practice. They're being employed as information managers, BIM Coordinators, BIM manager and architectural technologists. Irrespective of the job title, it is about digital construction and the managing the data and processes required to deliver a project. They're at the heart of the digital transformation of the construction industry. They have a broad understanding of requirements and become the link between the structural engineer, the architect, the services engineer and other disciplines.

Tell us about WorldSkills

WorldSkills is great for inspiring future generations. What strikes me most about the WorldSkills events is that they provide an opportunity for young people to get exposed to so many skills; they're seeing skills in action by people who're just a couple years older than them. To see so many varied skills happening in one place, not just digital construction but things like aircraft maintenance, plastering and beauty therapy, is brilliant and inspiring.

For people and businesses involved in training and development around digital construction and who've not yet been involved with WorldSkills, I'd encourage them to connect with the technical delegate for their country. Technical delegates are at the forefront of skills development, use the opportunity to find out what's happening with digital construction and BIM.

The AEC job market

The job market continues to be challenged. Demand for workers seems to be increasing, employers report concerns about talent as one of the top issues affecting their business. An industry survey revealed 91% of contractors, construction managers, builders, and trade contractors reported difficulty finding skilled workers[43].

In-demand roles in the new AEC landscape

Job role	Description	US salary range	US average salary
Architect	Architects **design a range of structures, including houses, apartment buildings, schools, libraries and commercial buildings.** What Is an Architect? Learn What Architects Do – 2021 *MasterClass*	$51k - $79k	$71,186
Design Architect	Design architects most correspond to the popular notion of an architect. They're **responsible for conceiving a project's overall design.** They interpret a client's needs, analyze the building site and surrounding environment, consider the budget, and create a design within these parameters. What Is an Architect? Learn What Architects Do – 2021 *MasterClass*	$33k - $100k	$60,500
CAD Drafter	CAD drafters **convert the designs created by engineers and architects into technical drawings.** These technical drawings are then used to build structures and manufacture products. Launch Your CAD Career without a Four-Year Degree *solidprofessor.com*	$33k - $69k	$43,448
Structural design engineer	Structural engineers **design, plan and oversee the construction of new buildings and bridges, or alterations and extensions to existing properties or other structures.** Structural engineer: job description *targetjobs.co.uk*	$59k - $78k	$70,000
Civil engineer	Civil engineers **design major transportation projects.** Civil engineers conceive, design, build, supervise, operate, construct and maintain infrastructure projects and systems in the public and private sector, including roads, buildings, airports, tunnels, dams, bridges, and systems for water supply and sewage treatment. Civil Engineers : Occupational Outlook Handbook *U.S. Bureau of Labor Statistics (bls.gov)*	$58k - $105k	$72,683
BIM Manager	A BIM Manager is a civil engineer who is **responsible for the implementation of Building Information Modelling (BIM) and the Digital Construction procedures at the design, construction and handover stages of a project.** Career profile: BIM Manager	Institution of Civil Engineers *ice.org.uk*	$60k - $124k	$88,487
BIM Coordinator	BIM (Building Information Modelling) coordinators are **responsible for digital processes associated with the design and construction stages of a project.** They ensure 3D models, drawings and structural data are hosted in one, accessible place and deliver project information model to clients. BIM Technician Job Description, Salary & Training *Go Construct*	$44k - $80k	$65,805

AEC career paths

EDUCATIONAL BACKGROUND

2+ YEARS
Vocational/
career technical
apprenticeship

4+ YEARS
Bachelor or Master's
degree in engineering
or construction

COMPLEMENTARY SKILLS & PROF DEV TRAINING

Skills
- Drafting
- 3D modelling and visualization
- Construction management
- Project management

Soft skills
- Collaboration and people skills
- Problem solving and leadership skills

Software
- Autodesk Revit
- AutoCAD
- Civil 3D
- 3ds Max
- Autodesk BIM 360

CAREER OPPORTUNITIES

CAD Drafter
Design Architect
BIM Coordinator

Architect
BIM Manager
Structural engineer
Civil engineer

Work in construction office, engineering or architectural firm, or for a building manufacturer

The currency of certification

AUTODESK
Learning Partner

Particularly in the digital economy, employers place significant emphasis on recruiting people with relevant technical qualifications. This holds true for the AEC sector. The validation of skills through certification continues to have significance for professionals wherever they are on their career pathway:

- 73% of respondents sought IT certification in order to obtain specific knowledge and competencies that would help them to upskill and keep pace with changing technology trends[44]

- Training combined with certification has the potential to make a greater impact than training alone; the vast majority of respondents indicated that the myriad benefits they obtained through the process of becoming certified — such as earning more professional credibility or retaining knowledge for longer — exceed the benefits they would've obtained if they'd gone through training without certification[44]

- Employers who support employee credentialing programs see significant improvements in their workforce, with employees being more productive, more efficient, more fulfilled, and more loyal[44]

- Certification has been shown to boost pay; 28% of candidates reported a salary uplift as a result of certification[44]

> I think it's a good thing to recommend to people to get certified. It's a standard and it gives you legitimacy in the workplace. Our company does pay for professional development. They make sure that all of us are up to date on current software and industry trends. An Autodesk certification is a good validation in your career. It clearly says that you know what you're doing, and it's not just me telling you that I know what I'm doing, it's verified.
>
> **Bryan Kish,**
> **Architect**

> It's a good certification to have that shows that you have experience with the software, which is really important on a day-to-day basis to be able to do things quickly and efficiently. For me, it's a way to let people know that I have the skills to work in that software and I can help people out in my firm.
>
> I also tend to spend some time on the forums answering questions and everything. There's a pretty good community within Autodesk. To have that certification there gives you credibility.
>
> **Zachary Jensen,**
> **Civil Engineer**

The currency of certification

If you're aiming for a BIM Manager career, Autodesk offers the following courses and certifications that can help you advance your career opportunities.

COURSES

- Revit for Structural Design Professional Certification Prep
- 3D Modeling Foundations and Substructure
- Revit for Mechanical Design Professional Certification Prep
- Systems Analysis for Mechanical Design Using Revit

CERTIFICATIONS

- AutoCAD for design and drafting
- Revit for structural design
- Revit for electrical design
- Revit for architectural design

HERE'S AN OVERVIEW OF THE TYPICAL SKILLS YOU'LL NEED TO MASTER

- Drawing and organising objects
- Drawing with accuracy
- Advanced editing functions
- Advanced layouts, printing, and alternative outputs
- Annotation techniques
- Reusable content and drawing management

For other AEC certifications on offer from Autodesk:

https://www.autodesk.com/certification/all-certifications#aec-certification

Visualising the future

DEMAND AND TRENDS MONITOR[31]

Emerging

Civil Planning

Jobs looking for solid modelling software almost doubled in the UK and Australia.

Associated roles in planning in France requesting 3D graphics and real-time 3D skills was c.4,000 in 2019.

Trend alert: Increasing use of 3D skills by transportation planners.

Trend alert: UK Chartered architectural technologists and town planning technicians requiring 3D graphics.

Growing

Civil engineers

12% of civil engineering job postings in Germany requesting 3D graphics skills.

UK civil engineering job postings in 2019 jumped to 22.6% — a 41.8% growth in demand in six years.

Trend alert: Civils moving to become a major industry within the 3D graphics world.

Leading

Architecture/Construction

UK jobs have more than doubled in demand for 3D skills, with 7,755 UK postings requesting these proficiencies in 2019.

Draftsperson is the most common occupation to request 3D graphics skills in the EU, call for 3D graphics skills in over 50% of jobs.

Draftsperson is the top 3D occupation in Germany, France, Italy, Austria, the Netherlands, Belgium, Ireland, Czech Republic, Sweden, Slovakia, Luxembourg, and Malta.

Trend Alert: Draftspeople seeing a shift toward real-time 3D modelling software, as job postings call for virtual and XR skills, especially in Germany and Poland.

Engineering

A significant percentage of all job postings for engineers request solid modelling and 3D modelling technologies such as AutoCAD or Solidworks.

In Spain and Germany, solid modelling CAD software is requested in a third of all graphics job postings.

Trend alert: In France and Germany, some engineers are beginning to incorporate real-time software into their 3D modelling.

Trend alert: Move toward real-time 3D modelling in an occupation that previously reliant on CAD.

Trend alert: Real-time 3D rendering skills, such as virtual and augmented reality, are being requested for engineering jobs in these European nations.

Learning from experience

Making an investment in developing skills has proven to reap rewards – at a business or individual level. Upskilling leads to meaningful work – good jobs – upskilling has the potential to trigger a virtuous circle: increased levels of skills lead to better jobs, and better jobs foster the further development of skills[28].

Employers across the AEC sector undertaking training on digital construction software, such as that from Autodesk, report seeing improved efficiency, better workflows, and being able to use software to its full potential. They also talk about the importance of certification to verify competency. Students and employees also highlight how relevant certifications are valuable for career development and reinforce knowledge and skills.

Michael McGuire, Course Leader, New College Lanarkshire

McGuire says the result is his students enter the job market with a decided advantage. "They have the utmost belief and confidence, if they're asked in an interview to do a CAD test, or if they're given a specific job to do while they're there, that they know how to do that now."

Autodesk case study, Design students in Scotland create sustainable house

Modena, Autodesk Authorized Training Partner, South Africa

"We often have clients say they have been working on their software for a long time and they don't need a fundamental course, but when they come on training, they quickly realise that ATC structured training teaches them best practice."

With branches across South Africa, Autodesk Authorized Training Partner, Modena focuses on providing customers with customised solutions that add value to proficiency, performance and service delivery. Modena's expertise spans across a number of professional design industries including architecture, engineering, and construction (AEC), product design, manufacturing and mining and media and entertainment.

CAD Masters, Autodesk Authorized Training Partner, Middle East

"Companies tell us our training speciality in BIM converts their business from the regular way to BIM which makes them save money, time and resources. Implementing BIM allows them to take on more projects and expand their market share.

"In addition, training has allowed many trainees to rise their positions in their companies or to join new companies with better positions."

Operating in Egypt and across the Gulf, CAD Masters provides training, technical support, and services for engineering and graphics software. CAD Masters offers integrated solutions in CAD & BIM technology by implementing strategies based on commitment, quality, customer satisfaction, and high return on investment. It works with many large construction and manufacturing companies, as well as collaborating with universities and institutes across the region.

CAD Masters recently signed a MOU with the Egyptian Ministry of Manpower for a train the trainers program for Fusion360 and has also been authorised by the Egyptian Engineers Syndicate.

Galaxy Academy, Autodesk Authorized Training Partner, Qatar

"Autodesk BIM software is the leading software application in Qatar and authorized by government sector."

"Professionals and students request BIM software to develop their careers and to find new positions. Courses and qualifications lead to career enhancement, better positioning and better employment opportunities."

Galaxy Academy provides BIM Management Consultancy services for architects, engineers, contractors and owners with high-value services in each fields of expertise, allowing it to develop multidisciplinary projects located anywhere in the world, where flexibility, adaptability to specific conditions and speed of delivery are essential conditions for success. As an Authorized Learning Partner, it supports construction companies, providing BIM training, coaching and hand-holding.

NCL NEW COLLEGE LANARKSHIRE

MODENA

CAD MASTERS Training & Solutions

GALAXY ACADEMY BIM Consultant & Training Solutions

Learning from experience

Closing the skills gap across regions and industries

Higher skilled workforce better suited for a knowledge economy

Employees have an increased **sense of agency and well-being**

Workers have a better understanding of their **worker rights**, increased participation in **collective bargaining** and wider political activities

GOOD WORK

UPSKILLING

Increased productivity

Positive workforce engagement with increased willingness to learn and self-develop

Better and more inclusive employer training opportunities for a stable workforc

Stronger collaboration between actors to foster continuous improvement and new approaches of training

Creation of new training to support the development of new sectors

How can we get ahead of the skills problem?

The effects of technological progress, together with the continuing impact of the COVID-19 pandemic and the global climate crisis, are contributing to the changing occupational composition of the economy and the skills and knowledge necessary to perform many jobs.

The current global skills gap is going to worsen as the AEC sector races to meet these challenges over the next 30 years and beyond. The gap between what companies need to grow and the skills available is widening, and most countries are not set up with the skills infrastructure to react.

Workers need access to programs that provide in-demand skills that lead to good jobs and careers. The most effective strategies incorporate work-based learning models; programs developed through partnerships between employers and educational institutions that pair classroom learning with on-the-job learning.

THREE SOLUTIONS

01
Strengthen your skills pipeline

02
Invest in collaborative programs – industry, training providers and academia

03
Recognise the importance of certification

01

Strengthen your skills pipeline

We need to strengthen the new talent pipeline and prepare young people with the skills required for an increasingly digitised and automated sector. Young people need to be excited about the opportunities associated with AEC earlier in their education journey – and opportunities to experience technologies such as BIM and real-time 3D should be included within learning at secondary school. Digital skills should become a core competency for students in secondary education, as part of the STEM agenda.

In addition, employers need to anticipate their future skills requirements, support retraining, and provide access to training now rather than later. This includes supporting employees to pursue professional certificate programmes, which are becoming increasingly accessible and affordable and provide a better alternative to sending employees onto a degree course. Professional courses are industry-specific learning and are vital to closing the skills gap.

02

Invest in collaborative programs – industry, training providers and academia

Key digital (immersive) skills need to be integrated across key curriculums; they should be taught as a foundational skill across various degree programmes from architecture and construction. A more dynamic approach to industry engagement is needed. Educators need to consider partnerships with industry and with expert training partners to help them stay abreast of developments.

Many software providers have partner programmes that provide subsidised and affordable access to their platforms, products, resources, and certification exams. These alliances and endorsements can also serve to differentiate and position institutions globally.

03

Recognise the importance of certification

Professional training will be necessary to upskill the existing workforce to help close the skills gaps. Certification can allow employees to quickly acquire specialist technical skills to improve productivity and demonstrate competence. Certification ensures a proven minimum baseline of skills has been met. Today's certification programmes are an affordable alternative to degree programmes, offer more flexibility, and are industry targeted.

Certification takes on greater importance in a sector such as AEC where roles, workflows, and technologies evolve rapidly. Professionals with certified immersive skills will have countless employment opportunities in the coming years.

In relation to actions to address skills gaps, the World Economic Forum[28] suggests the following:

Business: Anchor upskilling and workforce investment as a core business principle and make time-bound pledges to act

- Develop a clear "people plan", using a people-centric approach in which technology is aligned to the needs of workers and society
- Make long-term commitments to upskilling employees

Education providers: Embrace the future of work as a source of reinvention to normalize lifelong learning for all

- Prioritize vocational and higher education curricula that are "just in time" rather than "just in case", working with business
- Scale up the provision of self-directed learning and nano-degrees for lifelong learning
- Build bridges between national qualification systems and lifelong learning so skills are recognized globally
- Connect schools and places of learning with each other globally

Conclusion

This insight report highlights the challenges and opportunities facing the global AEC sector, all of which have significance for skills development – both on the near horizon and longer-term.

The sector faces a collective challenge. There's rising demand for skills as the world bounces back after COVID-19. Alongside this, the sector needs to adopt the skills it needs to play its part in mitigating against the impending climate emergency.

Adoption of digital construction techniques hold the key to increasing productivity and reducing waste.

However, around the world there are insufficient people with the skills needed to capitalise upon the advances in technology adoption across the AEC sector. The sector could be playing catch up for a long time. There's a risk it won't get there quick enough to address the challenges of climate change and the economic impact of the global COVID-19 pandemic.

Employers, academia and industry need to take collective responsibility to equip workers with the skills they need to make the most of the technology available today.

Together we need to invest in building these skills, to address the challenges facing us today and those coming down the line tomorrow.

> "
> **Adoption of digital construction techniques holds the key to increasing productivity and reducing waste.**
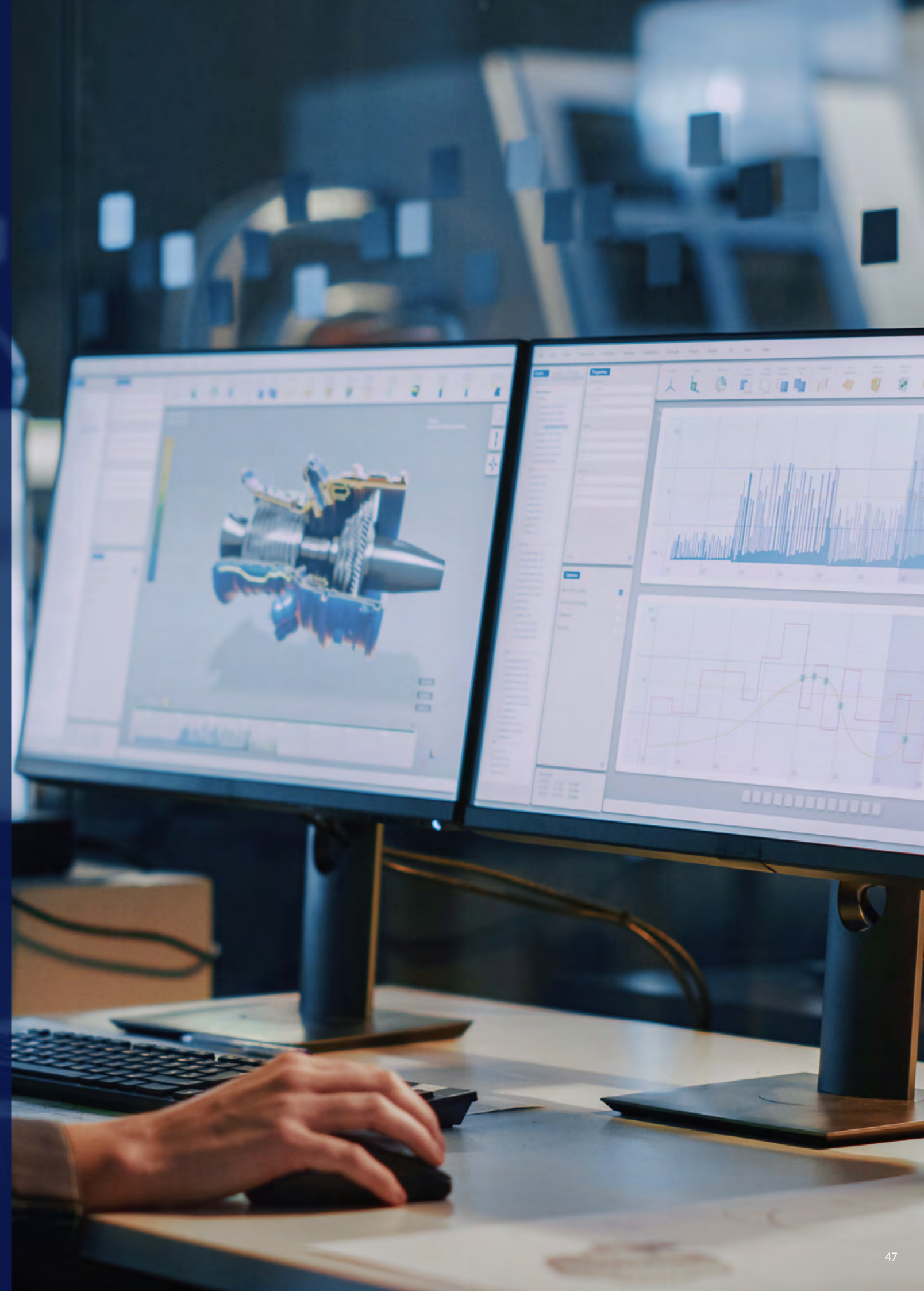
About the Autodesk learning program

With Autodesk courses and certifications, businesses can gain the knowledge and skills needed to create high-quality building and infrastructure designs.

Autodesk Authorized Training Centers (ATCs) are Autodesk preferred training providers who can help with employee professional development. They work with Autodesk Certified Instructors (ACIs) who are recognized for their product mastery and instructional skills. ATCs work with employers to evaluate business needs and adapt their training to workflow and processes. ATCs offer flexible delivery methods from classroom to instructor-led virtual training to ensure that your team gain the required skills in a way that minimizes business interruption.

Authorized Academic Partners (AAPs) are Autodesk preferred service providers to the academic market that help with faculty professional development and add value to programs and courses.

AAPs can offer comprehensive end-to-end service packages that combine training with access to Autodesk software and curriculum resources. They embed Autodesk professional certification within their courses, which are of value to faculties and students. AAPs can support and recognize students by rolling out projects, competitions, and extra-curricular training activities.

About KnowledgePoint

KnowledgePoint adds value to learning organisations by delivering a range of learning support services. From learning materials management to administrative services and global training network management, we make life easier for our learning industry partners.

Our customers are training and learning organisations and teams; they design, create and deliver learning programmes. We work in partnership with them, providing practical solutions which support these efforts. In doing so, we make a real difference to them and their learners. We help them achieve positive learning experiences and outcomes, boost customer and learner satisfaction, and realise cost and resource efficiencies.

We manage the global training networks for Unity and Autodesk; as such, we're the gatekeeper to official training programs for two of the most exciting software companies in the world. Through these programs, people and businesses develop the 3D, VR, and AR skills they need now – and they'll need in the future.

As the Autodesk Learning Partner Distributor for the EMEAR territory, we manage the training partner network including recruiting, onboarding, and providing ongoing support and enablement to academic and commercial learning partners.

AUTODESK
Learning Partner

Time to take action
to reconstruct skills

Find out how by talking to the KnowledgePoint team

Visit **knowledgepoint.com/future-skills**
or get in touch at **channel@knowledgepoint.com**

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