

---

# The Smart Building Advantage

*This page intentionally left blank*



---

# **The Smart Building Advantage**

**Unlocking the value  
of smart building  
technologies**

**Dr Matthew Marson**

---

**Published by Emerald Publishing Limited**, Floor 5,  
Northspring, 21-23 Wellington Street, Leeds LS1 4DL.

ICE Publishing is an imprint of Emerald Publishing Limited

**Other ICE Publishing titles:**

*Intelligent Buildings, 2nd edition*

Derek Clements-Croome. ISBN 9780727757340

*Digital Twins for Smart Cities: Conceptualisation, challenges  
and practices*

Li Wan, Timea Nochtá, Junqing Tang and Jennifer Schooling.

ISBN 9780727766007

*BIM for Project Managers: Digital construction management*

Peter Barnes. ISBN 9780727765291

A catalogue record for this book is available from the British Library

ISBN 978-1-83549-879-8

Copyright © 2024 Matthew Marson. Published under exclusive  
license by Emerald Publishing Limited.

Permission to use the ICE Publishing logo and ICE name is granted  
under licence to Emerald from the Institution of Civil Engineers. The  
Institution of Civil Engineers has not approved or endorsed any of  
the content herein.

All rights, including translation, reserved. Except as permitted by the  
Copyright, Designs and Patents Act 1988, no part of this publication  
may be reproduced, stored in a retrieval system or transmitted in  
any form or by any means, electronic, mechanical, photocopying  
or otherwise, without the prior written permission of the publisher,  
Emerald Publishing Limited, Floor 5, Northspring, 21-23 Wellington  
Street, Leeds LS1 4DL.

This book is published on the understanding that the author is  
solely responsible for the statements made and opinions expressed  
in it and that its publication does not necessarily imply that such  
statements and/or opinions are or reflect the views or opinions of  
the publisher. While every effort has been made to ensure that the  
statements made and the opinions expressed in this publication  
provide a safe and accurate guide, no liability or responsibility can be  
accepted in this respect by the author or publisher.

While every reasonable effort has been undertaken by the author  
and the publisher to acknowledge copyright on material reproduced,  
if there has been an oversight please contact the publisher and we  
will endeavour to correct this upon a reprint.

Cover photo: courtesy of BG-Studio/Shutterstock

Commissioning Editor: Michael Fenton

Content Development Editor: Cathy Sellars

Books Production Lead: Emma Sudderick

Typeset by: KnowledgeWorks Global Ltd.

Index created by: David Gaskell

---

# Contents

	Praise for <i>The Smart Building Advantage</i>	ix
	About the author	xiii
	Acknowledgements	xv
	Foreword	xvi
<b>01</b> .....	<b>Introduction</b>	<b>1</b>
	1.1. What is a smart building?	1
	1.2. Why we don't have a proper definition	1
	1.3. A definition that continues to change or why we bother with smart buildings	3
	1.4. The promise of a smart building	4
	1.5. What qualifies the author to write this book?	6
	1.6. Why we need this book	7
	1.7. The opportunity	7
	1.8. Why we need to keep the discussion generic	7
	1.9. Summary	8
<b>02</b> .....	<b>History of smart buildings</b>	<b>11</b>
	2.1. The cyberneticists	11
	2.2. Recent history	12
	2.3. The Edge	13
	2.4. Macro trends in the 2010s	13
	2.5. The pursuit of value in the mid-2020s	16
	2.6. Summary	17
<b>03</b> .....	<b>Approaches to assessing value</b>	<b>19</b>
	3.1. Traditional valuation	19
	3.2. Certifications	21
	3.3. Deriving business value from smart building technology	25
	3.4. Summary	27
<b>04</b> .....	<b>Changing skills</b>	<b>31</b>
	4.1. The education gap: A barrier to progress	31
	4.2. Bridging the gap with continuous professional development	32
	4.3. The role of vendor education and collaboration	32
	4.4. An educational framework for all	34

---

4.5.	Example of missing skills	34
4.6.	Case study	38
4.7.	Summary	39
<b>05</b>	<b>..... The new equation of real estate</b>	<b>41</b>
5.1.	The technologies of value	42
5.2.	How to calculate the return on investment	44
5.3.	Cost attribution	48
5.4.	Output and assumptions	50
5.5.	ESG value mapping	52
5.6.	Summary	54
<b>06</b>	<b>..... Enhancing ESG with smart buildings</b>	<b>57</b>
6.1.	What is ESG?	57
6.2.	Environmental	58
6.3.	Social	59
6.4.	Governance	60
6.5.	How can it be automated?	60
6.6.	Technology carbon budgets	61
6.7.	Fixing the industry's reliance on EPCs	61
6.8.	Summary	63
<b>07</b>	<b>..... Obsolescence</b>	<b>65</b>
7.1.	What is obsolescence?	65
7.2.	How to deal with obsolescence	66
7.3.	Matching construction to technology	67
7.4.	The kit of parts	67
7.5.	Ownership structure	70
7.6.	Operating structure	71
7.7.	Emerging practices	73
7.8.	Summary	74
<b>08</b>	<b>..... Why we've struggled to embed so far</b>	<b>77</b>
8.1.	Marketing nonsense and the erosion of trust	77
8.2.	Protecting market interests	78
8.3.	Those who build it, don't code it	79
8.4.	Shifting the blame	80
8.5.	Sidewalk labs	81
8.6.	Why would it change?	82
8.7.	Summary	83

---

<b>09 . . . . .</b>	<b>The strategies and tactics to be the winning property owner</b>	<b>85</b>
	9.1. Technology investment to a goal	85
	9.2. The method to the winning property	86
	9.3. Patchwork quilt architecture	90
	9.4. Optionality in calculations	91
	9.5. Marketing	92
	9.6. Summary	94
	<b>Index</b>	<b>97</b>

*This page intentionally left blank*

---

# Praise for *The Smart Building Advantage*

*The Smart Building Advantage* is a combination of data-driven insights and witty experiential learnings from Dr. Marson – a must-read for anyone designing, investing or operating in real estate. It is a modern day guidebook to untangle the endless PropTech jungle and focus on what is most important – return on investment.

*Elisa Rönkä, Global Head of SaaS Sales, Siemens*

I've known Matthew for over 10 years and over that time, I've quickly come to regard him as a second-to-none global thought-leader on 'smart' and 'sentient' buildings. Over the years that I've known him, he's taught me a great deal about the wonderful potential that the 'smart' built environment can deliver. More precisely, he continues to remind me of the promise of tangible and measurable positive life outcomes that our buildings can deliver for all of us. In this book, Matt delivers on that promise. *The Smart Building Advantage* brings my appreciation of his knowledge of and passion for this topic to an entirely new level. In this powerful treatise, Matt presents a well-constructed argument as to why we should all understand – and dare I say it, 'embrace' – the places that we usually take for granted. This book is masterful story-telling on a topic that we've quite simply ignored for way too long. Namely, that the buildings that surround us are increasingly places of technological marvel with the potential to fundamentally transform the human experience in ways that we can only now begin to imagine. If you live, work, or play in any type of building, this is a must-read.

*Sol Salinas, Global Executive Vice President, Capgemini*

In the world of computing on the edge and Generated AI, it's difficult to understand why smart buildings don't seem to keep pace with technology advances. *The Smart Building Advantage* provides a comprehensive look at smart buildings – across history, systems, skills, strategy, value and challenges, showcasing complexities which stifle smart building advancement. This book caps off with a proven approach to creating and running a smart building around four key property owner benefits. Well researched and easy to read, this book is a must-have for anyone looking to understand the value of the smart building space.

*Christy Nelson, North America Modern Work Lead, Avanade*

---

This book demonstrates how smart buildings, through convergence of technology and sustainability, offer unparalleled value by optimising energy consumption, enhancing occupant comfort and driving operational efficiency.

*Tom Smith, Global Director Property & Buildings, WSP*

Matthew really combines his two worlds – academic clarity and industry experience. Backed by rigorous research yet crafted for industry allure, it’s your go-to resource for mastering the Smart Building topic. The book seamlessly bridges theory with practice which makes the book also very suitable as an educational tool.

*Vitalija Danivska, Assistant Professor of Real Estate Business,  
Delft University of Technology*

This considered and pleasingly pragmatic book addresses the real issues facing everyone who designs, implements, manages, or occupies a smart building. Matthew Marson collects, distils, and applies a healthy dose of reality on current thinking, providing useful recommendations which frankly are essential for the smart building industry to thrive.

*Jake Fraser, Chief Technology Officer, Institution of Mechanical Engineers*

Matthew is a rare person in the real estate space who combines deep technical knowledge of all things Smart, with on the ground project expertise and an ability to engagingly communicate, without fluff or hyperbole. All of this is packaged in this excellent book which provides a clear expose and roadmap for delivering the best tech enabled real estate. A must-read for all forward thinking people designing, delivering and operating buildings.

*Sally Jones, Non-Executive Director & Advisor, Former British Land Head of Strategy, Digital & Technology*

Matthew’s book covers every area of ‘smart buildings’ you need to know and understand. The book tells it how it is, and how it should be. The market needs to move and needs education. This book will and should help with those. A lot of knowledge in this book, that you would normally pay a lot of money to get hold of. A great read.

*Michael Grant, COO, Metrikus*

---

Matthew breaks down the complex world of Smart Buildings into bitesize chunks, while weaving together the often competing and synergistic topics of sustainability, value and ever-changing technology in a seamless handbook for property owners everywhere.

*Rupert Lane MC, Chief Commercial Officer, REsustain*

*This page intentionally left blank*

---

## About the author

Eur Ing Dr Matthew Marson MEng (Hons) CEng IntPE(UK) FIMechE FRSA is an experienced leader, working at the intersection of technology, sustainability and the built environment. Having founded WSP's Smart Places practice and grown Accenture's offering in this field, Matthew led a €100 million business across a range of asset types and geographies.

Marson was named the Royal Academy of Engineering's Young Engineer of the Year 2022 for his contributions to the global Smart Buildings industry. As a recognised thought leader, Matthew is a keynote speaker at international industry events related to emerging technology, net zero design and places at the building and city scales – publishing in a variety of journals and books and earning a doctorate in Smart Buildings.

*This page intentionally left blank*

---

**Acknowledgements** This book has been almost a decade in the making. All the goodwill received means that I would like to acknowledge the immense contributions that those around me have had on the development of this book. Jamie-Leigh Chapman relentlessly motivated me, Nick Offer inspired me, Will Readshaw brought his analytical prowess in developing the model and Judith Marson proofed and perfected it. A big thanks goes to Adam Muggleton who kept me accountable to write this book. Christopher Lillington listened to every out-loud idea I had for this work.

I've also been incredibly spoilt with the amazing leaders who have supported me and shaped my career to date with their encouragement and the trust they placed in me to design and deliver the schemes that I have.

There's also a thanks owed to all those that I've fiercely debated with over the years. You've been pivotal in shaping my thinking and challenging me to find the best ways to communicate the value of technology in the built environment.

I also want to thank those who reviewed the work before its release, the time they poured into it and the importance that their feedback had on the final product.

---

# Foreword

The built environment is a unique realm for a technologist, where the swiftly advancing state of binary technology intersects with the more gradually evolving and artistic domain of architecture and design. It is a space where structures intended to endure and function for many decades encounter a world where swift alterations are possible with just a few lines of code and the press of the ‘enter’ key on a keyboard.

Navigating the intersection of these two worlds can be challenging for individuals on both sides, as their professional development rarely exposes them to the nuances of the other discipline.

I encountered Matthew Marson at this crossroads in 2017, as Accenture finalised its global headquarters in Dublin, Ireland – dubbed ‘The Dock’. This marked Accenture’s inaugural exploration into seamlessly integrating the physical and digital aspects of the built environment, all aimed at enhancing the employee experience with technology.

Following the footsteps of the renowned ‘The Edge’ in Amsterdam, opened a few years earlier, The Dock took a distinctive approach by transforming an existing structure, stripping it down to its essence, and rebuilding it from its core outward. At its inauguration, it was celebrated as the building with the highest number of sensors per square foot on the planet. Sensors adorned everything from trash cans to tea stations, Xbox Kinect cameras were linked to digital signage for personalised interactions via facial recognition, first generation digital badges were deployed and even a rooftop weather station captured real-time external air quality and particulate data for heating, ventilation and air conditioning (HVAC) adjustments.

The structure served as a living lab. While not everything unfolded as initially planned (for many of the reasons outlined in this book), it became a platform for learning, adaptation, and refinement. Matthew played a pivotal role in shaping both the vision and on-the-ground execution, demonstrating a comfort level discussing mechanical, electrical and plumbing (MEP) and HVAC engineering, workplace operational technologies, real estate financials, as well as the building’s facade, wall materials,

---

or the optimal polling frequency for room occupancy sensors to ensure accurate reporting and automation.

Subsequently, he ventured into more expansive and demanding projects, all driven by a consistent objective – how to seamlessly unite the realms of real estate and technology to unlock their full potential.

This book not only outlines the advantages achievable through the implementation of smart technologies in real estate but also candidly addresses historical and future challenges that the industry must collectively overcome. Matthew provides a framework for measuring smart building investments and elucidates on emerging industry shifts incentivising developers and operators to invest in these domains.

Few individuals possess the breadth and depth of knowledge in the built environment to speak authoritatively on building architecture, and the intricacies of smart building platform interoperation as Matthew does. Fewer take the time to share this knowledge for the advancement of us all. He emerges as a true visionary, capable of navigating the convergence of our traditional physical and new digital worlds and charting a course to harmonise them effectively.

This book stands as a testament to Matthew's expertise and experiences, offering an invaluable guide for individuals keen on exploring the potential of integrating the physical and digital dimensions within real estate. It sheds light on achievable benefits, discusses trade-offs, and navigates potential pitfalls along the journey in an unbiased manner – setting it apart from the often technically-driven narratives prevalent in many contemporary texts on the subject. In an industry grappling with resistance to change and segments actively seeking to impede or delay progress for commercial gain, this book stands as a beacon of impartial insight.

Since our initial collaboration, Matthew has continued his personal mission to bridge the realms of real estate and technology, evident in his professional career, the creation of Smart Building Bootcamp, his many papers, publications, speeches, monthly column in Smart Building Magazine and now this book. He is not just passionate about the historical aspects of these professions but, more significantly, about the immense possibilities that lie ahead

---

for the betterment of people, the planet and the financial performance of companies embracing the potential of smart buildings and workplaces.

Having had the privilege of working alongside him, collaborating, learning and drawing inspiration, I invite you to share in this experience and knowledge by delving into the pages of this book.

**Michael Przytula**

Managing Director, Intelligent & Digital Workplace, Accenture  
Host of the Creating Smarter Spaces Podcast

Dr. Matthew Marson

ISBN 978-1-83549-879-8

<https://doi.org/10.1108/978-1-83549-876-720241002>

Emerald Publishing Limited: All rights reserved

---

# Chapter 1

## Introduction

### 1.1. What is a smart building?

Defining a smart building is really challenging. There are conflicting views between academia, industry and even individual equipment manufacturers. For now, let's define a smart building as one that uses technology and the data it generates to improve the outcomes of a building – be that energy performance, improving the concentration of students or making patients healthier faster.

### 1.2. Why we don't have a proper definition

Existing literature in the field of smart buildings is often concerned with the very specific and nuanced definitions for practice, point solutions and proprietary technologies. Although there is no agreed consensus in academia or industry, the below definition is regularly cited:

An intelligent building is one that is responsive to the occupants' needs, satisfies the aims of an organisation and meets the long-term aspirations of society. It is sustainable in terms of energy and water consumption and maintains a minimal impact to the environment in terms of emissions and waste. They are also healthy in terms of well-being for the people living and working within them and are functional according to the users' needs. (Clements-Croome, 2014: p. 3)

The far-reaching nature of technology, and its ability to form part of a solution for many issues means that definitions have the potential to be laboursome and overly specific. It is possible to build on this definition by broadening it and defining a smart building as one that uses data to improve performance or outcomes in sustainability, space usage or for sapiens.

Although beyond the scope of this book, it is important to set the agenda by defining smart and intelligent buildings/cities as broadly the same, with the differentiation being that an intelligent building goes beyond a building with technology.

The joint working group of the International Council for Research and Innovation in Building and Construction (CIB), the Chartered Institution of Buildings Services Engineers (CIBSE) and the Association for Smarter Home & Buildings (ASHB), has been producing academic

research on smart buildings. Such works have strong technology and human-centred aspects, but centre primarily around automation and its effect on operational efficiency and occupant comfort. The body of research concerned with implementations and real-world examples has been growing, acting as an emerging means for the definition of a smart building and its functionality. Specific journals, such as the *Intelligent Buildings International Journal*, exist to document, discuss and propose topics linked to the field of research. Other built environment journals have increased their publishing in the field in recent years as its corporate popularity has grown.

There is an emerging yet extensive body of work from Original Equipment Manufacturers (OEMs) that discusses the benefits of smart buildings. How balanced and objective this work is is debatable, given their vested interest in a set of commercially successful products. Their contributions, however, are well researched, reasoned and referenced. From the vast swathes of grey literature written about smart buildings, it is evident that designers and operators are fulfilling the ambitions of those writing about the mere possibilities (Buckman, *et al.*, 2014). Despite some inherent sales bias, the grey literature offers valuable insight into practical application methods and real-world lessons learnt. As a rapidly advancing topic, the smart buildings domain is subjected to the whim of trend. For example, the need for platforms was most discussed between 2014–2018, before being overtaken by user experience mobile applications from 2018 to the present day. To further conflate the aforementioned corporate issues, those with a traditional supplier role in the construction process are using the terminology of technologists in misleading ways to suggest new capabilities for their existing systems and in situ implementations. Such behaviour has led to a notable distrust and an exacerbation of confusion across both industry and academia (Okraglik, 2019).

Smart buildings, by the nature of their system integration, are at odds with a highly specialised and divergent set of players. They need both specialists and generalists to make a design work. The coalescence of the different parts of the value chain in construction presents challenges that limit the success of what a designer sets out to achieve with a smart building. The construction process is designed to manage and reallocate risks to other parties (Smith *et al.*, 2019). Given the concerns of those implementing technologies for the first time around potential litigation, the smart building industry has made limited progress as risk management techniques have been successful in stifling innovation.

Anxiety of new practices (and the associated liability), combined with the advertising hyperbole published by the equipment manufacturers, has led to a dearth of academic texts about the technological advances of smart buildings and their outcomes. The motivation for this book is to document the incremental advances of technology and its application to the built environment; be that in academic movements, industrial shifts or financial contributions. Beyond the perceived ‘glitter’ of innovation, this book aims to describe the tangible value proposition of a smart building and how its description has morphed.

### 1.3. A definition that continues to change or why we bother with smart buildings

What a smart building is and what it does continues to evolve. Back in the early 2010s, companies and their smart building projects were concerned with sustainability – specifically energy consumption. Other than being a section of a corporate’s annual report, this focus, from a technical perspective, was one of limited ability. Furthermore, the business case for a sustainability project was a relatively simple undertaking: it either made a saving and a business had a lower monthly utility bill, or it didn’t. And so, organisations, under their corporate social responsibility (CSR) programmes, embarked on some simple smart building projects that looked to cut the cost of the energy operations of their premises.

As the quality and technical capability of internet of things (IoT) technologies improved over the years, we started to get under the skin of passive infrared sensors and how they could be used in order to optimise space. In fact, at the time and as the market recovered from the 2008 crash, we started to see rents rise for commercial properties. This meant that businesses had to start condensing the amount of space that they had. In the middle of the 2010s, we saw a huge proliferation of hot desking and shared community spaces such that it became appropriate to introduce desk sharing ratios. It was probably the first time, in Europe at least, where you might not have an assigned desk and instead only came into the office on certain days of the week. Another interesting source of market pressure at the time was how popular WeWork had become. WeWork and other coworking space providers had successfully taken spaces and condensed them to their fundamentals such that a person could rent a desk. Individuals seemed to like this new way of working – be that ping pong tables, beer on tap or the word ‘hustle’ carved into the cucumber in the drinking water. We had gone from having corporate office space of around 23 m<sup>2</sup> per full time employee ([HM Government Property Services, 2015](#)) down to something in some cases as aggressive as 6 m<sup>2</sup> per full time employee ([Russell, 2018](#)). This allowed organisations to cut a lot of the space that they had across their portfolios.

As a result of how aggressive some companies were in their space management, as well as the incredible growth that we’ve seen across the technology sector, we had a situation where a lot of employees started to feel like battery chickens. Again, smart IoT and smart buildings technology had improved to a point that you could start to measure some of the real-world health and productivity impacts of the workplace that employees were in. Rather than them being battery chickens, we told employees that they were in fact free-range chickens because we had deployed technologies that looked at particulate matter, carbon dioxide and other health indicators. The fact that their employers were trying to optimise their work environments to improve both their health outcomes and the productivity that they delivered back to the company, meant that smart buildings had, once again, changed how they were valuable for businesses.

Everything then changed in 2020 and smart buildings had to very quickly respond to the pandemic. Most technologies selected were put in place to deal with compliance – knowing

where individuals had been during their trips, when pieces of furniture or touch points have been cleaned and more. The audit and traceability of a potential infection-spread became paramount for organisations as we started to come out of lockdowns.

Many organisations, then, made a Climate Declaration. Lots of net zero carbon targets were born and technologies, particularly those from smart buildings, were beginning to be deployed in order to find the first and easiest carbon emission reductions. Smart building technologies were put in place to unlock both financial savings and carbon emission reductions.

We then used smart buildings technology as a way to help people get back to the office. It was often centred around allowing people to book spaces such that operational people could more effectively manage crossover, ensuring that employees were coming in on the same day so that they collaborate. Mobile applications and other booking tools could be compared with other data sets such as energy and health and wellbeing metrics. This insight meant that some organisations could now start to orchestrate confident, data-driven return to office mandates.

However, organisations are now struggling with where best to place their investments and make a strategic bet on the value that smart building technology and their real estate portfolios can deliver more broadly. This continues with what the next step towards their climate declarations and net zero carbon targets are, how they're able to cut even more space (given that we've proven that focused work can happen from home), while still delivering more experience when employees do come in. Furthermore, companies are looking for robust ways in which they can deliver equitable and worthwhile hybrid experiences. They're also considering how to deal with the difference in generational expectations and informal learning abilities for those that are newer to the workforce – especially when it relies on an individual's comfort with and ability to use productivity-enhancing tools like generative AI.

With a continually evolving definition, it's important to be clear on what *functionality* a project will deliver.

### **1.4. The promise of a smart building**

Our exposure to smart buildings through popular media presents differing views of capability but similar sentiments towards them. The Heuristically programmed ALgorithmic Computer, HAL 9000, featured in Kubrick's film, *2001: A Space Odyssey* (1968), depicts a malevolent and preservationist system that would jeopardise the lives of its crew. By 2001, The Ultra-house 3000 in *The Simpsons* ('[Treehouse of Horror XII](#)', 2001) keeps the sentiment alive by depicting a smart home that tries to kill Homer. Most recently, Dwayne Johnson's blockbuster, *Skyscraper* (2018) highlights the safety and security perils of installing smart building technologies. Despite the fantasy archetype of a smart building, owner and occupier demand is hastening our transition from traditional to smart buildings ([Marson, 2021](#)).

As our exposure to digital products and services increases, so do our expectations of the built environment. Our video streaming services are able to learn our entertainment preferences and anticipate our needs. Our buildings largely remain static in terms of temperature, work setting variety and the interactions that they facilitate – the pace of change is incomparable with digital capabilities. Services such as Apple Pay have replaced the need for physical bank cards and yet it is commonplace that office workers carry a physical security badge for their office. Amazon is able to deliver almost any item for the following day and yet a maintenance issue in a building can take weeks to rectify. A growing tension between the realities of our buildings and our digital experiences means that:

Digital is no longer the centrepiece of brand experience. Emphasis is shifting onto how best to use it as an invisible enabler of physical and sensory experiences. As interactions with users evolve from periodic engagements via a screen to consistent, connected experiences, organizations must create new services that are deeply integrated in the physical world. A major shift is underway in technology, fuelled by lower costs, users' growing angst about their 'screen addiction,' and the disaggregation of core technology components, such as cameras, microphones, speakers and screens, which are increasingly being embedded in an array of different environments — especially in the home [...]. From Airbnb to Amazon, Deliveroo and Alibaba, a growing number of primarily digital brands are now placing greater emphasis on physical presence while making the most of digital and data to improve experience. (Fjord, 2018)

Beyond experiential benefits, smart buildings are helping owners and operators close the design-performance gap post-occupancy (Pelsmakers, 2012). Low-cost sensing technologies are able to give insight on poor performance. Combined with analytics from large experiments and vast research, suggested interventions allow designers and operators to reduce the performance gap (Clements-Croome, 2014). The understanding of the performance gap has since been expanded to consider occupant experience, health and wellbeing, productivity and more. Our building stock is still of relatively poor quality when compared with the technologies that can be deployed within. Performance of the physical world is lagging behind the sensing technology and is exacerbating the mismatch between the digital and physical worlds (Salam, 2019).

The majority of this book will be focused on the workplace as a tangible and highly relatable typology to give demonstrable examples that explain the model presented. Workplaces also benefit the most clearly of all three of the value levers (sustainability, space and sapiens – see Chapter 2). This model, however, remains applicable to other typologies of spaces.

For example, in stadia, energy saving, and the associated public messaging of being sustainable, remains at the forefront of those that operate these spaces. Space management is prevalent to ensure the greatest monetisation of parking facilities, foot-traffic to retail outlets, and

the queue management of the toilet facilities. Experiential (sapiens) outcomes such as virtual reality (like the experiences delivered by the Golden State Warriors), or VenueNext's snack to seat – all require smart buildings technologies to meet our expectations of a digital experience in a physical building.

Finally, in healthcare, energy reduction and asset life span are key concerns of operators – as is the maximisation of space within existing assets. Finally, clinical outcomes such as reduced stay-time can be improved through better air quality, additional blue light (linked to circadian rhythms): tracking of patients, ability to locate specialists and equipment (such as finding a cardiologist or defibrillator in critical moments) (Rome *et al.*, 2019) – all need smart building technology as a backbone.

The combination of changes in what society expects from our buildings (against digital services), the concern over the design-operations performance gap of buildings, and the business imperative to data-enable our spaces provide a compelling set of reasons for the importance of smart buildings.

### **1.5. What qualifies the author to write this book?**

The author has been cited as one of the world's foremost experts in the design, delivery and operation of smart buildings and cities. Having trained as an Architect and Engineer, earning an MEng in Structural Engineering and Architecture, the author went on to complete a PhD in Smart Buildings.

Professionally, the author has been responsible for the smart designs of first-of-a-kind smart cities in the Middle East, Europe's largest commercial building, a notable tower on the west coast of the United States, airports, hospitals and offices with signature architects such as Foster + Partners, BIG, HOK and Renzo Piano Building Workshop. Furthermore, he has supported Fortune 500 occupiers with their portfolios and many state-level smart city designs in the USA, China, Finland and Ireland.

His global reach has been demonstrated through the multiple keynote presentations given at notable industry conferences, as well as the well-read monthly column in *Smart Building Magazine*.

The publication of the author's works acts to capture the zeitgeist of design in the built environment by discussing the pertinent topics, and the associated complexities of integrating technology. From these learnings, this book presents a framework for how the value of smart buildings has been derived and how it has changed over time.

The author's mission has been to capture the learnings from real-world applications of emerging technologies to the built environment. Working primarily with the Chartered Institution of Building Services Engineers (CIBSE) Intelligent Building Group (IBG), the author worked with academics to shape and produce peer-reviewed research.

## 1.6. Why we need this book

The digital transformation of buildings has been slow. We've all experienced how Uber has successfully improved the taxi journey experience by improving the matching of demand to supply and enhancing transparency for the safety of the passenger and streamlining the payment process. There are millions of taxi rides that happen globally every day, often taking under 30 minutes from start to end. Buildings and their digitalisation happen at the speed of construction (3–5 years), and at a volume in the thousands rather than millions. As such, we simply haven't amassed as much experience as other industries have.

Even when something great has been achieved, it's been kept secret by companies or individuals thinking that they've developed a 'secret sauce' that could be monetised. Combining the secrecy of success with a prevalent distrust of vendor marketing claims and notable industry warning-stories – being able to find a trusted source is a challenge for all parts of the value chain.

The author has been in a unique position where they have worked on a range of projects for a range of asset types, in a variety of geographies. This broad exposure has allowed the development of this book and the set of heuristics presented, in order to calculate a rough order of magnitude for both the costs and the benefits of realising a smart building. It is this broadness of exposure that accounts for a variety of real-world variables, be that application variances, best practices and expectations for different asset classes (e.g. hospital vs school), the variety of vendors by geography and the deviations in standards and regulations across the globe.

In essence, a text that creates a yardstick for the value that this technology unlocks will be pivotal. It will set the methods for scaling industry adoption, standardise the technology capability and create a common set of expectations for a smart building...perhaps to a time when we drop the word 'smart'. The values presented in this book have been created using a set of global experiences between 2014 and 2022.

## 1.7. The opportunity

*For most, the opportunity that a smart building can bring is the ability to unlock US \$3 in business value for every US \$1 invested in technology.*

Targeting a range of value levers, a smart building can realise improvements in sustainability; cost management; space utilisation; human experience; health and well-being; productivity leakage, and more. All aspects are essential to businesses now and going forward.

## 1.8. Why we need to keep the discussion generic

Overspecificity when analysing the built environment does not support wide applicability. Although there are many shared components, there are many different value drivers between a hospital, stadium, university, office and more.

The continually developing nature of technology means that discussion in terms of functionality is best suited to an obsolescence-free discussion.

For the purposes of high applicability of context, the majority of this book will use office/workplace examples owing to their broad appeal, relevance to the majority of the population and range of appropriate value levers.

## 1.9. Summary

- Our simple smart building definition is a building that uses technology and the data it generates to improve the outcomes of a building.
- The primary purpose of a smart building has changed considerably over the years.
- There is a notable and sizeable set of opportunities that smart buildings are poised to unlock.
- The pace of digital transformation is much slower in the built environment than that of other industries, which is why its documentation and synthesis has been lacking to date.
- A business stands to triple its investment in smart building technology if applied correctly.

### REFERENCES

- Buckman A, Mayfield M and Beck S (2014) What is a smart building? *Smart and Sustainable Built Environment* **3(2)**: 92–109.
- Clements-Croome D (2014) *Intelligent Buildings: An Introduction*, 1st edn. Routledge, Oxford, UK.
- Fjord (2018) Physical Fights Back. <https://trends18.fjordnet.com/physical-fights-back/> (accessed 28/12/2020).
- HM Government Property Services (2015) *Employment Density Guide*. GM Government, London, UK.
- Marson M (2021) *The Evolution of Smart Buildings*. University of Westminster, London, UK.
- Okraglik H (2019) Smart thinking: Appification [interview] (08/08/2019).
- Pelsmakers S (2012) *The Environmental Design Pocketbook*, 1st edn. RIBA Publishing, London, UK.
- Russell P (2018) IBM business to business with WSP [interview] (July 2018).
- Rome N, Cassidy K (2019) Smart thinking: Smart healthcare [interview] (23/05/2019).
- Salam D (2019) Smart thinking: 29 – Smart design [interview] (26/09/2019).
- Skyscraper* (2018) [film] Directed by Rawson Marshall Thurber. Legendary Entertainment, USA.
- The Simpsons: Treehouse of Horror XII* (S13, E1) (2001) [film] Directed by Jim Reardon. 20th Century Fox, USA.
- Smith T (2019) Smart thinking: Drivers for strategic value [interview] (27/06/2019).
- 2001: A Space Odyssey* (1968) [film] Directed by Stanley Kubrick. Metro-Goldwyn-Mayer, UK.