The business case for intelligent buildings

Using bytes to turn building performance into business performance

ARCADIS

Executive Summary

The rapid acceleration of digital technology has transformed the real estate industry for the better. More innovation, more data, and more technical expertise; the way we design, deliver and operate buildings has changed dramatically, and will continue to do so in the future.

Technology has become increasingly integral to every aspect of our lives, and now across the places where we live, work and learn. As more systems become automated, digitized, integrated and connected, everything from how we switch on the lights and regulate temperature to how we manage access and security is evolving at lightning speed.

In the last decade alone, the market for smart buildings has risen exponentially and, by 2025, is estimated to be worth in excess of US$100 billion. But with so many new and ground-breaking technologies emerging every day, how many of us truly understand what makes a building 'intelligent'? And is that investment worthwhile?

We want longevity from our buildings. What we don't want is technology that will be obsolete in two years. The best intelligent buildings are those that stand the test of time and, rather than succumbing to the latest craze, feature carefully considered technologies that genuinely cater to the needs of occupiers – the residents, employees, visitors or shoppers who come into and use the building every day.

Of course, this isn't just about new buildings. Intelligent building technology can be incorporated at any stage of the design, build, or operational phase of development, but it's important to understand what this means. In such a complex market it can be hard to align the human benefits with the strategic business case for investment.

What will give me the best return for my money?

This is the issue we want to address. Drawing on our collective experience, we've brought together and categorised the different technologies that go into making an intelligent building. We've analyzed costs and defined benefits, all with the ultimate aim of defining the true value of an intelligent building.

Of course, there is no 'one-size-fits-all' approach, and not all technologies are created equal. But if we can shine a light into the different aspects – and costs – involved in creating an intelligent building, we can provide greater transparency and support better commercial decision making.

The size of the prize is huge, but only if you select the right technology for your needs and the outcomes you want to achieve. In this report, we'll set out how to do this, along with outlining exactly what creating an intelligent building could mean for you, and the benefits that will resonate long into the future.

Sandeep Kapoor
Head of Intelligent Buildings

"The truth is many intelligent buildings fail to progress due to worry about cost and a limited understanding of value. A lack of technical expertise and data across industry means costs are over-estimated, projects are loaded with perceived risk and the business case appears uninvestable."

Introduction

We spend 90% of our time within buildings, whether that's at home, school, work or for leisure or recreation time. They are a crucial part of our everyday lives. Yet at the same time, thanks to heating, lighting and the use of appliances, buildings are responsible for 40% of harmful global carbon dioxide emissions every year.

Buildings provide a significant opportunity for us to improve the quality of life for people, address climate change challenges for our planet, and maximize efficiency of our spaces to drive prosperity for our organizations.

Why Intelligent?

Technology is one of the most impactful and cost-effective additions to our toolkit in the fight against climate change, rising cost pressures and creating healthier environments for people, and this is increasingly true for the places where we work, live, learn and play.

Intelligent buildings work by integrating systems and data points across a building to provide additional functionality and intelligence to the occupants, operators and owners of that space, ultimately improving the building performance.

Most business costs can be broken down into:

90% Staff *(People)*

1% Energy *(Planet)*

9% Building rent *(Profit)*
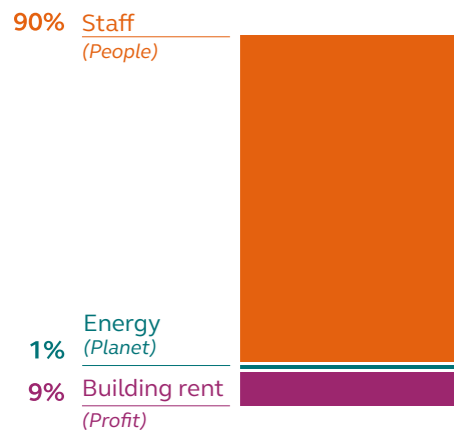
(Source: World Green Building Council)

Planet: reduce your consumption and emissions

The most widely recognised value an intelligent building delivers is energy savings. Although these benefits are significantly smaller than those realized by other benefit areas, the current climate crisis is forcing organizations to look beyond the financial return and focus on the environmental impact of their energy consumption.

Heating, ventilation, and air conditioning (HVAC) alone accounts for on average 40% of the total energy consumption within a building. Along with lighting energy, this can be significantly reduced through integration with Internet of Things (IoT) devices and energy analytics software packages that support the Building Management System (BMS) and enable local controllers to operate these assets more effectively.

Profit: optimising the space you occupy

The next benefit area focuses on real estate and begins to transition from building performance to business performance. More specifically, we investigate how intelligent building technology can support an organization in optimising a built asset, in terms of the space utilisation as well as maintenance, and even confidently reducing footprint without impacting operations.

The COVID-19 pandemic has accelerated a shift to hybrid working and organizations are still getting to grips with how best to use their space, along with dynamic occupancy patterns over the course of a single week. Intelligent buildings act like accordions and can expand and contract to meet changing requirements through the creation of zones and neighbourhoods that can be switched on and off via space booking applications. However, an organization may find that the most cost-effective strategy is to reduce their footprint.

People: improve productivity, wellbeing, and retention

The final – and most significant - benefit area focuses on how an intelligent building can improve the experience of all its users, including tenant employees, visitors, operators (e.g. FM, security, IT) and even owners. The majority of an organization's costs are spent on its people, so by delivering an asset that can positively impact productivity, wellbeing, and attract and retain talent, an organization can realise significant improvements in business performance.

The COVID-19 pandemic has changed our views and expectations of a high-quality working environment. Organisations will need to redefine what the workplace looks like and how it operates if they are to attract employees back to the office and realise the benefits of face-to-face collaboration.

Organisations will need to make sure their workplaces exceed this standard in order to attract employees back to the office and realise the business benefits of face-to-face collaboration.

Why now?

In recent years, the falling cost of technology has made intelligent buildings increasingly feasible to deliver. At the same time, the impact of COVID-19 has made them not only desirable, but essential. This could be from a space planning perspective, for example to facilitate social distancing, but also as the demand for physical space lessens, then the requirement for existing spaces to be of a higher quality will increase. All industries need to attract people back into their buildings, from colleagues returning to the office, to customers visiting retail stores. Intelligent building technology adds 'kerb-appeal', and also ensures that buildings are operating at their optimum levels, while still meeting the needs of the people within them.

Why aren't all buildings 'intelligent'?

The intelligent building market is still relatively immature. We might be familiar with the concept and application of smart systems, but the leap to create a truly dynamically-connected and interoperable intelligent building calls for greater market confidence, together with a better understanding of the benefits case.

The truth is many intelligent buildings fail to progress due to worry about expense and a limited understanding of value. With a lack of technical expertise across the industry, costs are often over-estimated, projects are therefore loaded with perceived risk, rendering the business case uninvestable.

Identifying why these issues and misconceptions arise will help when it comes to overcoming the challenges holding back the delivery of intelligent buildings.

1. **Awareness and Knowledge**
    Intelligent building projects cut across multiple industry disciplines, requiring expertise ranging from traditional cost and mechanical, electrical and plumbing engineering to newer technical skills, such as user experience design, software deployment and a strong understanding of the Internet of Things (IoT). With little formal training, built environment professionals are expected to augment their knowledge 'on the job', where the absence of common ways of working and communicating can lead to misunderstandings and delays.

2. **Skills**
    Due to the complex operational and technical interfaces of an intelligent building, delivery requires a plethora of skills from different operations, engineering, and business functions. IT and software professionals will often take on amplified roles, as cybersecurity and networking come to the fore. This means bringing together groups who would traditionally work across very different boundaries and in very different ways, adding another layer of complexity when it comes to project managing delivery.

3. **Delivery timescales**
    In software and innovation circles, the philosophy of 'fail fast' is commonplace; if something doesn't immediately add value, you reinvent or move on. This is in stark contrast to the multi-year programmes associated with construction projects, when the value of a solution designed early in the process can only be realized once it becomes operational, often years later. So how can we know if an intelligent building solution is right for a new build development, or if we should retrofit intelligent building technology later in the process? Is there a risk the technology will move on? It is only very recently that we have been able to glean insights and apply learnings from notable smart buildings around the world, such as The Edge in Amsterdam and The Dock in Dublin.

4. **Investment and value for money**
    When it comes to making the business case for an intelligent building, it must come down to return on investment. Whether in terms of increased revenue or reduced costs, being able to understand and quantify tangible benefits – both human and economic - will provide the impetus for overcoming challenges and driving forward future delivery.

This report combines data and experiences from real projects with market research to help address these concerns, focusing particularly on proving value.

Intelligent buildings bring together multiple systems and data points across a building to create a rich picture of how it is being used, so that owners and operators can maximize performance, whilst providing occupants with an enhanced experience when using the building.

What makes up an intelligent building?

The Technologies

Click on any of these technology icons to explore what, how and why these technologies help to make an intelligent building.

There are typically twelve broad technologies that we consider to be the main ingredients of an intelligent building. These are in addition to any industry standard, base-build systems you would expect to find in most building stock.

It's important to note that the technologies outlined here are not intended to serve as an authoritative checklist, rather a guide for considering high level examples of functionality that support the outcomes - or benefits - you may want to deliver.

One size does not fit all

When it comes to deciding which technology to deploy in your intelligent building there is no one-size-fits-all solution. Instead, it's about defining the functionality that will maximize impact for your business and occupants, and then selecting the technologies that will deliver that functionality.

Each of the technologies we have outlined in this report have different levels of performance and can be stitched together in various ways to unlock the desired functionality. This creates a multitude of potential technology options when it comes to creating an intelligent building and reinforces the need to undertake robust definition and design phases before deploying any technology.

Shifting the lens from 'Cost' to 'Value'

Traditionally, organizations have always seen their buildings as a cost. As a result, investment decisions involving intelligent buildings have almost always been driven by how much different technologies and systems cost.

However, more recently the benefits case for an intelligent building has grown stronger, with studies proving the positive impact they can have on building performance, particularly when it comes to energy and maintenance savings and making the best use of space. However, these benefits can be far exceeded if we take into account impact on business performance; an area that – until now – has been harder to quantify. An intelligent building can increase productivity, improve

employee wellbeing, and support the retention and attraction of talent, to the extent that, far from being seen as purely a 'cost', the building itself becomes value-adding to the business.

In this paper, we leverage our extensive project experience to join the dots between the cost of an intelligent building and the benefits that can be accrued, not just in terms of some of the easier-to-quantify areas of energy and space savings, but also more broadly in people terms. We have defined the individual contribution different technologies and systems make across the three benefit areas of People, planet and Profit aiming to shift the focus from 'cost' to 'value' when it comes to supporting the decision-making process.
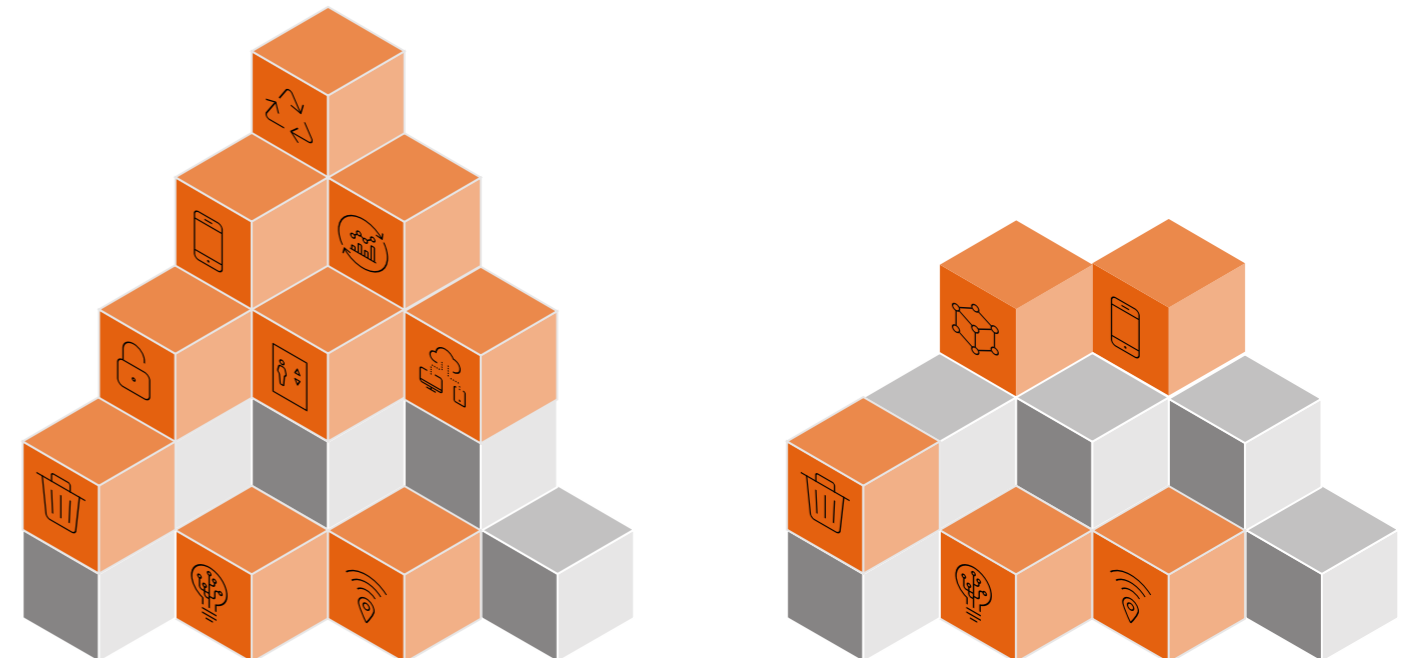
Typical benefit areas

People benefits:
- Attraction and retention through enhanced user experience.
- Improved productivity by providing optimized environmental conditions.
- Reducing absenteeism by providing a healthy workplace.

Planet benefits:
- Reducing energy use through heating, ventilation and air conditioning analytics.
- Using analytics to limit water usage and minimize waste.

Profit benefits:
- Using analytics to improve how space is used and maintained.
- Reducing maintenance costs through fault detection and diagnostics.

Our approach: context and method

Determining the value

We have used a discounted cash flow methodology to estimate the Net Present Value (NPV) to owner-occupiers seeking an intelligent building. To do this, we identified the additional costs and benefits of intelligent buildings through the analysis of both real world projects and research studies.

The detailed methodology for each benefit area can be found in the appendix.

Why the office?

The workplace revolution is at full tilt. With digital and societal expectations and shifting corporate culture already driving change, the COVID-19 pandemic is a significant accelerant. Whatever the 'new normal' looks like in a post-vaccine world, even now it is clear that offices will continue to be a key part of business' operational and employee propositions. They serve as a 'living CV' for the organization and a bedrock of corporate and brand identity, social connectivity, collaboration and client engagement.

As a key differentiator for businesses to attract and retain top talent, workforces of today demand an environment which allows them to thrive, whilst protecting the habitat around them. In offering such world class facilities, intelligent building technology can bring significant value by creating a more productive, healthy, and sustainable workplace.
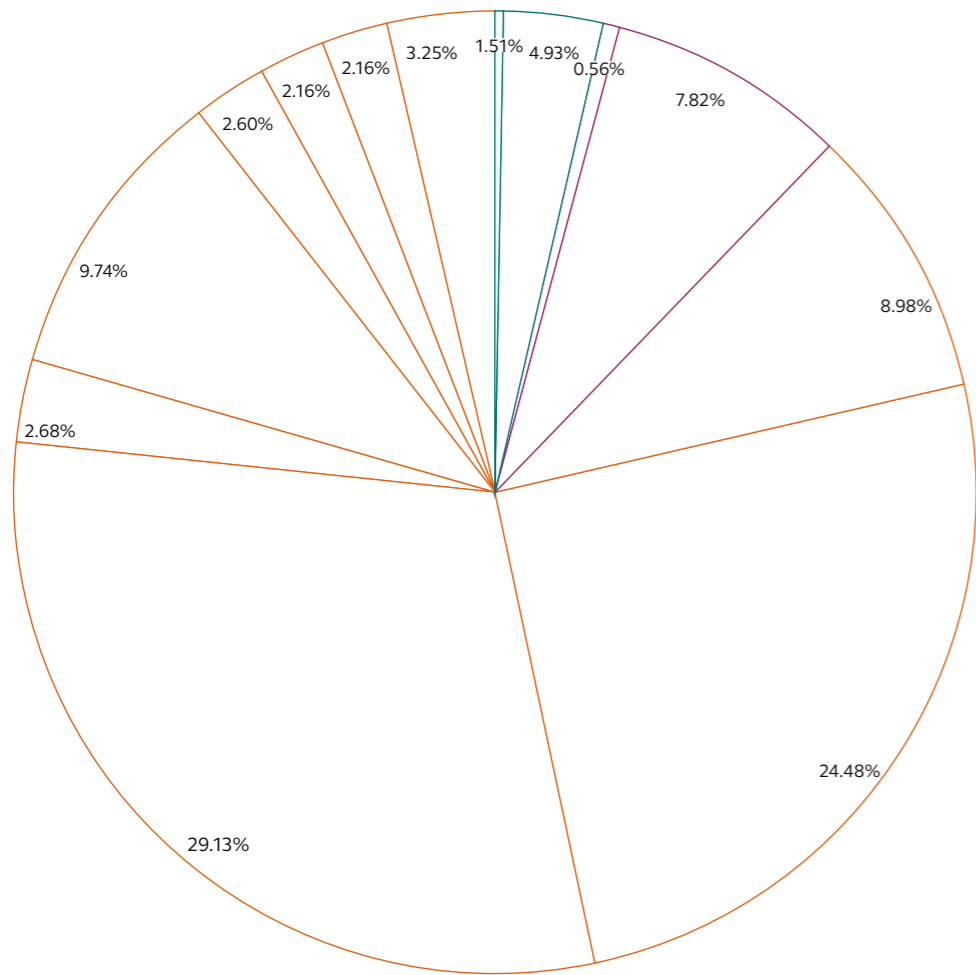
The Test Case

The analysis in this report has been developed using the example of a theoretical building occupied by a hypothetical organization. Although these numbers may not completely reflect your own building or organization, the underlying methodology is easily applied to any scenario.

(Representative example)

Our findings

Click the targets on the diagram for a detailed breakdown of benefits per asset

- People
- Planet
- Profit

Pie chart values: 29.13%, 24.48%, 8.98%, 7.82%, 0.56%, 4.93%, 1.51%, 3.25%, 2.16%, 2.16%, 2.60%, 9.74%, 2.68%

Total NPV over 12 years test case

People	Planet	Profit
€50.27m	€3.81m	€4.95m

Benefits Aggregate, Costs Don't

The key consideration when assessing the value for the overall intelligent building is that the financial benefits aggregate, but the costs do not. Each individual system and technology has to be purchased only once, but can contribute to multiple different financial benefits. Some design elements, such as Pervasive Connectivity, serve almost all of the benefits and act as enabling infrastructure for the entire intelligent building. Others, such as Intelligent Waste, serve a specific purpose and only contribute to a single benefit.

Overall Return on Investment

Our analysis shows that the combined benefits deriving from an intelligent building can deliver an organization, aligned to our scenario organization and building, an annual return of c. £12.5 million.

Over 12 years, and taking into account the cost to deliver these benefits, this equates to a Net Present Value (NPV) for our test case worth £42.5 million when it comes to improvements and efficiencies in the People category, £3.2 million in energy savings (Planet), and £4.2 million return on investment when it comes to real estate optimization (the Profit category). For our test case, this breaks down to an annual profit of £12,480 for every single employee, or £9.71 per sqm of real estate.

People matter most

It is clear to see that, although there are significant energy savings and real estate benefits to be had from an intelligent building, ensuring that it delivers for its people is critical. Although energy and real estate benefits may be easier to quantify and have a significant evidence base behind them, the people benefits involving productivity, wellbeing and talent far outweigh these and account for 90% of the overall return of an intelligent building.

As the market matures and the long-term benefits of intelligent buildings become measurable, we will see the evidence base for the people benefits increase, which in turn will support mass adoption.
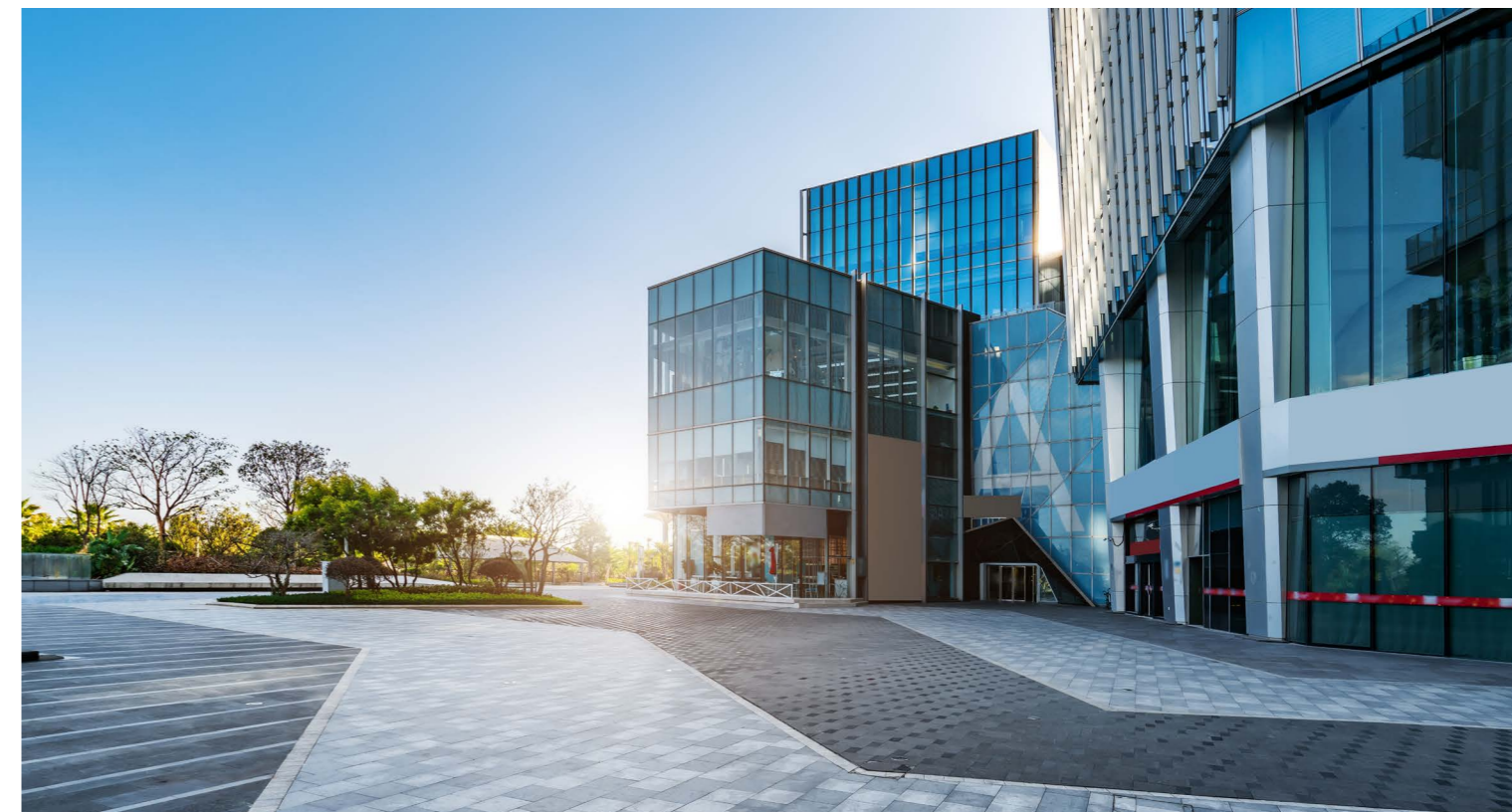
Translating to Individual Systems and Technologies

We can also translate the return on investment from benefit areas to individual systems and technologies. This will be particularly useful in situations where organizations have limited budget to spend on their intelligent building and want to know what systems and technologies to buy to deliver the biggest "bang for their buck".

NPV over 12 years for the test case

Rank	System or Technology	NPV	NPV/ee	NPV/sqm
1	Energy Analytics	€ 17,926,886.02	€ 4,484.76	€ 448.66
2	Intelligent Lighting	€ 12,079,379.20	€ 3,021.89	€ 302.31
3	Enhanced Security and Access Control	€ 7,249,258.61	€ 1,813.54	€ 181.43
4	Location Services	€ 4,403,273.21	€ 1,101.56	€ 110.20
5	Mobile Application	€ 3,964,475.96	€ 991.79	€ 99.22
6	Environmental and Water Quality Monitoring	€ 3,812,439.25	€ 953.76	€ 95.41
7	Intelligent Waste	€ 3,609,814.39	€ 903.07	€ 90.34
8	Space Booking	€ 2,540,413.67	€ 635.53	€ 63.58
9	Enhanced Vertical Transportation	€ 2,121,342.46	€ 530.70	€ 53.09
10	Digital Screens and Signage	€ 1,292,717.24	€ 323.40	€ 32.35

*The table does not include the Intelligent Building Platform and Pervasive Connectivity technologies as these are considered enabling infrastructure and critical for any intelligent building – the cost of these technologies has been apportioned across the ten technologies in the table when calculating the NPV.

Conclusion

Until recently, organizations viewed their buildings and workplaces as a cost on their income sheet, independent of their strategic goals or as an enabler to enhance business performance. Even for the early adopters who saw the significant opportunity intelligent buildings provide, companies couldn't quantify the financial value. But now there are clear metrics that demonstrate how intelligent buildings enhance productivity, reduce absenteeism for employees, as well as reduce energy consumption and real estate needs.

By applying our 12 often-seen intelligent buildings technologies to our hypothetical company, in an office of 40,0000 sqm with 4,000 people, we can see:

The total combined benefit of:
€59.03m
(NPV over 12 years)

Profit per employee:
€1,230 per year

Profit per Square Meter:
€123 per year

These metrics demonstrate how intelligent buildings significantly impact the bottom line through improved energy savings, real estate savings and enhanced people experience.

The question is no longer 'how much does an intelligent building cost?' It is 'how much can my company benefit by working in an intelligent building?' Or perhaps even more pertinently for landlords, can I afford not to create an intelligent building?

Beyond the office: adding intelligence across industries

People

Planet

Profit

Office Benchmark

Each project is bespoke, with the technologies available offering a 'pick-and-mix' selection of options and levels of sophistication that can be curated according to the outcome you want to achieve for the users of any building. This can vary depending on how people interact with different spaces, as well as the impact of different building typologies and configurations.

Here we have provided an indicative view of how the technologies can be applied across different building types, and the value they will generate. Rather than applying our

methodology bottom-up, this has been done by looking at the relative impact the technologies can have across the three benefit areas of People, Planet and Profit, compared to our office baseline test case. For example, we can see that Intelligent Building technology applied in a hospital can deliver significant benefits across all three categories of People, Planet and Profit. In contrast, in Stadia projects Intelligent Building technology will deliver significant benefits in People and Planetary terms, but will have little impact when it comes to space and maintenance optimization (as defined in our Profit category).
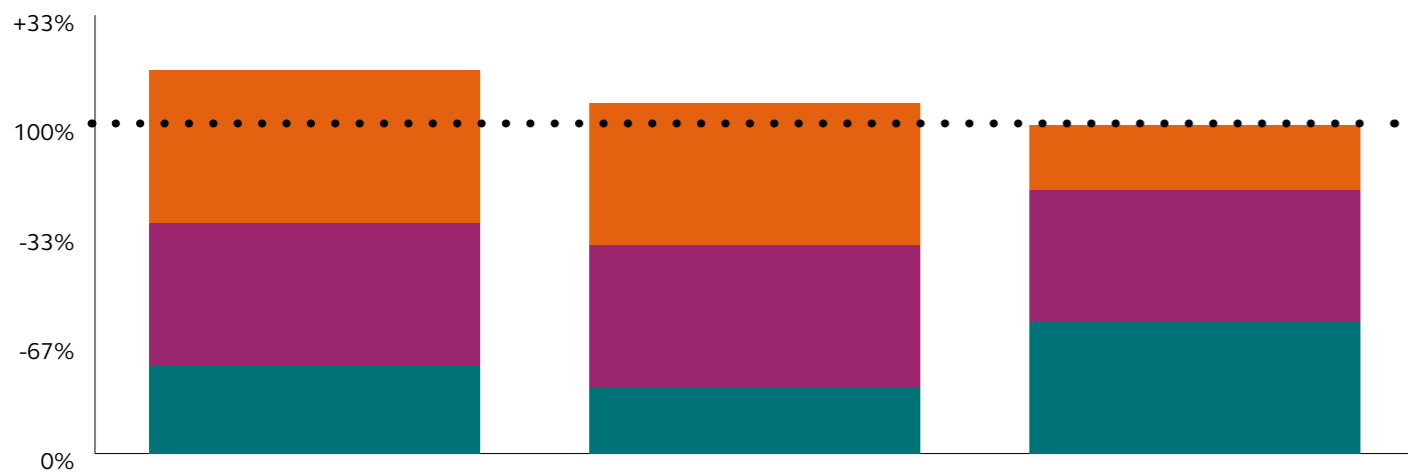

Hospitals

Resilience is vital. Fault detection, diagnostics and other analytics software can be used to limit equipment downtime and ensure that essential systems stay online. Centralising hospital data brings additional considerations when it comes to privacy issues, and segregating data will be key. It is also important that any intelligent system or service helps to generate time savings for hospital staff.

Retail

The main drive for intelligent systems in a retail environment is to provide services that help to increase the rental value or encourage leasing by providing a better experience for both tenant and customer. This can include through targeted marketing and retail analytics that focus on customer interactions within a space. When it comes to owner-occupied retail, understanding how space, energy and equipment is being used, by both staff and customers, can provide valuable insight. A mobile application or visitor portal can help people navigate around the space, tailor their experience, and collect data. Where a landlord provides this sort of front-end application, the data can be used by retail tenants to optimize their services.

Manufacturing

Focusing far more on finding efficiencies within the space and in energy consumption, manufacturing spaces benefit from being able to optimize building stock and ensure that operations can be altered for different purposes. In many cases manufacturing buildings are underutilised, so monitoring these spaces to ensure equipment isn't being unnecessarily run can help to limit degradation of building systems. In live environments, health and safety must be included within the design criteria. However, systems and services that enable us to maintain healthy and safe environments look very different within this type of space.
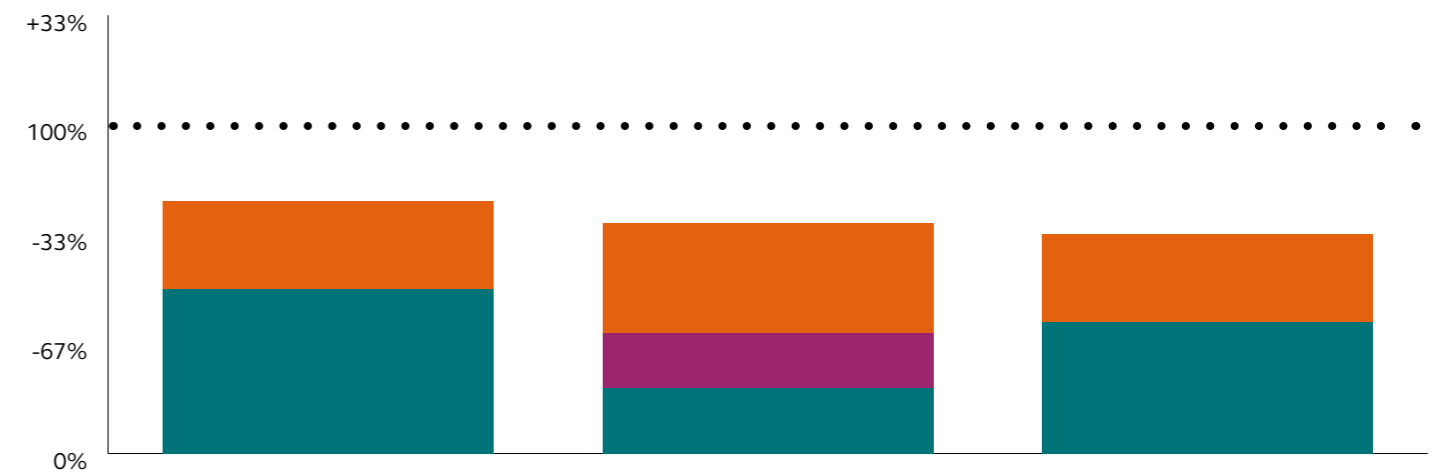
Stadia

These spaces are focused on visitor experience. Technology is typically geared towards managing security, providing information and enhancing user experience through networked digital screens and signage pointing visitors to amenities and seating, as well as offering valuable opportunities for tailored marketing. Operationally, intelligent building technology can reduce energy use and costs, while enhanced security offerings, such as CCTV analytics, can automate alerts and direct staff where needed, thereby driving efficiencies against staff time.

Transport Hubs

Security is paramount and understanding footfall or movement trends is key. Enhanced security monitoring can be provided by CCTV systems with additional analytics software capable of monitoring vast amounts of space for security alerts and other anomalies. This can help security staff to react faster to potential issues. Providing information to users, including wayfinding and journey planning, is also an important driver when designing these spaces.

Residential

The most important consideration is creating a long-lasting, functional experience for the user. Residents must have access to information on energy and water use, while being able to control their environment in a far more granular way than users of other building types. Tenants may have differing needs, and separate offerings can be packaged up in a tiered system which can be semi-tailored to individual tenants. Security access control and visitor management is a high priority; users must be able to easily manage guest access without compromising overall security.

When to go from just a building, to intelligent

We've seen how the benefits case for an intelligent building stacks-up. But at what point in the design and build process should you consider installing the necessary intelligent building technology?

The industry is still very new, and for projects that have been under construction for many years, it can often come as an afterthought. In this respect, designers, contractors, vendors - and indeed the solutions themselves - must be able to react to hugely varied points of implementation. But even if ideas haven't been baked into the design from the outset, which we suggest is optimal, there are still a multitude of options and approaches available.

We've already completed technical design, what can I do?

Most importantly, you need to understand any potential limitations in the current design. This will ensure maximum effect from the minimum of interventions. Augmenting design documents to unlock additional data streams is a good first step. Even small adjustments to the design documentation for the Building Management System can be taken forward by a contractor to allow data points to be exposed through different protocols. Ultimately this means that analytics software can have more access to any available data.

Construction is live, is it too late?

There is no set point at which your building has come too far in construction to make any meaningful changes. Options are limited only by contractual obligations, and any designs these contracts are set to deliver against. With the rate of change in technology, late deployment can actually be beneficial, as what you lack in design options, you make up for when it comes to accessing the most cutting-edge products and solutions. However, at such a relatively late stage, it is usually a good idea to flip normal intelligent building deployment on its head.

Ideally you should start with ensuring data can be collected, stored and accessed by any system or software included in the design. But once construction is underway, it is not always possible to carry out this preparatory work. Instead, you need to focus on creating the outputs first – i.e. the dashboards and applications that rely on the data being in place. At this stage, we can understand exactly what systems are being delivered and the standard to which they have been designed. Post-practical completion, we can then go back into the build systems and unlock the data we have identified as being of most value.

Imminent completion

It still isn't too late to add building intelligence. Applying software-only solutions such as booking software for desks, rooms and other assets can provide an instant uplift. Analytics software can also be layered onto existing building systems to find operational efficiencies and cut costs from day one. A pipeline of later enhancements can then integrate existing base-building systems with software-only solutions to enhance services. For example, adding a network of sensors to the booking service can allow analytics software to track check-in data against bookings made. This type of detailed information can give real-time insight that will help to improve how spaces are being used.

Retrofit

Almost all the technology described in this report can, in some way, be deployed into existing buildings as part of a retrofit. In fact, in some regards it is easier to apply intelligent building technology to an existing building than a new one. From a business case perspective, it is easier to understand the use cases that could have the most impact to existing buildings, as their problems and opportunity areas are clear to see. With a baseline of performance data already available, it's easier to see if the technology you implement makes a difference.

However, for retrofit projects the process is slightly different. Instead of interrogating base build designs and providing uplifts, as with a new build project, existing buildings already have dormant data that can be leveraged. After designing the vision and functionality for your intelligent building, you should undertake a gap analysis of the data and systems required, versus what is already available. This will enable you to see which interventions will have the most impact.

Roadmap to delivery

Our high-level roadmap details the steps required to effectively deliver an intelligent building. Regardless of the point you're at in planning, constructing or retrofitting a building, this provides a useful guide to help you navigate a new and rapidly evolving sector.

User Experience

Space Utililisation

Net Zero Carbon

Maintenance

Building Intelligence Product

Strategy | **Design** | **Deliver** | **Intelligence**

1 Confirm the Vision

Define the strategic objectives, vision, and user experience for the space. At this point you should prioritise high-level objectives across human experience, space optimization, sustainability and wellbeing.

2 Define Functionality

Once the value and benefits you want to target are understood, the next step is to identify and list the practical use cases that will deliver on them.

3 Digital Benchmarking

Consider what the wider market is doing, benchmark use cases and build your business case. In undertaking this step, you should establish a baseline for your technology solution against similar developments, important trends and market movements.

4 Digital Due Diligence

Whether a new build or a refurb, the likelihood is that either an existing building or existing design will exist. At this stage, you should undertake a gap analysis between the 'as-is' state and your 'to-be' vision. Identify existing dormant data and systems, and uplifts required to meet the desired solution.

5 Cost Modelling

Undertake a comprehensive assessment of costs. It is important to ensure that the commercial team understand the nuances of intelligent buildings, to ensure an accurate representation of cost, rather than an over allocation of risk.

6 Design Assurance

Assemble a team to deliver the project. This may include individuals from the previous steps, but their focus is to ensure that vision and requirements are properly translated to the design team and into outputs.

7 Vendor Identification and Selection

Undertake a tender process to procure software and technology vendors, potentially including a Master Systems Integrator (MSI), platform provider or software provider(s). A key consideration here is the evaluation framework used to assess vendors.

8 Manage and Deliver

The role of this team will be to manage overall delivery. This team should have an in-depth understanding of intelligent buildings and be accountable for control of programme, risk, cost and contracts.

9 Deployment, Commissioning, Handover and Training

Intelligent building programmes are about people as much as built asset transformation. As such, operations and change management plans should be developed to ensure that people are bought into the solution as build progresses. Deployment and commissioning should be managed to check that everything works as intended, before handover and training to ensure that people understand how they interface with the technology.

Case Study

Our new office space at 80Fen

The way we work is changing. At Arcadis, we are shifting the emphasis from 'where' to 'how', and in doing so needed a more modern, functional workplace that could flex and adapt to our evolving needs. We wanted to create an environment that works for everyone - providing a more inclusive experience; enhancing wellbeing; improving collaboration and innovation; and driving a culture of trust, respect and ownership. Technology has a key role to play.

Arcadis has long been at the forefront of digitization in the property sector, looking at ways to use technology and data to improve efficiencies, sustainability and the operation of buildings of all types. The way in which we approached our own office space was no different.

Our new office at 80 Fenchurch Street in London has been designed as an environment for collaboration, creating social connections, and engaging with our clients. Smart technologies have been embedded as a key design principle, with our own Building Intelligence solution helping us to optimize space, save on energy and maintenance costs, and improve health, wellbeing, and productivity for all our people.

Designing the right solution

A series of surveys, interviews, and workshops helped us to understand the physical and digital needs of our people. From how often people wanted to come into the office, to how they would use the space once they were there, our user-experience design processes and tools helped to define the ideal employee experience, together with the intelligent building technologies that would facilitate it.

The result is a fully flexible, functional space built around the needs and preferences of our people.

It will support the concept of 'activity-based working' by providing greater diversity of settings, with over 20 different types of workspace.

Smart' features have been embedded as a key design principle, and the space is equipped with Arcadis's own Building Intelligence software, recording 1.85 million data points every day to show how well the building is operating and how people are engaging within it. For example, Building Intelligence software can help people find the right spaces for their tasks. The desk booking system also means available spaces can be turned 'on' and 'off' as required, managing capacity and reducing space requirements by over 30%.

The combination of a mobile app, room wizards, large interactive displays and dashboards all help to improve how people experience the space.

As well as enabling us to make the best use of space, Building Intelligence also means we can optimize energy and maintenance use and reduce the operational impact of the building.

Real time sensors monitor the indoor environment and help cut energy and water consumption or turn lights off when an area is unoccupied. Meanwhile, air quality and thermal comfort sensors regulate the environment and ensure people are comfortable. This reduces energy needed for heating, ventilation and air conditioning by as much as 28%, and a 70% reduction in lighting energy.

Looking to the future

When you combine new flexible ways of working with the sensors, machine learning and management insights that come with Building Intelligence, it can create a rich picture of how the building is operating and how its users are engaging within it.

This in turns means we can flex our space and be agile in the different ways it can be used. Collecting data over time also means we can test theories and adapt the environment. This isn't just a one-time fit-out, it's a step change in how we use and curate space.

Challenge:

We wanted to create a more efficient, functional, sustainable and inclusive workplace that better reflects the changing nature of the workday and our workforce.
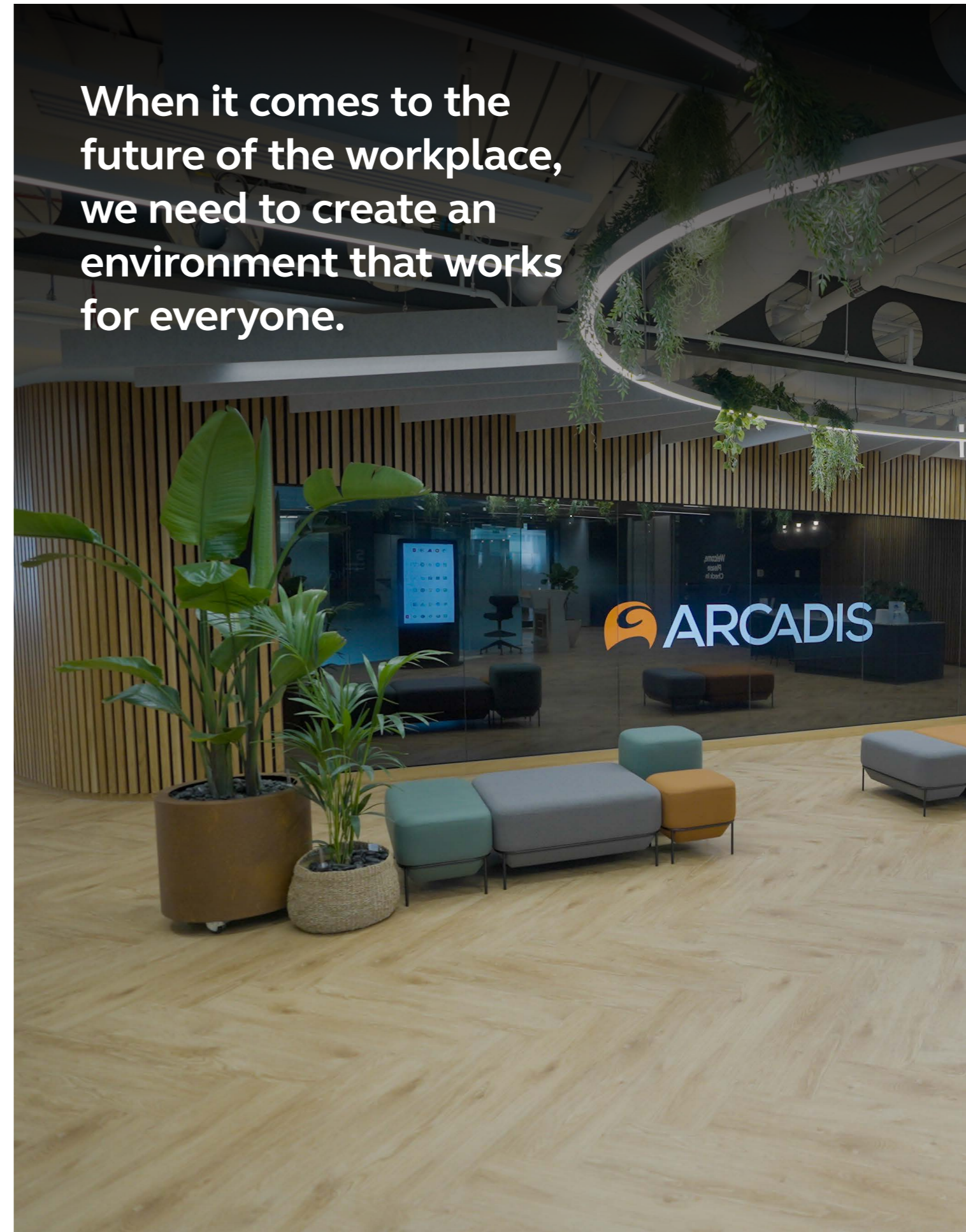
Solution:

80Fen emphasizes sustainability, flexibility and choice; all enabled by technology and digital innovation.

Impact:

A fully flexible, functional space built around the needs and preferences of our people.

When it comes to the future of the workplace, we need to create an environment that works for everyone.

About us

About Arcadis

Arcadis is the leading global Design & Consultancy firm for natural and built assets. Applying our deep market sector insights and collective design, consultancy, engineering, project and management services we work in partnership with our clients to deliver exceptional and sustainable outcomes throughout the lifecycle of their natural and built assets. We are 29,000 people that generate €3.4 billion in revenues. We support UN-Habitat with knowledge and expertise to improve the quality of life in rapidly growing cities around the world.

About our Intelligent Buildings Practice

Our intelligent buildings practice brings together expertise from different backgrounds and disciplines. We have experience delivering intelligent buildings, places and cities across the globe for owners, operators, tenants and governments. We support clients across all building types and sectors; from skyscrapers in London, New York, Hong Kong and San Francisco, to brand new cities in the Middle East and hospitals and universities in Europe.

We understand the complexity that intelligent buildings pose and can support clients through every step of designing and delivering an intelligent building. Our team work end-to-end across the full lifecycle of a project, from user experience design and intelligent buildings definition, through base build uplift and detailed definition, to product procurement and delivery assurance.

Appendix:

Methodology

Cost Confidence

Cost clarity is key to ensuring the accuracy of the value an intelligent building can deliver. Having delivered numerous projects, we have built up a cost database that supports the benchmarking of both the physical and digital elements of an intelligent building.

Costs associated with hardware have been determined using actual project data, spanning different manufacturers, specifications, and typologies, to benchmark market competitive unit rates for devices, physical infrastructure, and other intelligent building components. Where multiple sensors are being deployed throughout a building, the quantity of the hardware is driven by a per unit area rate, which has also been benchmarked. In some instances, such as with hardware related to space booking and occupancy analytics systems, quantity is driven by building headcount rather than per unit area.

Software costs cover the capital and operational expenditure associated with applications, virtual infrastructure, solutions and networking. Upfront costs include the provisioning of on-premise and cloud servers and services and the deployment of any white-labelled solutions. The majority of these cloud services and vendor solutions also have attributed recurring operational expenditure in the form of licenses and subscriptions. Database hosting, including data warehouses and lakes, also feature as an operational expense. Like with the hardware, a benchmarking exercise has been undertaken across multiple vendors and providers to ensure market competitive costs for software. For the delivery of bespoke solutions, including master systems integration, costs have been

developed based on a labor rate and time to develop these solutions.

We have used a discounted cashflow methodology over a 12-year period to estimate **Net Present Value (NPV)** to building owners and occupiers for the benefits of an intelligent building. The methodologies for each benefit area are outlined as follows.

Energy & environment

Benefit from HVAC savings through IoT:

Methodology:

1. Take HVAC energy consumption as 40% of total energy consumption (both electrical and gas)
2. Multiply by the utility cost of electricity and gas respectively (assumed at €0.33 kWh and €0.12kWh)
3. Multiply by 28%, which is the sum of estimated savings on HVAC energy through occupancy adaptation (3%) and Energy Analytics (25%)

Benefit from lighting savings through IoT:

Methodology:

4. Take lighting energy consumption as 5% of total electrical consumption
5. Multiply by the utility cost of electricity (assumed at €0.33 kWh)
6. Multiply by 70% which is the estimated savings on lighting energy through occupancy adaptation and daylight harvesting

Real estate

Benefit from reduction in rental footprint through multiple technologies:

Methodology:

1. Take the average maintenance cost for a building (€25.70 per sqm)

2. Multiply by the total building area
3. Multiply by 8% which is the expected saving on maintenance cost through FDD

Benefit from space optimization:

Methodology:

1. Take the total rental area that acts as useable space
2. Multiply by the rental value of that useable space
3. Multiply by 18% which is the estimated savings on rental footprint through occupancy and space data provided by intelligent lighting (10%), locations services (3%), and space booking (5%)

People

Benefit from reducing front-of-house non-productive time through multiple technologies:

Methodology:

1. Take the total number of front-of-house employees
2. Multiply by the average revenue per head per year
3. Multiply by the average profit margin for the organization
4. Multiply by the average non-productive time per day per employee (4%)
5. Multiply by 27.5% which is the estimated savings on non-productive time through enhance user experience provided by digital screens and signage (4%), mobile application (10%), locations services (10%), enhanced vertical transportation (1%), and space booking (2.5%)

Benefit from productivity improvements:

Methodology:

1. Take the total number of front-of-house employees
2. Multiply by the average revenue per head per year
3. Multiply by the average profit margin for the organization
4. Multiply by 3% which is the estimated improvement in employee output from a healthy working environment provided through a combination of energy analytics, environmental and water quality monitoring and intelligent lighting

Benefit from maximising employee output through a healthy working environment:

Methodology:

1. Take the total number of front-of-house employees
2. Multiply by the average revenue per head per year
3. Multiply by the average profit margin for the organization
4. Multiply by the average number of sick days per year per employee (1.2%)
5. Multiply by 30% which is the estimated reduction in employee sick days from a healthy working environment provided through a combination of energy analytics, environmental and water quality monitoring and intelligent lighting

Benefit from reducing employee sick days through a healthy working environment:

Methodology:

1. Take the total number of front-of-house employees
2. Multiply by the average revenue per head per year
3. Multiply by the average profit margin

for the organization
4. Multiply by the average number of sick days per year per employee (1.2%)
5. Multiply by 30% which is the estimated reduction in employee sick days from a healthy working environment provided through a combination of energy analytics, environmental and water quality monitoring and intelligent lighting

Benefit from increasing attraction and retention through an overall intelligent building:

1. Take the total number of front-of-house employees
2. Multiply by the average front-of-house annual salary
3. Multiply by the average cost of separation (90%)
4. Multiply by the average separation rate (34%)
5. Multiply by 5% which is the estimated reduction in separation rate from having an intelligent building

Benefit from improving hard FM efficiency through energy analytics and pervasive connectivity:

Methodology:

1. Take the total number of hard FM employees
2. Multiply by the average hard FM annual salary
3. Multiply by 45% which is the estimated improvement in hard FM efficiency from energy analytics (25%) and pervasive connectivity (20%)

Benefit from improving soft FM efficiency through intelligent waste:

Methodology:

1. Take the total number of soft FM employees

2. Multiply by the average soft FM annual salary
3. Multiply by 12% which is the estimated improvement in soft FM efficiency from intelligent waste

Benefit from improving IT efficiency through pervasive connectivity:

Methodology:

1. Take the total number of IT employees
2. Multiply by the average IT annual salary
3. Multiply by 10% which is the estimated improvement in IT efficiency from pervasive connectivity

Benefit from improving security efficiency through enhanced security and access control:

Methodology:

1. Take the total number of security employees
2. Multiply by the average security annual salary
3. Multiply by 10% which is the estimated improvement in security efficiency from enhanced security and access control

Benefit from improving visitor management efficiency through enhanced security and access control:

Methodology:

1. Take the total number of VM employees
2. Multiply by the average VM annual salary
3. Multiply by 7.5% which is the estimated improvement in VM efficiency from enhanced security and access control

About Arcadis

Arcadis is the leading global natural and built asset design & consultancy firm working in partnership with our clients to deliver exceptional and sustainable outcomes through the application of design, consultancy, engineering, project and management services. Arcadis differentiates through its talented and passionate people and its unique combination of capabilities covering the whole asset life cycle, its deep market sector insights and its ability to integrate health & safety and sustainability into the design and delivery of solutions across the globe. We are 29,000 people that generate €3.4 billion in revenues. We support UN-Habitat with knowledge and expertise to improve the quality of life in rapidly growing cities around the world.
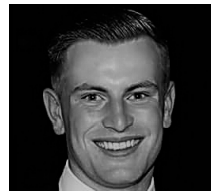
www.arcadis.com

Contact our experts

Dr Matthew Marson
Global Market Sector Director
- Technology

E matthew.marson@arcadis.com

Will Readshaw
Associate Director
Intelligent Buildings

E will.readshaw@arcadis.com

With contributions from:

Jonathan Treece - Associate Director | Intelligent Buildings
James McAlister - Principal Consultant | Intelligent Buildings

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