INTELLIGENT ARCHITECTURE \ ISSUE ELEVEN

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It is our belief that the Architectural design profession has a crucial role to play in addressing the issue of preventing the spread of disease through the spaces we inhabit and the materials we use in construction.

INTRODUCTION:

In response to the COVID-19 Global Pandemic, early 2020 saw Scott Brownrigg's Design Research Unit diverting its entire focus to considering ways of minimising the spread of contagion through architectural design in the built environment.

This dedicated edition of iA explores just some of the research areas that we've been working on over the past 6 months.

Here CEO Darren Comber, responsible for instigating the initiative, explains the rationale behind the research and introduces this edition.

Historically, our cities and buildings have been shaped by disease. Cholera influenced the modern street grid and the Plague and Tuberculosis have all influenced and left marks on urban architecture and our city centre planning.

19th-century epidemics prompted major changes in our approaches to city planning, introduced to prevent overcrowding and improve poor sanitation which promoted the rapid spread of disease.

If Covid-19 can be extinguished soon, the urban fabric might not change much.

Plague, Cholera and Tuberculosis worked on cities slowly. They forced change because people believed they would return, or simply never leave.

However, in stark contrast, where Covid-19 is different is that it has also struck remote ski resorts and suburban conurbations… it is not specific to density. It's not a purely city based pandemic as those experienced in the past. It relies on speed of spread and that's where our ability to seamlessly travel has now given it a platform.

What is certain is that the world will be a different place for many years to come, but out of all forms of crisis, positive opportunities emerge effecting change, whether that be on an environmental, social or economic level. The extent of these positive changes remains unclear at this time, but things we once took for granted will now be cherished to embrace this change.

A clear result of the Pandemic is that people are travelling less and the culture of 'what's on my doorstep is where I'll go' is now a by-product of this period. In many ways this has some positives as it has fostered a community approach that was less prevalent before we all stayed at home, so that should be encouraged and retained.

We have discovered parks and spaces around us we never knew existed only a few minutes from our front doors, yet not that long ago we chose to travel to what we saw as more exciting areas. What this might lead to is a return to the local culture and a return to local bars and restaurants for the benefit of the wider economy rather than travelling. What we are experiencing is that major conurbations now need to compete with what is convenient.

Combine this with consideration for the environment, how we treat those within it, and our attitudes towards it are sure to change in a positive way. Sustainability will be even more on the agenda and we could see significant changes to our lives. Hydroxyl radicals which occur naturally in the open air will drive a greater desire to be in open spaces. More open space and more responsive buildings surrounding them – more 'my space' and the provision of personal space. All of this will have a defined impact on where we chose to work, be based and culturally interface.

Back in March we determined that the question of what changes we might experience and how we could address minimizing the rapid spread of contagions needed addressing by the architectural profession and that we'd focus our attention to doing so. It is our belief that the Architectural design profession has a crucial role to play in addressing the issue of preventing the spread of disease through the spaces we inhabit and the materials we use in construction. Can the design of future buildings and environments provide one of the key solutions to both human behaviour and the spread of contagions? We believe the profession has a duty to society to respond to this question and explore ways that can deliver a more positive future.

Through our Design Research Unit, our global staff located across the UK and internationally in New York, Singapore and Amsterdam and through collaborations from within the profession, academia and the research world we embarked on a series of research areas to establish how this could be achieved.

A fundamental question being asked is how can we limit the spread and impact of future epidemics? Imperial College London looked at the connection between bats (carriers of coronavirus) and ground mammals – but insisted that neither were independently or mutually to blame, that the real cause was changes in human behaviour. Given that much of our behaviour is dictated, or at least influenced by our environments - how can new building technologies, building typologies and community engagement projects inform these necessary adjustments in behaviour?

We've looked at research into the current trends in building densities, shapes and forms, through to material science and nano-technology that not only looks at the value and properties of historic materials – copper, brass etc. but also into emerging

Can the design of future buildings and environments provide one of the key solutions to both human behaviour and the spread of contagions?

self-repairing and self-cleaning materials using organic nano-biotic robots. If we can coat metals in PV coatings, what other coatings can we use to protect and resist virus spread?

The research also explores automation of processes and prediction modelling using digital twins for not just buildings but whole urban environments.

The global pandemic of the COVID-19 virus is changing the world. It will have outcomes that we might be able to predict, but many have yet to emerge. What is clear, is that it will change the way in which we live, work and socialise together, even after we return to some semblance of the normality we once knew.

We won't…and perhaps must not simply go back to the way we behaved before…embrace the positives from this change… utilize the opportunity and encourage a better quality of life.

This issue of iA considers some of the thought leadership pieces we have produced in response to this current time. It is by no means exhaustive, our research continues and the topic is wide ranging, the issues to explore are numerous, but through evidence based design there are solutions that can positively contribute to the future environment ●

PURE RESEARCH:
The Future of Airport Planning Post Covid-19

The impact of Covid-19 on the Aviation Industry has been unprecedented. Earlier this year the Airport Council International (ACI) reported that air travel was down by 95% from a year ago as a result of the travel ban and lockdowns in many countries. They also estimated that passenger numbers for 2020 could drop by 40%, representing a significant decline in revenue for airlines and airports across the world. Here, Director Maurice Rosario looks at how airports and airlines can rebuild confidence in air travel through changes in terminal planning.

The social distancing measures introduced in response to the World Health Organisation's [WHO] call to reduce human interaction and limit transmission of the contagion seems to have worked and is likely to remain in place for some time. So what measures have some airports put in place to help rebuild trust amongst passengers and what further could be done? Scott Brownrigg have been looking into these and have drawn up a research paper that explores this area, suggesting options that relate to passenger flows and queuing capacity. We look at some of the highlights of the report here.

Any intervention to an existing terminal processing layout is likely to have a direct impact on queuing areas and processing times for passengers. Demand, process time, design peak period, maximum queuing time and space per person will all affect such interventions.

By analysing passenger flow pre and post Covid, the impact that social distancing and new passenger safety measures will have on terminal planning and processing facilities can be determined. All processing facilities will result in reduced processing numbers and throughput of the terminal. →

What measures have some
airports put in place to
help rebuild trust amongst
passengers and what
further could be done?

Queueing reduction capacity formulas

A_p	=	Existing space provided per passenger for queuing *(m2 per pax)*	Input
S_d	=	Social distance required *(m2 per pax)*	Input
P_s	=	Percentage of existing queuing space lost	Input
P_q	=	Percentage of existing space remaining for queuing	Input
PC_r	=	Percentage of capacity reduced for queuing	Output

A_p	=	Existing space provided per passenger for queuing *(m2 per pax)*	1.8m2
S_d	=	Social distance required *(m2 per pax)*	3.0m2
P_s	=	Percentage of existing queuing space lost	30% = 0.3
P_q	=	Percentage of existing space remaining for queuing	70% = 0.7
PC_r	=	Percentage of capacity reduced for queuing	Output

$$PC_r = P_s + P_q * \left(1 - \frac{A_p}{S_d}\right)$$

$$PC_r = 0.3 + 0.7 * \left(1 - \frac{1.8}{3}\right)$$

$$PC_r = 0.3 + 0.28$$

$$PC_r = 0.58 \ (58\%)$$

Passenger segregation sections

Social distancing measure
(screen at every lane)

Social distancing measure
(screen at every other lane)

The queuing reduction capacity formula above should not be taken as an absolute measure of the terminal throughput. There are several other factors and mitigation that can be considered in assessing the ultimate impact on terminal processing capacity as noted in the diagrams. However, there could be an alternative whereby the number of processing facilities are maintained by providing adequate screening between them and for the queuing public. Examples of how this can be achieved are illustrated below.
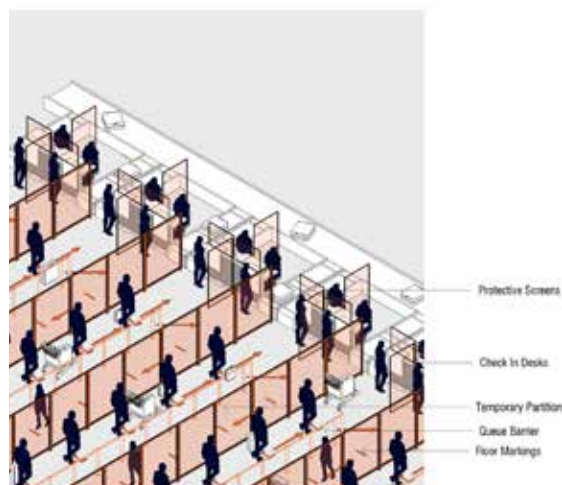
1. Check-in queueing option
This option provides one exit lane for each queuing lane with tension barriers and screens every other lane. For this option the measures for social distancing and segregation may result in a 70% reduction of queuing passengers. This layout reduces dramatically the congestion for queuing areas but the impact on passenger numbers is greater and may not be viable.
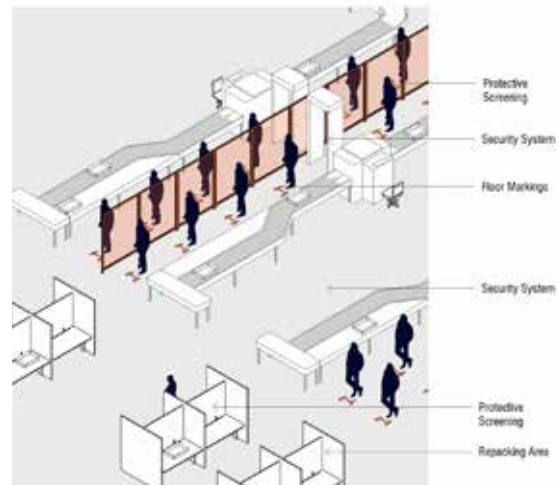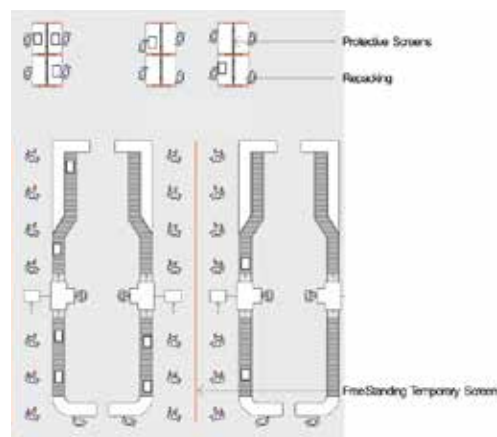
2. Security screening queueing option
The above allows for one passenger per lane dropping bag, with two queues segregated by a central screen. Throughput numbers may be affected, further detail would be required to assess impacts on processing capacity. Queuing layout prior security can also be modified.

1. Check-in queueing option

2. Security screening queueing option

ABOVE
'Digital Twin Unit' - Scott Brownrigg and Atlas Industries' Digital Twin service launched in 2020

The impact on processing time may depend on potential additional procedures such as time required to disinfect processing facilities periodically during operational hours, additional health documentation from passengers, etc. Whilst the impact on queuing areas will be directly linked to the local social distancing policy of the city, country or airport itself, capacity peaks may or may not be impacted depending on the measures applied.

The reduction in the capacity assessment for a queuing area does not have a direct impact on the throughput of a particular processing facility. Detailed analyses will be required to ascertain the outcome of a given solution.
Measures to lessen the impact of social distancing and the reduction in queuing capacity could include:

- Increasing queuing areas, if further space is available within circulation zone.

- Encouraging passengers to use automated or remote facilities including remote bag check-in for example.

- Spreading the peak demand through slot management where possible.

- Increasing the number of processing desks per flight to speed up throughput

- Limiting terminal entry to passengers only.

- Providing UV sanitation and contactless security procedures.

Further possible solutions will vary from one terminal to another where buffer zones/ under-utilised areas can be used to increase queuing areas and processing numbers.
By limiting entry to the terminal to passengers only, the additional circulation space generated as a result could be used for queuing zones; potentially increasing processing capacity. Other measures airport operators could introduce include:

- Providing masks and possibly gloves to all passengers on entry to the terminal.

- Introducing passenger self-health checks prior to travel to detect possible symptoms.

- Limiting carry-on luggage to a laptop case and hand bag only to potentially speed up the security screening process.

- Increasing the rate of natural ventilation. However, this should involve consultation with the local health authority to determine its effectiveness given the airport location.

- Using robotic cleaning and sanitation systems.

- Introducing remote baggage check-in 24 hours before a flight, with bag tags applied in a similar way to bag drops, however tags should be printed remotely and affixed to the bag at the time of collection by the airport or delivery agency. This will not remove the current bag drop but reduce processing time at airports.

- Providing or increasing bag pick-up service where available.

For the longer term, airport operators may wish to consider the creation of a Digital Twin of their terminal, a responsive system that connects physical and digital systems. Which will enable the operator to quickly retrieve asset information for decision making, diagnose problems remotely and test proposed fixes before having to apply them to the physical component.
It is hard to predict any long term measures and assess the impact caused by this global pandemic on the future built environment. This will undoubtedly require a significant amount of research and evaluation by various regulatory bodies to ensure the effectiveness of future provision. However, we can only assume that there will be greater scrutiny in providing a healthier environment and a future trend that balances commerce and critical health. What is clear is that the current crisis indicates that these two aspects are not in opposition, but are mutually inclusive ●

You can read the full report here:

scottbrownrigg.com/design-research-unit/articles-publications/covid-19-the-potential-impact-on-airport-terminal-design/
To request a copy please email: c.donald@scottbrownrigg.com

PURE RESEARCH:
The Social Contact Pod

The most vulnerable in our society have the greatest need to be protected from the Covid-19 virus. However, to protect them from contamination they are isolated from their friends and family in care homes, hospices and rehabilitation centres across the UK. Here Associate, Felicity Meares discusses our response to this – The Social Contact Pod.

The Social Contact Pod is a practical, rapidly-assembled solution created with CLT experts, Rambol and M&E and sustainability specialists, Hoare Lea. The Pod allows families to spend valuable time with loved ones without the risk of contamination. It recognises the desperate need for people, particularly the elderly, to maintain a physical connection with loved ones despite the virus; bringing back that all important connection that has so swiftly been cut out of our lives. Allowing for that most human of actions, grandparents can hold the hands of their grandchildren once again.
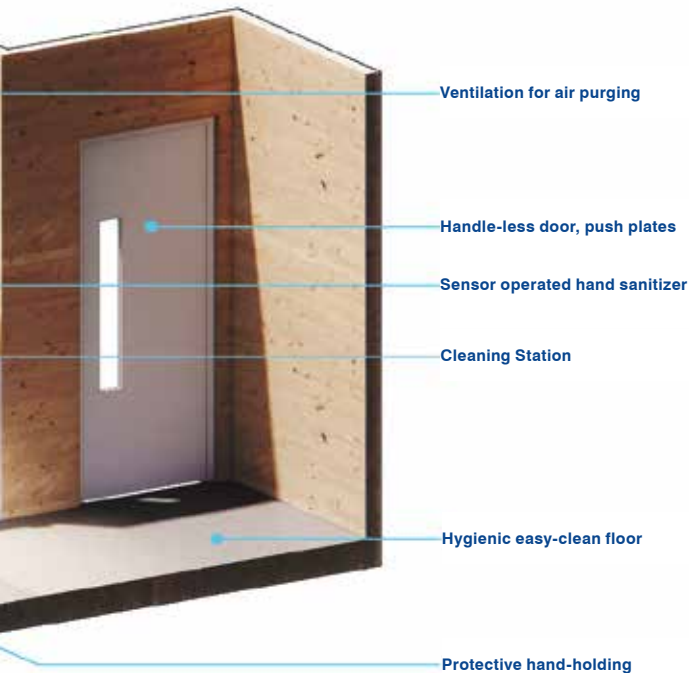
Constructed from simple low cost glulam (CLT) panels (potentially surplus stock from house builds), it is lightweight, rapidly constructed and is easily transported on the back of a standard truck or pulled on a trailer. It can be installed at the entrance to a care home and/or dropped in a carpark or garden for immediate use. Importantly it's been designed to be fully sustainable so that pods can be repurposed or recycled with relative ease when they are, hopefully, no longer needed.

Within the fully accessible design, a Perspex partition separates the two groups; an area of plastic membrane allows for human contact and hand holding. In terms of internal comfort the pod has high levels of air quality and natural daylight, along with a comfortable temperature, acoustics, and access to fresh air. Simplicity is key to the design, the pods are cost-effective to run, with the lowest carbon emissions possible, and feature simple controls for people to adjust their environment as needed. The Pod has the flexibility to be used in other scenarios, including providing a safe space for doctor-patient consultations. Each side of the partition incorporates a handle-less door, ventilation, a cleaning station with a sensor operated sanitiser and a flip up/down table. A perforated acoustic metal ceiling has integrated speakers to support communication. With sustainability in mind, the Social Contact Pod is designed to be completely off-grid, powered by solar panels and battery. Neil Wylde from Hoare Lea explains, →

Perforated acoustic metal ceiling with integrated speakers

Perspex Screen

Flip up/down table

Fully accessible design

ABOVE
The Social Contact Pod by Scott Brownrigg, Rambol and Hoare Lea

Ventilation for air purging

Handle-less door, push plates

Sensor operated hand sanitizer

Cleaning Station

Hygienic easy-clean floor

Protective hand-holding

"Through the design of the Social Contact Pod, we hope to be able to bring back the much-needed physical connection that so many families and friends are craving. For a project like this, where safety is paramount, the internal environment and engineering is incredibly important. Ultimately its off-grid design makes it not just a space that can provide precious moments for families and friends, but one that looks to how we can design for a better future."

The sudden and dramatic changes to our lives have affected all of us, but we have to be aware of how terrifying and isolating this is for the most vulnerable in our society. As architects and designers it is our duty to help to bring social contact back to the elderly and vulnerable in a safe and familiar way ●

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DESIGN PROCESS:
Office of the Future

Our workplaces are facing a series of challenges in a rapidly changing future. The design and creation of new workplaces will need to be radically different from the past. Here, Director Ed Hayden looks at some of the challenges and solutions in creating the office of the future.

Some of the key challenges we face in new office design can be considered under three general headings:

- **The pandemic impact, transformation of our ways of working.**
- **Responding to infection, creating healthy working environments.**
- **Climate change – designing for net zero carbon.**

THE PANDEMIC IMPACT, TRANSFORMATION OF OUR WAYS OF WORKING

The very way in which we work has changed overnight. The pandemic has transformed large parts of the centralised office-based workforce to a dispersed homeworking society, and the effects of this are likely to last. What does this mean for the structure of companies and what they will require from offices in the future?

Technology offers autonomy, allowing anyone to work remotely anywhere, and the implementation of 5G technology will reinforce this. Individual 'computer-based' focused working may well take place in the home setting, so we must consider what becomes of the traditional commercial office building.

Whilst homeworking offers many benefits it also has some major disadvantages. Dependent on your circumstances, and if you have the space, it can be great for focused tasks. You can work without interruption, surrounded by all the comforts of a home office tailored to your specific requirements. But this is not universal, and conversely sharing a dining table with partners and young children can be very disruptive. However we can see that this shift to a homeworking lifestyle has been embraced
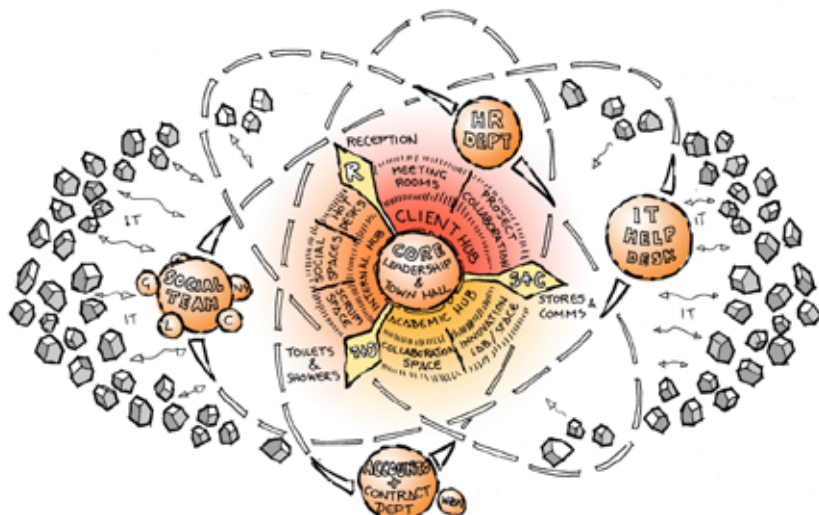
by the majority of those who can do it. So what becomes of our offices, and what do we need from them in the future?

Collaboration, face-to-face contact and human social interaction are awkward and limited over the computer or phone screen. Fluid meetings where multiple items can be discussed in a freeform manner, splitting away from the primary topic and rejoining with new ideas, can be very difficult over networking software. Our buildings need to fulfil that role and become places for human cooperation, and forums for creative collaboration, each one a crucible for a specific field of exploration and discovery.

The new organisational 'system' of a company can be seen as a central core around which homeworkers orbit, connected together by a web of powerful IT. Between the core and the

home-workers, specific groups connect the two, managing Accounts, Technology, Human Resources and the like.

So what happens at the centre?

The 'core' contains a Leadership Team, Client Hub, Internal Hub and Academic Hub. Each building becoming a creative crucible, a forum for discussion, presentation and learning, all focused around an area of expertise or creative exploration.

The Leadership Team sets the direction for the company as they have always done, making the strategic decisions but also forming the 'glue' that holds the company together. But there is more to the core than that, the company still requires a 'forum' for learning.

The Academic Hub is a place where knowledge can be handed from experienced older employees to the more junior staff, (not something that happens naturally over video conferencing software), and where specific areas can be discussed in a freeform way.

The Internal Hub provides space for those for whom home working is not practical or desired, and allows for teams and groups to come together to exchange ideas and socialise. This form of human face-to face interaction and collaboration is a valuable part of building a team ethos and is not easily replicated remotely.

Finally, and possibly overlapping the two, is space for the Client Hub. Presentations, building client relationships and collaborating 'around the table' are still of key importance when building business relationships and engaging with clients or external partners. However, to rebuild acceptance of the 'office'
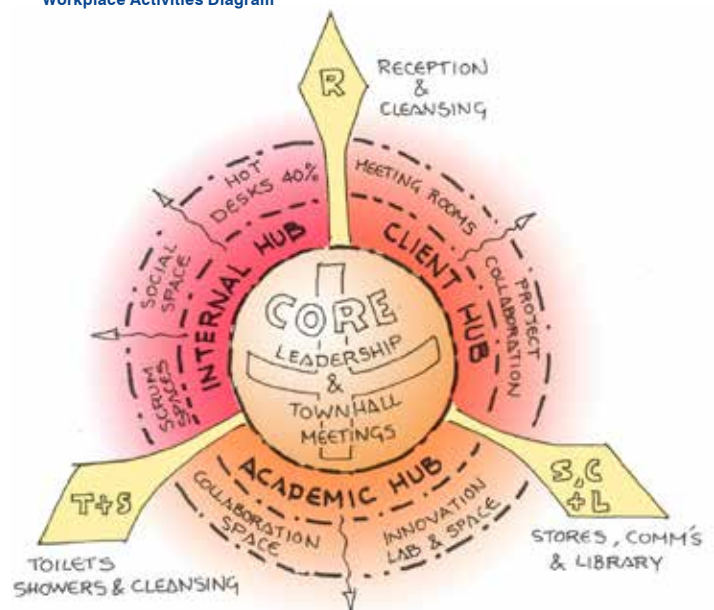
we need to provide healthy environments, and to create these will require fundamental changes, which will be reflected in the offices we design for the future. →

BELOW LEFT
'The New System of Work' Diagram

BELOW
Workplace Activities Diagram

RESPONDING TO INFECTION, CREATING HEALTHY WORKING ENVIRONMENTS

Responding to the challenges of the current (and future) pandemics the design of offices will need to limit the risk of infection spread. The office of the future will need to mitigate against the spread of future contagious diseases and allow the office to continue running effectively through any future pandemics, this has a number of fundamental effects on office design. The prevalent use of air-conditioning has meant that in general 90% of the air in offices is recycled, and this is supplemented by 10% fresh air.

This may no longer be acceptable given the perceived risk of airborne infection spread. We anticipate a reversal, with 90% of fresh air being a new requirement, with possible changes to the design guidance such as the BCO, WELL Building Standards and Building Regulations.

Whether or not this risk has been proven there is still the issue of the building occupants' perception; knowing that the air is re-circulated and not filtered may well create anxiety and discourage occupants from using the space.
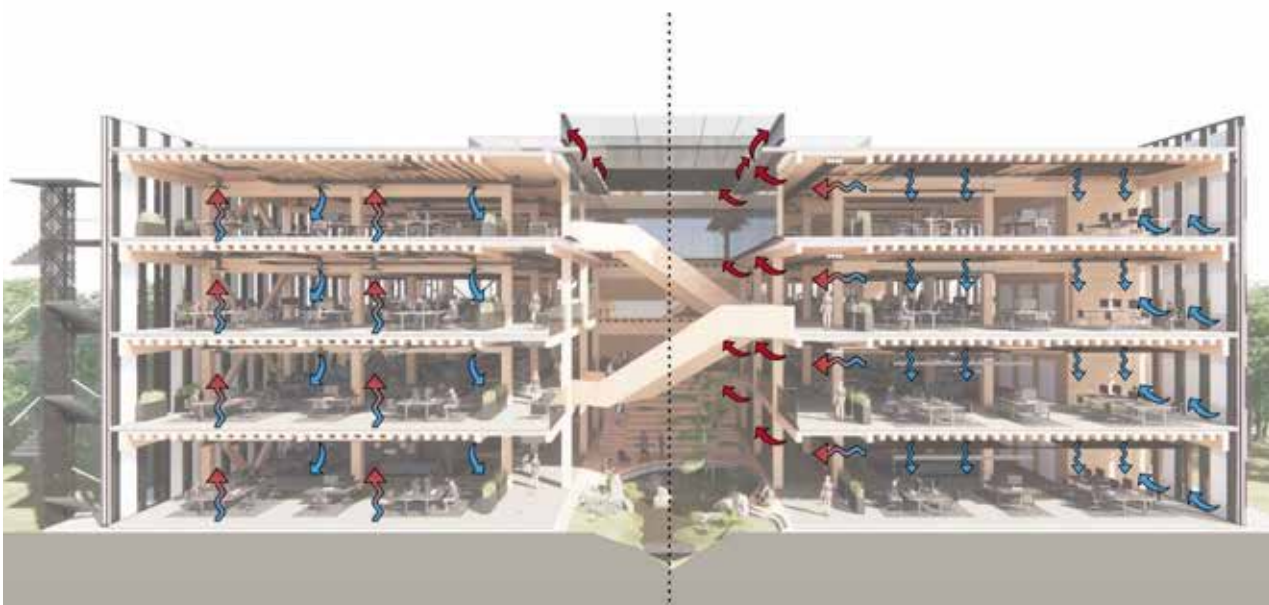
A move to a natural or displacement ventilation solution with increased fresh air and avoidance of recycled air is a solution. The office of the future uses the atrium stack-effect to draw fresh air in through the façade and vent stale air out through the roof avoiding cross contamination risks.

A visual representation of the air quality in the form of an environmental 'dashboard' accessed from any device and displayed prominently in the office will give comfort to the occupants that the safety and quality of the internal environment is under constant review.

During the winter, stale air is collected at the top of the atrium and used to preheat fresh air using a plate heat exchanger, again avoiding contamination. The heating and cooling of the space is implemented using radiant panels which can radiate heat (or cool) to adjust the internal temperature.
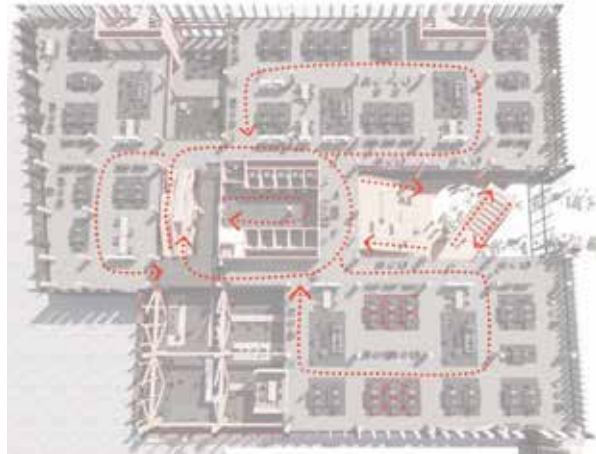
Reduced occupation densities, carefully planned layouts, and limited contact with surfaces (such as door handles) are all matters that may become normal design considerations in the new generation of workplace design.

Other features such as inbuilt routes which avoid close contact, split staircases allowing separated up and down routes, and Superloos with UV light cleansing between uses are likely to be adopted to reduce the infection risk over the longer term.

ABOVE
Design for safe and specious circulation routes, separated up/ down stairs, and one-way superloo cores.

CLIMATE CHANGE – DESIGNING FOR NET ZERO CARBON

Finally, the greater crisis that humanity faces is the effect of man-made climate change.

We have a pressing need to address the amount of carbon dioxide that is released in the occupation and construction of our office spaces. 30% of the carbon is created during the construction phase, and in order to achieve 'net zero carbon' buildings must address this issue. Switching from carbon

BELOW
A central atrium with displacement air on the left side and fresh air and radiant panels on the right

ABOVE AND BELOW
'The Creative Crucible' Timber Office Concept

intensive materials such as concrete and steel to materials which 'sequester' carbon into the building fabric is fundamental in achieving these goals.

The use of mass timber in the form of LVL, CLT and Glulam as the building structure is the solution. This is a 'better than zero' solution during the life of the building (and potentially beyond). The office of the future uses pre-manufactured, zero waste timber construction systems with innovations such as LVL rib deck panels, CLT timber core walls and Glulam columns and beams to create efficient attractive sustainable spaces. This combines perfectly with the other aims of a flexible collaborative working environment and a healthy naturally ventilated workspace.

CONCLUSION

The new office concept combines all of these considerations, providing a healthy attractive environment which encourages collaboration and creativity without impacting on the health of the planet. We look forward with anticipation to a new era of workplace design which encompasses these goals, and we are already seeing a shift in the mindset of clients, occupiers and developers to be vanguards in the creation of the office of the future ●

PURE RESEARCH:
What if Schools were Designed for Wellbeing?

Here Helen Taylor explores how school design can support the health and wellbeing of teachers and pupils in the post-Covid world.

HOW COULD SCHOOL DESIGN SUPPORT THE HEALTH AND WELLBEING OF TEACHERS AND PUPILS IN THE POST-COVID WORLD?

Wellbeing in school environments is often approached as remedial, something that will stem or address problems, when we might approach it as enabling young people to achieve their potential, and enable resilience, creativity, independence. Health and wellbeing is not just safeguarding, daylight, acoustics and ventilation, it's also capability, which includes having choice and agency. In the post-Covid world, physical environments for learning will need to be comprehensible, manageable and meaningful. A brief for a school, thinking only about wellbeing and capability, might be very different.

What would meaningful spaces look like if school design briefs were created around delight, happiness, values, community relationships, and social experiences? We have seen during the recent lockdown period that schools are not just places to fill young people with knowledge. Similarly, wellbeing is not just remedial, it is not only about stemming or addressing problems but a purpose in itself.

Wellbeing in schools has been talked about in terms of mental health but it is more than that. It means enabling children and teachers to reach their potential, to lead a meaningful life of value. Wellbeing is a sensory and physical experience-conscious and unconscious. Research shows we spend 90% of our time indoors. So design matters for wellbeing because the built environment affects how we feel, what we do, our ability to perform tasks, and our health- even more so for growing developing children or anyone with sensory or physical impairment.
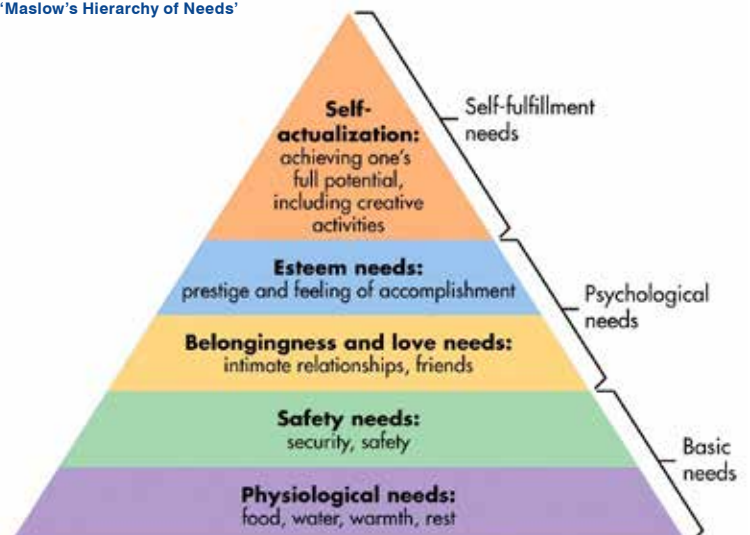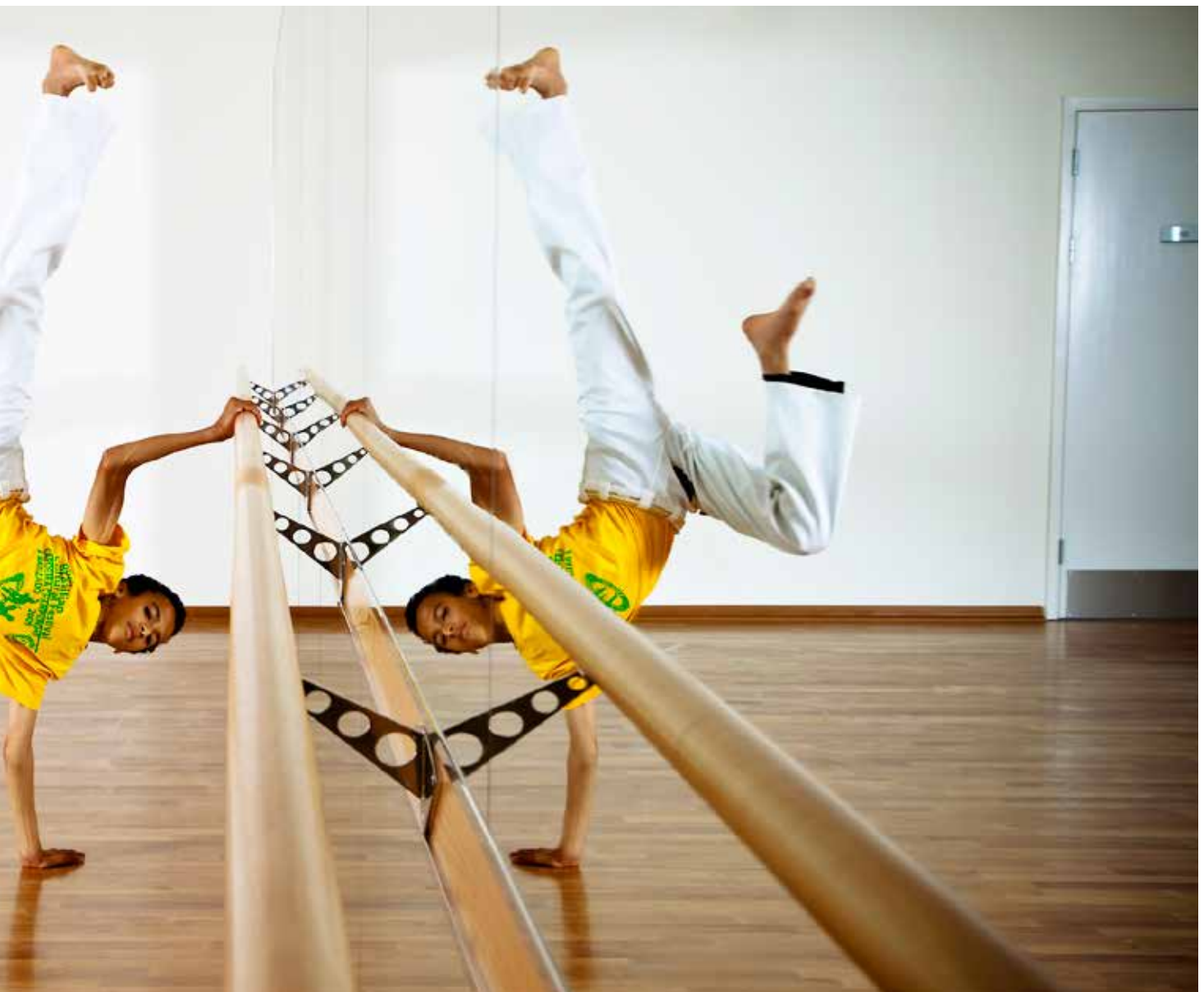
ABOVE
Photo copyright of Adrian Hobbs

BELOW
'Maslow's Hierarchy of Needs'

Architecture and design have an important role in supporting basic hygiene, health and safety. Space standards, access and security, water and sanitary systems, heating and cooling, acoustics, light, ventilation and air quality all have a demonstrable impact on our comfort, and sometimes on our ability to lead a productive life.

Architects and designers need to avoid falling into the trap of only using their own experience of school, and perhaps their children's. School communities- children, staff and others, parents and visitors, are not a homogeneous group. Do we truly understand the experience of those working in the school? Do we understand what drives behaviours and the way that buildings are used and operated?

Schools want an environment where learning can take place in comfort and calm. Where people- students, staff, visitors- are able to focus and no aspects of the building impact negatively or intrude. An inclusive school that meets the needs of everyone. Some of that is invisible or sensory- light, airflow, acoustics or movement around the building. Designs must consider the needs of the most vulnerable children in schools. The ability of mainstream schools to provide an environment that can support a range of needs is a vital element for inclusion and wellbeing.

The importance and value of schools as a community resource and civic space has grown in the context of the loss of a number of community facilities in the UK: libraries, surestart centres, even local shops, over recent years. Schools can have amazing sports facilities and outside space that could also be useful for the community. Writing wellbeing into the brief could create a culture shift that places the pupils and the community at the centre of the briefing process and delivers a more holistic approach.

There is a strong argument for the value of including children in the design process, as well as others who might already have a good understanding of wellbeing and the needs of students such as Educational Psychologists. Can we enable young people to have ownership of the briefing, design and creation of learning space? Should more space be 'given' to students for their own use and control? The pandemic has led to calls for Ofsted to start assessing pupil's wellbeing. Perhaps giving students an input into their school environments should become a standard part of their learning experience? →

During the Lockdown experience drawing, painting, and music activities have proven to be very important in keeping children and adults occupied, in good spirits and good mental health. Looking ahead should there be a greater focus on the arts in schools? Can we have a policy change to drive schools to focus on the creative curriculum and cultural capital as part of the inspection framework? Whatever their background, we need to provide children with an environment and experience that is going to model and inspire ideas for their future. We create a variety of working environments in our offices to give different places to work to suit different persons. Should we have a range of classroom settings, as we increasingly do in or office environments, or should classrooms be more neutral spaces that can be tailored to the topic at any one time? Now schools have all been forced to move to online learning, will the experience impact future education delivery? Could there be less classrooms and more spaces for social interaction, and life-skills, such as communication and developing friendships. Things which are very difficult to achieve online? In some cases, home learning has meant a mix of age groups and abilities learning together. Could maintaining an element of online learning facilitate grouping pupils in other ways in the future, not just by age? Schools need a variety of space for both the learning time and the unstructured time, and flexible enough to be future proof.

The 'open-air' schools of the 1930s, built for another pandemic: the outbreak of TB before vaccines were invented, were inspired by 19th Century 'sanitoria' and the 'outward—bound' ideas of Baden-Powell. Their designs included bi-folding doors and retractable roofs to maximise access to fresh air and sunshine. Children were outside whatever the weather. These were lauded at the time for the positive impact they made on some children but fell out of fashion when better post-war housing and healthcare reduced some of the issues they were set up to address. They are a clear acknowledgement that schools are not just for passing on knowledge

'Nature Deficit Disorder' has become a recognised condition for children lacking exposure to nature. How can we safeguard and better value outdoor space? How can we introduce green infrastructure within schools? Can we integrate Biophilic Design for example- improving connection to nature- that has shown to increase rates of learning by 20-25%, test results, concentration levels and attendance, and to reduce the impacts of ADHD. Early years in Scotland have introduced a mandatory 20% external learning and play allocation within their funding area metric. Does access to outdoors need to be mandated as it is in Scotland or Sweden or as 'learning through movement' is in Denmark? Or would extending the curriculum to outside for all ages be enough?

As a result of the Lockdown in the UK, there has been a dramatic improvement in air quality and a drop in carbon emissions. Many of our streets are traffic free. Children are cycling safely. People in cities are hearing birdsong for the first time in their lives. All those things benefit our wellbeing. Will the current emergency spark a green recovery as part of wider socio economic recovery? How might schools and school design support that green recovery? We need to build a case around the increased use of landscape and consideration of the micro-climate around schools. Not least because, as well as wellbeing, it offers vital sustainability benefits in terms of biodiversity, reducing heat gain, reducing solar gain and other positive benefits.

Children are well aware of the climate emergency and ecological crisis. They have been leaving school to protest

Schools can have amazing sports facilities and outside space that could also be useful for the community

ABOVE
St George's College Activity Centre - completed in 2019 by Scott Brownrigg

about it. The student-led 'Teach the Future' campaign is calling for all new school buildings to be net zero by 2022 and existing buildings by 2030. School environments provide an opportunity to help young people understand their place in the world and the impact of their behaviour and the built environment on the planet. School buildings can be a learning tool. What lesson should school buildings be teaching?

Sustainability needs to include inclusivity so schools can meet as many needs as possible without adaptation and reduce support needs. If buildings are going to endure and last for 100 years, they have to be adaptable without the need for significant capital investment. Well-loved school buildings can become part of the local heritage. Are we building schools now that will become a valued part of the local architectural fabric?

Ultimately it's not about specific spaces but the footprint as a whole. How can both the indoor and outdoor spaces support positive relationships and interactions? Being part of a community of learners, or a learning community, is a holistic experience, physical and environmental as much as social, emotional, psychological and developmental. They are inextricably linked.

The World Health Organisation defines health as not an absence of disease but measure of health and happiness. Good Health and Wellbeing is one of the established United Nations Sustainable Development Goals. The WELL Building Standard is the latest industry system for assessing buildings specifically for wellbeing- focussing on air, water, nourishment, light, fitness, comfort and mind. What built environment indicators might be used for wellbeing in schools? What should the brief for wellbeing include if we want every child to flourish? ●

The full report can be viewed at:
www.scottbrownrigg.com/company/news/report-what-if-schools-were-designed-for-wellbeing/
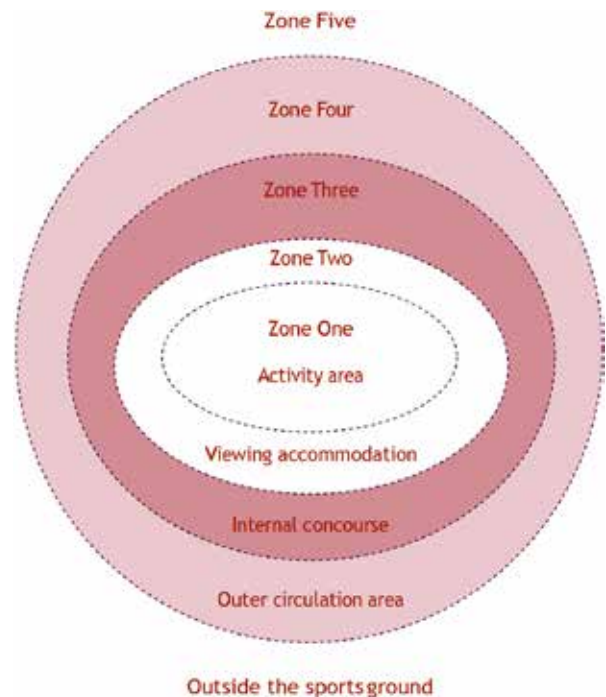
PURE RESEARCH:
Returning to Stadia

The very essence of sport presupposes movement. A stadium – a theatre of sport – actually contains two performances which often occur simultaneously. There is the one on the field of play, and the responsive or reactive one from the audience, the spectators.

Play has recommenced in many stadia for TV audiences without the benefit of a 'real' crowd. The joyous communal spectator experience of stadia, whether for sports, music or other spectacular events, is only currently available to us remotely. How might stadia re-open safely?

On 17 July 2020 the UK Sports Grounds Safety Authority [SGSA] published draft guidance to help sports grounds plan for social distancing when the Government permits the re-admission of fans. What does this mean in practice? Board Director Neil MacOmish and Director of Practice Helen Taylor discusses.

INTRODUCTION

Modern stadia don't only accommodate individual events; practice spaces, function rooms, changing rooms, fitness suites, physio and medical facilities, offices and a club shop are not unusual. Coaching and viewing balconies, restaurant and dining, kitchens, offices and corporate hospitality are also

becoming core requirements for both sporting excellence and financial viability.

Until there is a vaccine it is unlikely that full capacity can be accommodated in existing stadia and may be reduced to a fifth of usual numbers, which will significantly affect income[2]. No doubt in principle stadia players, staff and visitors will be encouraged to disperse and keep their distance as much as possible. This needs to be balanced with careful control of entry and security checks which will need to continue. There will be higher risk 'touch points' such as ticket barriers that will need particular spatial provision and procedures put in place. Even for reduced numbers, arrival and departure will still have to be carefully managed and additional staff are likely to be needed for stewarding and crowd management.

Technology will be invaluable. From managing ticket sales[3], virtual modelling of seating arrangements and movement, to implementing timed and touch-free access, and contactless payments. Digital ticketing systems provide a ready-made automated track and trace system, providing data on exactly who attended and where they sat. Stadium analytics[4] may even be able to track movements while individuals are in the stadia using Wi-Fi or GPS. Depending on space and layout, in some stadia it may be possible to zone areas to limit exposure between groups of people, while building in overrides for safe emergency escape. A 'digital twin' of the stadia, that provides a 3D digital data driven model of the physical space, will allow for dynamic planning for individual events and 'virtual views', or fly-throughs of adjusted space provision or signage and how it will look.

ARRIVAL

The sequence of arrival is an important part of the spectator experience, it commences the performance. A stadium event is an exciting experience[5] and visitors will want to be reassured that their experience will still be exciting as well as positive and safe. Both linear movement and static spaces for moments of rest, the gathering of the crowds and the accentuation of excitement and expectancy, need to be maintained. And the ability for non-ticket holders to access the space around a stadium may need to be considered carefully to enable this experience to be retained.

Visitor information on the stadia website will be invaluable and could be enhanced by a 'virtual visit' that provides an online fly through of what they will experience during their visit. This can allay a lot of fears and reduce the potential for unhappy customers for staff to have to deal with. A great experience is in everyone's interests. Some health and safety precautions that have become normal during the last few months, such as keeping distance in queues and provision of sanitiser stations, can be accommodated with some space planning, however provisions such as the wearing of masks might prove difficult for fans screaming in support of their teams or music idol although wearing them to get to and from their seats may be more enforceable.

TICKETING

The event experience begins at ticketing and seating selection. As noted above, digital ticket sales can manage track and trace. Stadia may have their own data about typical group size of bookings that could be used for modelling. For example-seating layouts could assume layouts in pairs with 2m spacing and plan capacity and bookings on that basis. Alternatively, users could be permitted to make collective group bookings for seats immediately adjacent to each other to maximise occupancy, as long as they meet the latest Government guidance for social 'bubbles' and provide contact details for all members of the party. This could work for a family group or a small group of friends. Groups of Season Ticket holders could establish their own 'bubble' for the season. As appropriate distance would need to be maintained between each small group, a dynamic digital seating model could allow for seat allocations to be planned on an event specific basis depending on the technology available. For ease of management, it may be necessary to leave every other row of seats unoccupied. The SGSA draft guidance includes a number of examples of possible seating layouts.

Any VIP, private dining or box areas will need to be assessed to ensure that safe distance can be maintained but, as above, a group 'bubble' could be permitted to use these areas. For the purposes of the SGSA Supplementary Guide, a social bubble is defined as a group of up to six people from no more than two households. The provision of catering or other services would need to be assessed on a venue by venue basis and a risk assessment undertaken to ensure that staff and visitor safety are considered. Scott Brownrigg can offer any stadia or arena safety risk assessments that may prove beneficial to owners and operators alike.

External non-seated areas will have to rely on reduced capacity and social distancing guidelines. The SGSA guidance refers to 12.5 persons per 10 sq m. Internal non-seated areas may only be bookable by a single 'bubble' group unless some kind of space partitioning or screens can be safely implemented. Floor markings are unlikely to be effective separators. These would have to be installed without interfering with safe evacuation.

Ultimately the adjusted capacity of the stadia will need to be assessed and established based on the capacity of the circulation space and other public space rather than seating arrangements[6].

Many ticketing systems now integrate travel and parking booking that will assist with providing data on numbers of visitors arriving by different means and allow routes from parking or transport hubs to be reviewed. Current guidance on public transport use may result in a preference for arrival by car, but indoor parking provision may need to be reduced to allow people to keep a safe distance when entering or exiting the car park or their vehicles. Prioritising those travelling in groups, as well as those with a disability, will assist with management as well as mitigating any impact on traffic or air quality around the venue. As with seat ticketing, staggered arrival times may assist.

ENTRANCE

Ticket sales are likely to come with some terms & conditions, or a 'code of conduct', in relation to attendance, which the SGSA Supplementary Guidance makes clear, however temperature check zones at arrival could be enforced as a back up to screen enthusiastic fans who may not be willing to miss events even if they are feeling unwell. Arrival and departure are time consuming activities even in usual circumstances so all available entrances and exits should continue to be made available, even with reduced numbers attending, and staggered allocated entry times where that can be put in place.

Security searches are expected to continue therefore bag search or similar areas will need to be laid out to allow staff and public to maintain distance. Staff PPE will need to be enhanced at these key higher risk 'touch points'.

The drama of arrival is an important part of designed movement flows. It is generally considered that to arrive at an upper level and then migrate downwards, reveals the pitch or the sporting theatre in a way in which enhances that arrival experience. Managing access routes, as outlined below, should allow existing arrival sequences to be retained.

CIRCULATION

Whilst there are obvious similarities in some design principles across all sporting stadia, the general use differs across sports. The Safety at Sports Grounds Act 1975 (commonly known as the Green Guide) is the bible of design principles that govern specific requirements for a large number of the elements that constitute the stadium. It is applicable to grounds that have a capacity of 10,000 seated spectators or over.

For example, cricket matches have a longer duration (Twenty20 games excluded) and have a number of natural break periods (bowling change of ends, fall of a wicket etc), and often 45 minutes for lunch. Even the bish-bash of the Twenty20 games has some of these breaks. This takes away the crowd rush and pressure on ancillary facilities (particularly toilets) in the 15 minute half time break that needs to be accommodated for football and rugby. Equally because of the length of the game, cricket spectator arrival is more relaxed and casual,

→

although this has a different effect on movement around the stadium.

The second major difference is viewing time. A day's cricket is 6-7 hours which enables seats and seat spacing (including terrace goings) to be more generous. There is no necessity for crowd segregation either, which has a significant effect on spectator movement.

There is an ebb and flow between the crowd inspiring the players and the players inspiring the crowd. This is facilitated by several things – acoustic properties are important, but good sight lines and an unobstructed view of the action combined with a terraced section that provides those good sight lines. Physical intimacy to the playing area is perhaps even more significant but may need to be adjusted to keep a comfortable distance between the players and the spectators.

In addition, the pragmatics of people flow within the stadium fabric are usually assessed on a simple level against the following design criteria defined within the Green Guide;-

• Entry capacity – determined by the number of persons capable of entering the ground in 1 hour – usually 660 people per turnstile per hour- to maintain social distancing this may be reduced significantly.
• 10% of the ground can be 'unreserved seats'- the use of these will need to be managed carefully to maintain 'track and trace' requirements
• Stair widths – usually 1.2 – 1.8m - this will require 1 way systems to be put in place wherever possible
• Concourse capacity – usually 20 persons per 10 sq m - even with 1m social distancing this could reduce to 5 or less depending on dimensions so at least a quarter of usual capacity.

Internal and external concourse areas will need to be reviewed to rehearse general circulation routes. One way systems and floor markings and demountable barriers could assist visitors in maintaining suitable distance. Sanitising stations and enhanced cleaning regimes will be required in all public areas[7] .

TOILETS

Assuming a reduced occupancy for events, toilet capacity should be plentiful and allow for alternate cubicles and wash basins to be closed to ensure individuals can maintain a suitable distance while using the facilities. Urinals may need to be closed depending on spacing. Hand driers should be shut off and paper towels provided. All bins should have lids and be foot operated. Automated flush or tap provision will reduce

points of contact, but cleaning regimes and waste management will need to be enhanced and staff PPE will be required in all cases.

REFRESHMENTS

Outdoor refreshment concessions should be able to operate with contactless payments and socially distanced queues facilitated with markers. Transparent plastic screens at counters have become commonplace already and some great apps are available to minimise the need for paper menus or queuing.

Indoor refreshment concessions will need the same provision but may also need additional measures- particularly if they rely on automated ventilation or extract. Self-service food areas are unlikely to be possible and any self-service cutlery/ condiment provision will need to be removed. Any seating/ dining areas will need to be reviewed for space layouts and cleaning requirements.

Concession holders will need to carry out risk assessments and operational plans for how they will manage the health and safety of staff working in the concessions. Staff may be required, or wish to, wear masks.

WASTE AND RECYCLING

The current pandemic situation has unfortunately led to an increase in disposable plastic products and containers for hygiene reasons. Many stadia do not permit visitors to bring their own food and drink in any case but increased visible recycling provision would be beneficial, particularly if any water fountains need to be shut off. The use of bio-degradable materials for containers should be encouraged wherever possible. As in the toilet areas, bins should be touch free or foot operated.

INCLUSIVE ACCESS

Many stadia rightly pride themselves on being inclusive facilities however this may rely on lift access or other provision such as specific designated seating areas. Continuing to meet the needs of disabled people and their carers must be assessed on a venue by venue basis to ensure that inclusive access can be maintained safely. Any new signage, sanitiser stations, demountable barriers, communications or changes to routes or seating availability must not negatively impact inclusive access.

VENTILATION AND OTHER ENVIRONMENTAL SERVICES

Every stadia will need a specific assessment of any air handling provision particularly for covered arena or those with retractable roofs. The ability to provide appropriate ventilation at all times to all areas will be a fundamental requirement of re-opening. Few indoor stadia are naturally ventilated so outdoor arena will have an advantage in terms of delivering fresh air.

Hosting high profile events such as an Ashes Test, that historic cricketing battle between England and Australia, usually requires meeting essential criteria set down by the England and Wales Cricket Board (ECB) and the Test Match Status. This includes such requirements as 15,000 permanent seats of which 10% had to be covered, a media centre to facilitate 200 press members, TV and Radio studios, outside broadcasting facilities, test officials accommodation (third umpire, TV replay etc) and ancillary accommodation. Assuming these standards are not relaxed, and social distancing needs to be maintained, this will reduce the potential number of stadia able to accommodate such events.

STAFF ACCOMMODATION

The legal responsibility for the occupational health and safety needs of employees is unchanged. Maintaining staff health and safety will be key and will require a review of the staff provision from arrival to locker storage, welfare areas, refreshments, toilets, circulation and higher risk contact points with visitors.
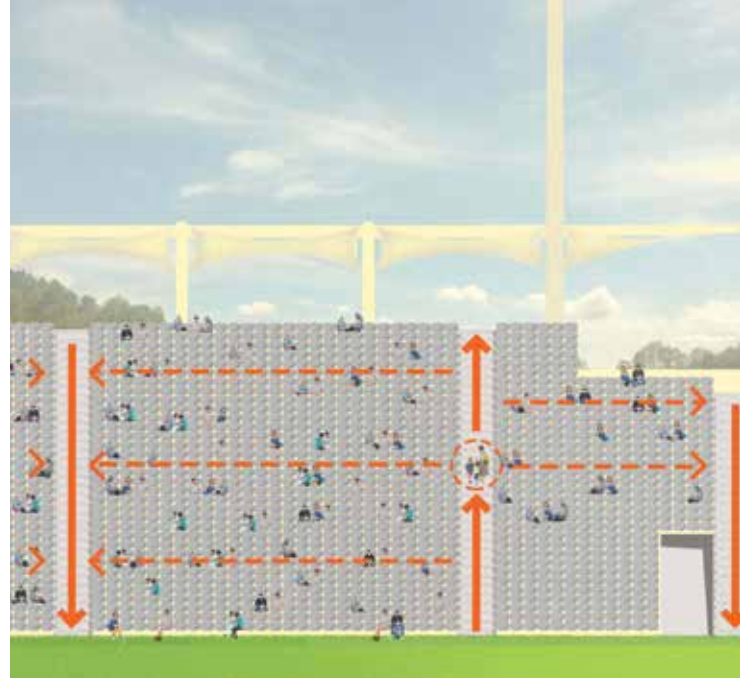
DEPARTURE

Although arrival times and entrance routes can be staggered and managed, departure and exit is typically more difficult as everyone typically leaves at the same time and potentially through different routes than through which they arrived. It may be necessary to stagger departure times or maximise potential exit routes to allow visitors to disperse and maintain distance as much as possible. This will need to be clearly communicated to spectators before arrival. Events ending late in the evening may have a particular challenge, with visitors wanting to leave quickly to catch trains or beat traffic, so event start and finish times may need to be adjusted accordingly.

ACCIDENTS, INCIDENTS OR EMERGENCIES

It is vital that basic health and safety provision is not compromised by any Covid-specific changes. For example, fire exits and ambulance or other emergency vehicle access need to be maintained, and the roles and responsibilities of staff and the procedures for emergencies should be reviewed on a venue by venue basis. The Green Guide requires that a stadium must be able to be evacuated to its safe zone within 8 minutes and the playing area can be a designated safe zone but only for a short temporary basis. While the SGSA Supplementary Guidance states clearly that, in the event of an emergency, standard operational procedures will generally take precedence over social distancing requirements, it is still the responsibility of individual stadia to review their own plans and assess the risk. **It may also be worth a temporary relaxation of the rules which apply to the definition of safe zones. Currently**
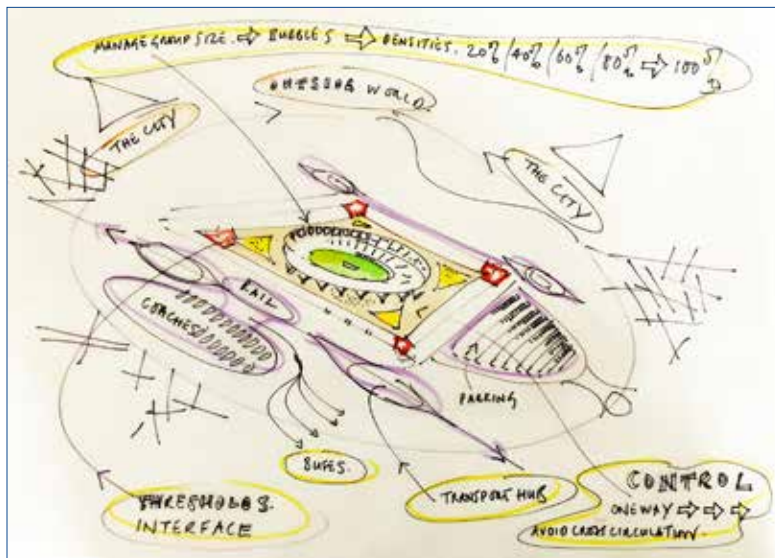

the playing area is not allowed to be included. However, to consider the playing area as a safe reservoir for a limited number of spectators that may be in attendance, this should allow for emergency services to deal with whatever that emergency may be, then facilitate an orderly evacuation.

Responsibility for all people present in a sports ground lies at all times with the ground management. The ability to carry out a virtual rehearsal of arrival, entrance, circulation, seating, toilets, departure and emergencies with a digital twin could make all the difference.

Arguments will rage on about whether crowds should be allowed back in at all, and the shifting science does indicate that even within an external environment like stadia, there are positive benefits to wearing masks, but certainly there are commercial and viability issues coming to bear that allude to the absolute necessity of spectators in seats. They provide the backdrop and ambience that truly make watching sport on television a theatrical experience, give home and away teams a competitive edge and the limited return of sport in our lives (even under some of the current 'fake' conditions) have been a welcome shot in the arm to a huge part of the populations wellbeing ●

1. sgsa.org.uk/planning-for-social-distancing-at-sports-grounds/
2. sportsvenuebusiness.com/index.php/2020/05/27/stadia-arenas-the-roadmap-back-to-reopening/
3. skidata.com/en/business-areas/stadiums-arenas/
4. digitalmortar.com/sports-analytics-stadium-analytics-sports-crm/
5. deloitte.com/content/dam/Deloitte/us/Documents/consumer-business/us-deloitte-sports-analytics-POV-10302014.pdf
6. stadium.curtin.edu.au/contact/stadium-reopening-information/
7. theo2.co.uk/visit-us/security
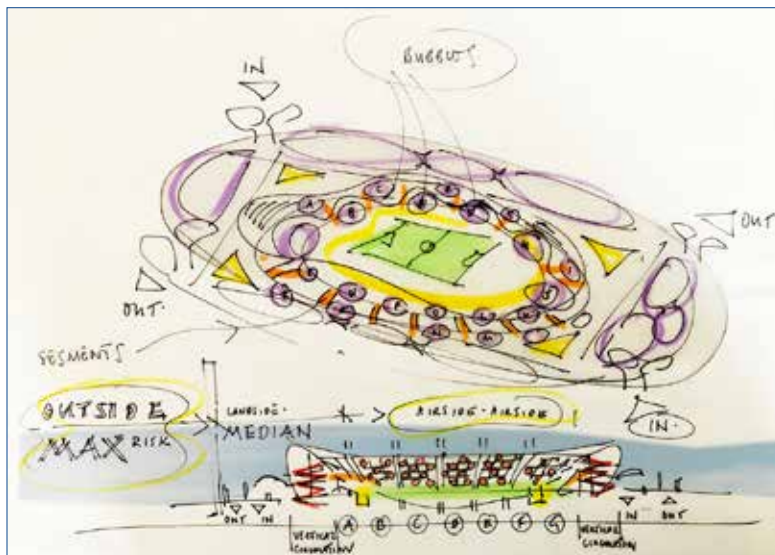Sketches by Alistair Brierley
Other images by Samuel Utting

COVID TRANSFER IN STADIA | MANAGING RISK - A GRAPHIC NARRATIVE

1. Wider context. The city and the destination.

Mitigation of virus spread starts in the wider context and is dependent upon adherence to government advice and legislation.

People will arrive by bus, train, car and on foot and each group should acknowledge and minimise risk. Intersection and convergence represent potential transfer.
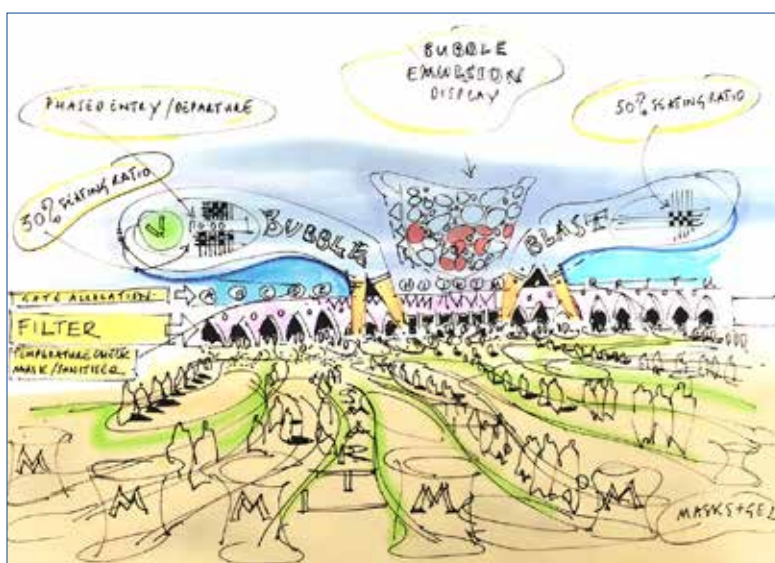

2. Aerial and section. Schematic stadium planning.

Compartmentation is the key to managing spread amongst larger groups.

Circulation spaces between bubbles must be managed in terms of one way systems and proximity.
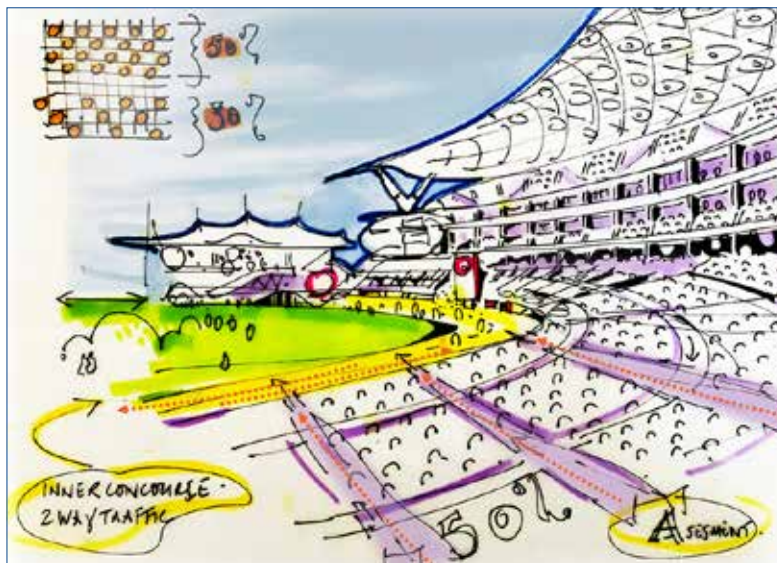
At the moment of entry into a stadium context individuals must accept their responsibilities to a wider group and not attend if feeling unwell.

3. Entrance view. Filters and thresholds.

Attendees at events will be offered masks, sanitiser and a temperature check and will be managed in terms of dedicated queuing choreography.

Gate allocation is predetermined, and entry and exit will be phased. Each threshold represents a check and all transactions will be contactless.

4. Stand perspective. Density variations.

Successful management of crowds will depend on density within the overall stadium and individual stands.

Levels may vary on different tiers with the lowest levels most likely in the upper stands and the highest in the lower levels.
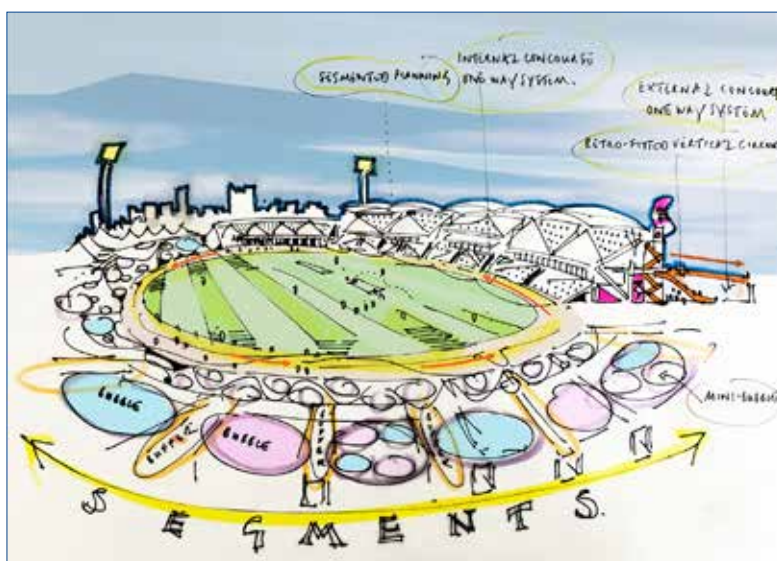
Additional concourse space will need to be released to manage circulation patterns.

5. Schematic section. Aviation parallels.

The aviation sector and terminal planning offer many insights into how we can manage crowds within stadium environments.

Using the Airside -Landside and Arrival-Departures parallels, general circulation ,group sizes and health security checks will mitigate risk and allow the public to feel more secure.

6. Aerial. Segments and compartmentation.

Seating patterns and densities will be optimised for individual stadia.

Compartments will be filled and emptied on a timed basis, and retro fitted vertical circulation ramps and stairs will help to separate incoming and outgoing spectators.

DESIGN PROCESS:
Retrofitting Offices in the Future-
Eden House, London.

How we work and inhabit office spaces following the current pandemic has been intensely debated since the outbreak. Whilst thoughts on what it will mean for the office buildings we inhabit seem to vary, there are some common themes emerging around how office buildings will need to react in the future, says Director Nick Ridout.

In more recent times, the density at which we occupy buildings has increased, with standards moving from 1 person / 12 sq m of space, to 1/10 and now 1/8 as standard. Co-working providers such as WeWork have been occupying at densities as tight as 1/4.5 sq m. This has come with attendant increases in requirement for cooling, alongside a regulatory downward pressure on energy use leading to increased levels of re-use and recirculation of the air within office buildings. We have been working in ever-tighter proximity to one another, and breathing more and more of the same air.

The Covid-19 virus has brought into focus the desire to be more flexible in our work patterns, but also the desire and requirement to be less densely accommodated and to breathe fresher air. Whilst not necessarily at the Government-prescribed 2m apart, we do not want to be in such close contact with one another, in particular for long periods of time in an indoor environment.

The offices we design address flexibility. There has been a big shift in the way that we use offices over that last 5-10 years with a move to more agile working. Retrofit is an increasing trend due to suitability of stock and the understanding of the embodied energy within; so how do the trends of reduced density and inter-human contact, fresher air and increased staff wellness manifest themselves? How do we retrofit offices and make allowances for these? We take the current refurbishment of Eden House in Spitalfields as an example to explore this.

VENTILATION

The current ventilation strategy uses around 90% re-circulated air. Fresh air is drawn in through the Air Handling Units on the roof and expelled into the offices. Air is then extracted through the Fan Coil Us at soffit level, this re-circulates the air and moves it through the space. Options for enhancements include:

Enhanced Filtration
The first option proposed is to provide enhanced filtration, with filters designed to remove airborne bacteria from the air. Ducted outside make-up air will be used for the WCs, shower and changing areas, rather than air from the office area. More cleaning and maintenance is proposed to maximise effectiveness of filtration and ventilation systems. See Figure 01- Enhance Filtration Diagram:

Purging
On top of enhanced filtration, purging could be introduced. This runs the system at high speed for a limited period to replace all of the air within the building with fresh air. Increased system noise when purging could be positive - the occupants are aware when the building air is being 'cleaned' leading to better occupant confidence and comfort. See Figure 02 - Purging:

Full Fresh Air
All of the above solutions use re-circulated air. Ideally, air would be 100% fresh. A calculation showed that in order to use the current system, but eliminating re-circulated air, an additional 13 sq m per floor of ductwork would be needed. The ducts branching across the floorplates would need to be so deep as to mean inadequate headroom for occupation beneath, so this was not considered further.

Full Fresh Air - Displacement 'All Air' system
A displacement 'all air' system provides 100% fresh air. Air is drawn in and expelled at low level at slightly cooler temperature, then extracted above as the air heats up and rises to the high level extract fans, then expelled externally. Additionally, filtration in the AHUs and Down Flow Units assist with improving the quality of the air. This option would require finished floor levels to be raised by around 150mm to provide a 300mm floor zone, disrupting existing level thresholds around the core and stairs. See Figure 03 – Displacement All Air System:

Natural Ventilation
A significantly more intrusive option is to introduce openable windows to allow occupants to let in fresh air. Air would then be drawn out through extract fans and expelled externally, meaning less ductwork that the displacement system. Smart technologies can advise occupants when to open windows based on air quality both internally and externally. Eden House has a fully glazed façade that is south facing, so an option exists to replace the brise-soleil with an offset glazed screen to create a void to create a stack effect. Air heats and rises within, dragging it through openings in the façade, expelling it at high level. Openings on the north side, likely a combination of user and automatically controlled, allow air in to be drawn across the office floorplate. This would require an acceptance from the tenant that temperatures might exceed normal ranges on particularly hot or cold days, and the acceptance of potential noise pollution – as traffic becomes more electric, will this matter? See Figure 04 – Natural ventilation:
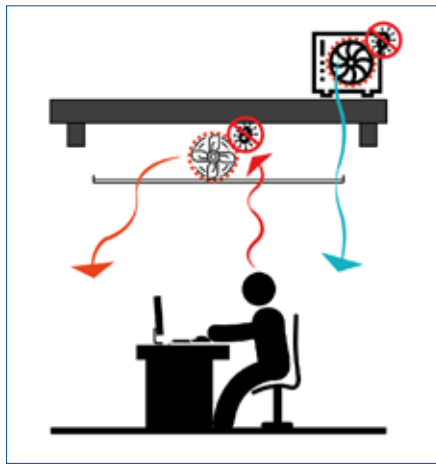
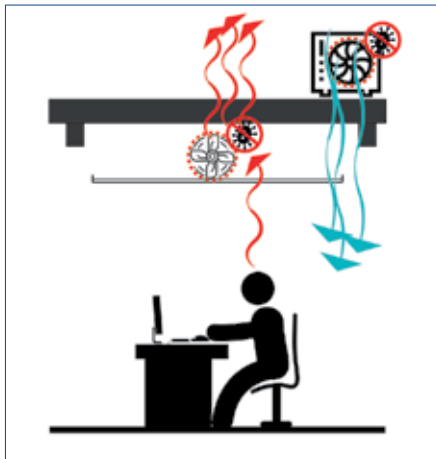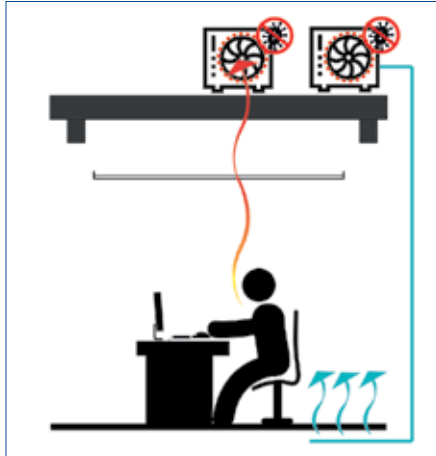**Figure 01- Enhance Filtration Diagram:**
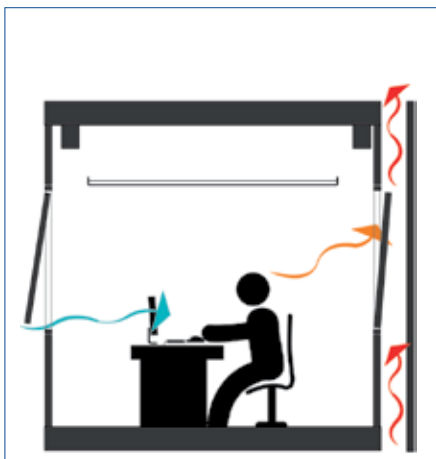

Figure 02 - Purging:

Figure 03 – Displacement All Air System:

See Figure 04 – Natural ventilation:

The office market has been shifting towards more flexible and amenity driven solutions for some time now – the ultimate manifestation of this being co-working

REDUCING CONTACT

In our current climate, close human contact is not desirable. As an existing building, there are limitations on which spaces can be altered. Many of the walls in the cores provide structural cross bracing. There is also the commercial consideration of retaining existing lettable floor area, but it is important to consider how people move around the building to reduce contact. Some of these are via changes to the built fabric, but importantly, some of these measures will rely on a change of behaviour by building users.

Arrival Sequence - Reception Desk
The reception desk is the first point of contact for a visitor, the first point of interaction and welcome into the building. However, this is one of the most highly-trafficked spaces and the receptionist will come into contact with a high volume of people. These options look at solutions for reducing risk of contamination between the receptionist and the visitor. →
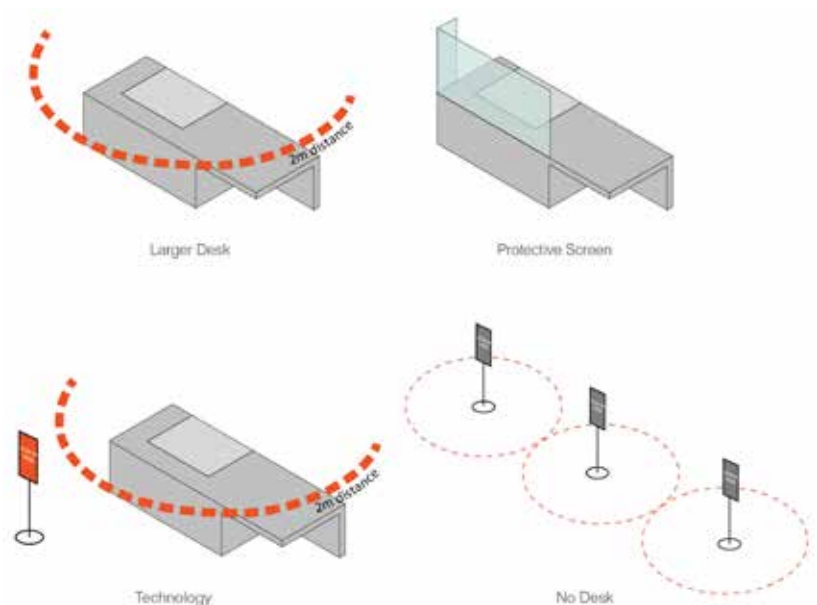

Figure 05 – Options for receptions desk

General Circulation

Doors are required on main circulation routes for security and fire separation. Passing through the doors without touching them can be achieved in a number of ways as illustrated Handles and surfaces that cannot avoid being touched can be treated in a number of ways to reduce the time which bacteria can remain alive on them.
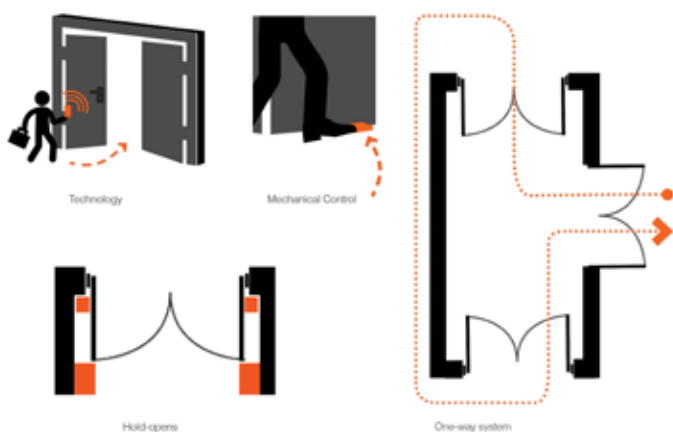

Figure 06 – Door Options

WC's and changing facilities.

As above, options to reduce contact exist for using doors. Other options, such as labyrinth entrances to WC areas are possible, using Superloos (self-contained cubicles with wash hand basins and drying within) and provision of hand sanitizing station on entry and exit can be implemented.
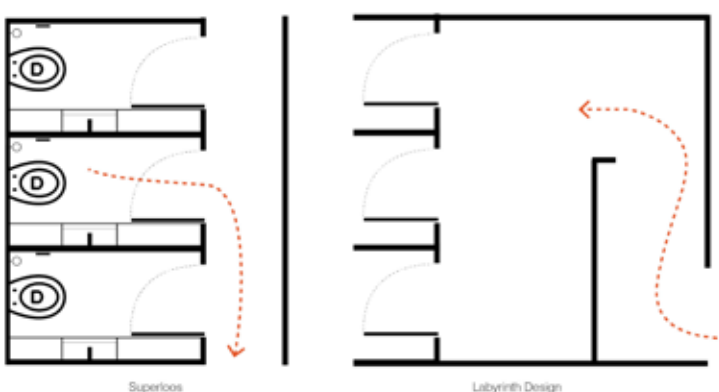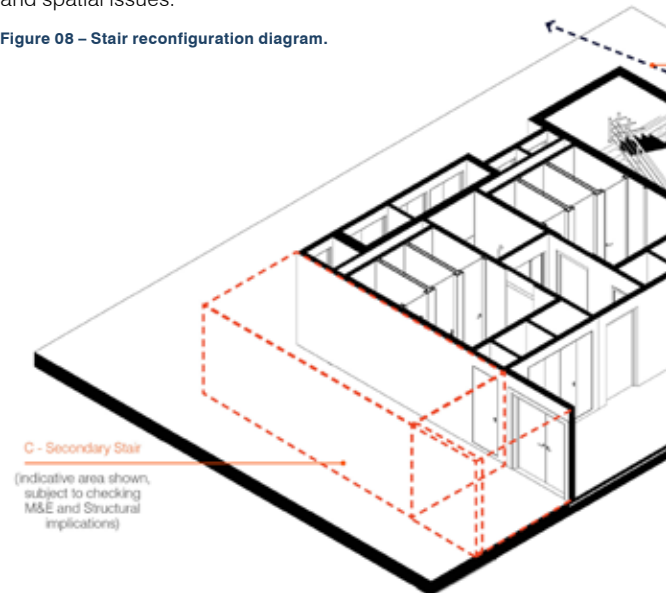

Figure 07 – WC Circulation alternative diagram.

Vertical Circulation - Stairs

There is only a single stair on the main core in Eden House, with a secondary means of escape on the other side of the floorplate – this is often the case in office buildings. In order to reduce contact, an option would be to allocate one stair to go up, and one to go down, or to introduce 'up' and 'down' lanes on the one normally accessible stair. Introducing an additional stair into the central core would have significant structural, cost and spatial issues.

Figure 08 – Stair reconfiguration diagram.

Lifts

Lifts are a space which require close proximity – whilst some people will always need to use these, by making the stairs visible and as nice a space to be, it will encourage people to use these when they can, easing pressure on lifts. The use of these could be limited, which would increase waiting times, also encouraging others to use the stairs.
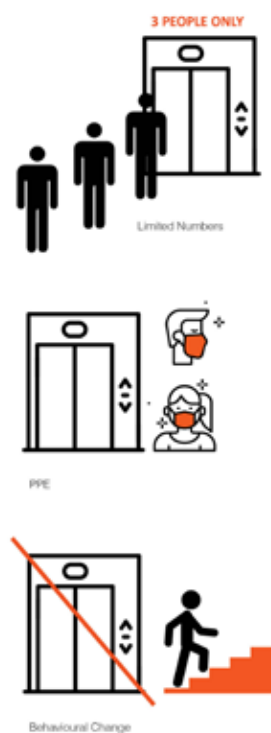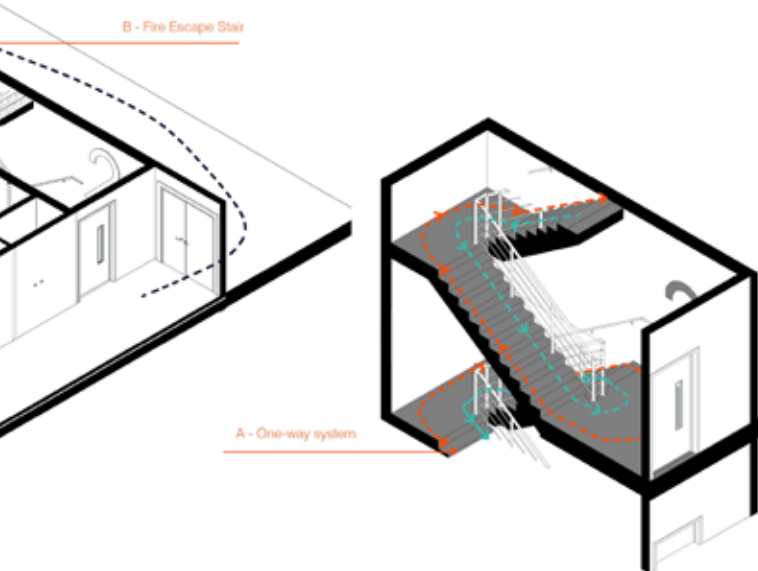

Figure 09 – Lifts options diagram.

B - Fire Escape Stair

A - One-way system

CONCLUSION

Whilst if there is another pandemic, it is likely that people will opt to work from home, rather than travel on crowded transport systems (another topic), there is an increasing awareness of the potential for spread of infection in the office space. When working within existing buildings, there will be, as always, restrictions on adaptation to existing structure to insert different plant systems and alternative routes.

The solutions above rely, to an extent, on a change of expectation and behaviour by tenants of the building, with some level of distancing and also a potential widening of comfort parameters – in reality, only for a few days each year.

There will be the usual pressure on maximising lettable office floor space, however it might be that the quality of this space, or indeed the amenity space, e.g. communal meeting space as above, might be a new way to extract value for the landlord. The office market has been shifting towards more flexible and amenity driven solutions for some time now – the ultimate manifestation of this being co-working. We believe that there is gap between fully flexible co-working and the traditional long term, very inflexible lease – perhaps this might be the catalyst to drive through this change of renting models with smaller tenant office footprints, and a payment towards enhanced amenity ●

Building Visitors

In the past, we have welcomed guests into our office space for meetings and events. The attitude to this might change in the future with a greater awareness of transfer of infection.

We have proposed a communal meeting space, which could be set up to allow for appropriate social distancing, have a more intense cleaning regime, and be closer managed, adjacent to the reception. Whilst this would be landlord space and reduce lettable space, it could be paid for by tenants as a facility they can use, and mean they need less of the same facilities in their own demise.

Figure 10 – Ground floor meeting space diagram.

Communal Social Space - Ground Floor

RESPONSIVE SYSTEMS:
Digital Twins

Big events like world wars or global recessions accelerate learning and cultural change. The pandemic we are currently dealing with is no exception. Changes to how our buildings and infrastructure function have been spectacular in the short term and look set to remain in flux for some time to come. One day, with digital twin technology our buildings will respond and adapt to this uncertainty dynamically and help us plan for change more effectively.

Here Board Director, Richard McCarthy discusses the digital twin and why now could be the tipping point in its evolution.

BELOW
Diagram showing three major advancements in technology that have enabled Digital Twins in Manufacturing. *Source: Dr Michael Grieves article - Perspective, ARUP Digital Twin Report, November 2019*

IS NOW THE RIGHT TIME TO INVEST IN CREATING A DIGITAL TWIN OF YOUR BUILDING?

So what is a digital twin and why could now be a tipping point in its evolution? Well, digital twin technology offers the opportunity to plan and predict how we use our buildings with an intelligent replica. It is a 'live' responsive system connected in real time between the physical and digital systems.

The idea has been around for a long time. In the 1980s titans of industry like, Rolls Royce and Siemens worked with simulations called 'digital shadows'. Even earlier, in the 1960s, NASA used 'pairing technology' to help launch Apollo 13.
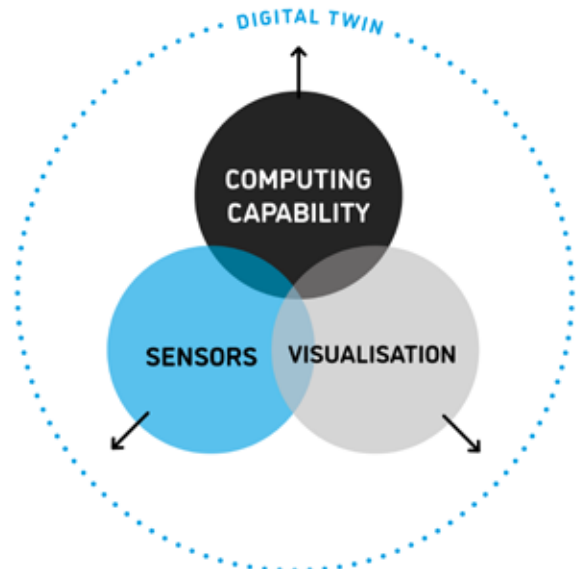
The term digital twin was first coined in 2003 by Dr Michael Grieves as part of his work on whole life costs. He said recently: "*The digital twin, concept from its origin over a decade ago to today, has always relied on progress in two very different areas: technology and culture*".

Great ideas often arrive before we have the know-how to really make them zing. And often before we know why we need

them. As Henry Ford famously said, '*If I'd asked people what they wanted they'd have said "a faster horse"* '.

In the last decade computing power has more than doubled every eighteen months (Moore's Law). All this processing power means the idea that machines can learn and adapt through experience is now a reality. We've reached a point where when you combine machine learning and AI with the Internet of Things (IoT) sensors that gather data in the real world. The digital twin concept is now viable on a scale that starts to makes sense, for the built environment to engage with.
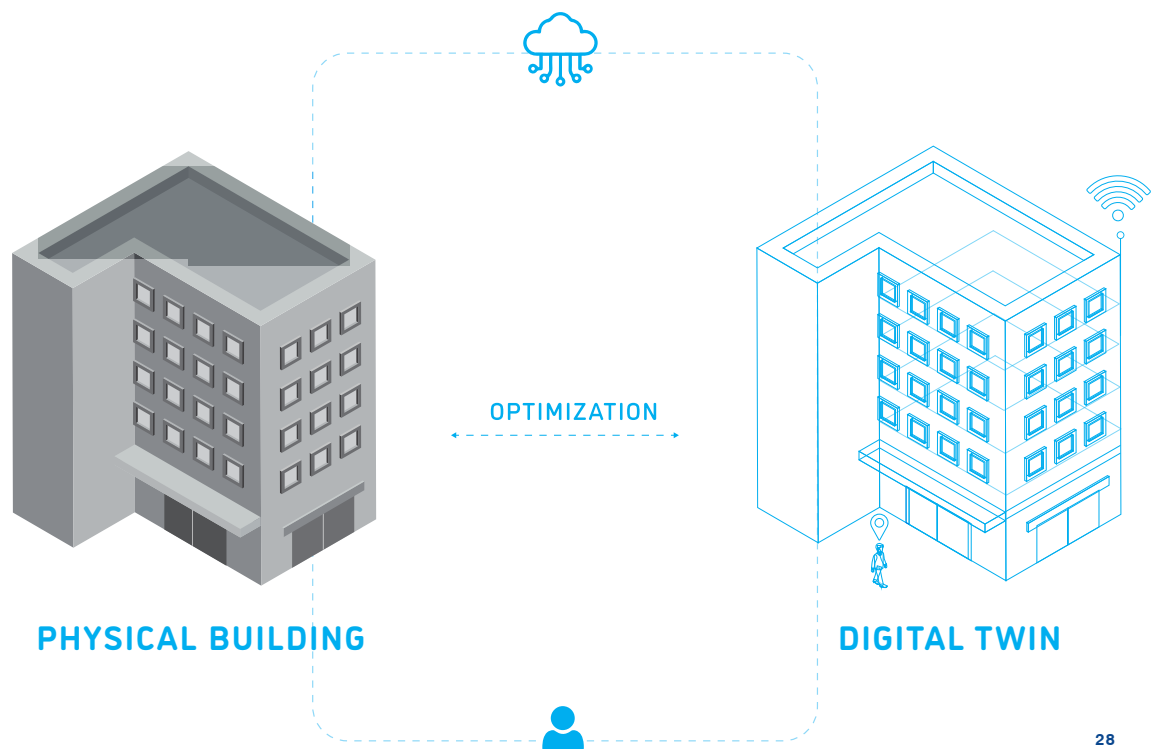
Culturally however these technologies are highly disruptive and people, especially property people are hesitant to adopt new ways. They need to be brought along or shocked in to action. Nothing brings people along faster than a global crisis where the value of being able to plan and test response scenarios in real-time with everything you need at your fingertips becomes readily apparent. Cue Covid-19.
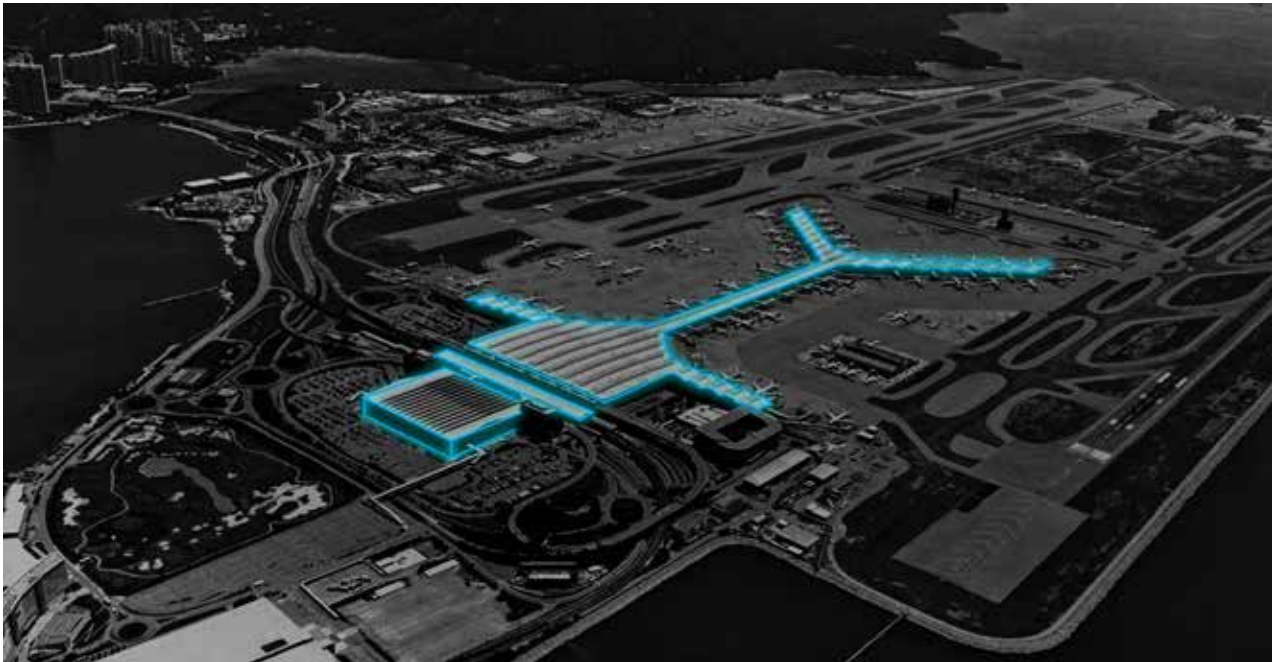
TYPES OF DIGITAL TWIN

Back in 2000 we began talking about smart cities. It started to become a reality when Google Maps was launched in 2005. A form of digital twin we all rely on to navigate and find what we need close by when we need it. In 2010 Google announced its self driving car development. A baton picked up by Uber's self driving car division, the Advanced Technologies Group. Integrating automated vehicles is a key challenge for our cities on their smart journey. Singapore has created a digital twin of the entire city they are using to plan for the arrival of automated vehicles.

BELOW
How it works: A Digital Twin is a virtual 3D model which integrates data from different sources. It is made available real time and can be visualised and analysed through a human-centric interface to make predictions.

PHYSICAL BUILDING

OPTIMIZATION

DIGITAL TWIN

This type of digital twin brings together network of systems at a city scale but the fidelity of the model as with Google Maps is still fairly basic. At a smaller scale components parts such as engines or assets like an airplane, or F1 car are developed and tested using high fidelity digital simulations.

Rolls Royce recently announced plans to expand its digital eco-system beyond design simulations and create digital twins of all its physical products in-field to obtain and exchange real time data and controls with its customers, partners and suppliers. It's not dissimilar to how apps on your mobile devices continually feed data back to Apple or Google and their developer partners to improve the user experience.
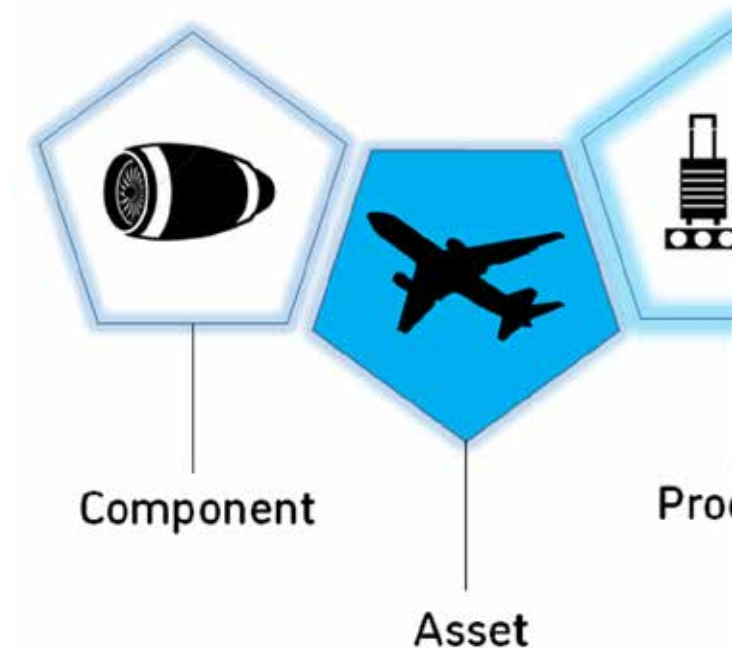
In between the city scale and component scale of digital twin technology, sits our buildings and infrastructure. They require a relatively high level of fidelity but also contain a significant number of decentralised systems. Each generating data streams that have to be mapped to the digital twin and made sense of. This takes a lot of computing power and complex modelling which perhaps explains why digital twins at building scale have lagged behind their industrial counterparts.

BUILDING OWNERS WILL IMPLEMENT DIGITAL TWINS SIMPLY AT FIRST

A digital replica of your building in itself is a useful commodity. It replaces rooms full of dusty old drawings, manuals and specifications. Both digital and paper information with a dimensionally accurate, as-built model of your building covering every nook and cranny. A single source of truth.

This is a great base to plan and react to situations like a pandemic with confidence but a digital twin is so much more than just a replica of your building. A digital twin gives you a comprehensive snapshot of all functioning parts of your built environment in real time. It tells you how they are interacting with the people using your building.

Imagine a child accidentally drops a coin into the mechanism of an escalator. An oscillation sensor linked to the digital twin is listening and detects a slight change in frequency. A maintenance crew is dispatched to retrieve the

Component

Asset

Pro

coin immediately, before it causes more serious damage and puts the escalator out of action for weeks. Oscillation sensors have been used as a preventative measure on oil rigs for years but now they're part of your buildings arsenal of digital tools.

How often this happens, how long it takes for the maintenance crew to reach the escalator and deal with the incident, the impact on movement and waiting times due to an escalator being down temporarily, is all information stored by the digital twin. Overtime the model evolves using this type of behavioural and operation data to learn and provide insight at each stage of the assets life-cycle. This includes dealing with a crisis. Valuable data on how systems interact with people, the weather and other variables will improve the accuracy of predictive modelling.

Although the benefits of a digital twin are easier to see and measure in the controlled environment of product development and industrial processes, building owners are starting to take the leap and invest in digital twins.

It's because of not despite their complexity that building types such as airports and hospitals with big operational expenditure budgets are latching onto the cost saving benefits of developing digital twins to help run their facilities. They will start simply but overtime the digital twin will evolve to collect and visualise the right data, apply the right analytics and rules.

Hong Kong International Airport is a good example. Their vision is to develop itself into a smart airport, using digital twin technology to create an enjoyable and hassle-free experience for passengers. Imagine arriving at the airport, your pre-approved avatar appears in the digital twin and you glide seamlessly to your seat on the plane. Subtly tempted by advertisements of all your favourite products along the way.

In the meantime whilst they develop the technology to realise this vision, Hong Kong believe the digital twin will deliver immediate operational and capex planning benefits.

In a Covid-19 scenario the digital twin of your airport can be used to run simulations testing the impact on queuing times for different screening configurations. Using back data to help inform capacity studies and analyse the impact of social distancing measures have on people flow.
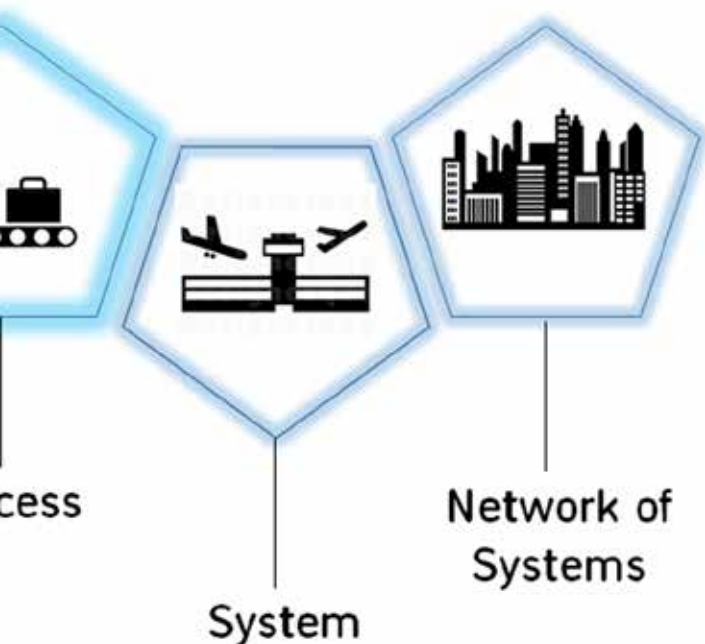
MANAGING OUR RELATIONSHIP WITH BIG DATA

How we visualise data is important. In his 1984 novel Neuromancer, William Gibson invented cyberspace, a virtual reality data-space called the 'matrix'. Giant corporations represented by imposing architectural constructs of data you interact with like a physical building. A 3D model of your building provides a familiar setting to interact with its digital systems in much the same way as the desktop environment on your computer replicates an old fashioned office setting with its filing cabinets and waste paper bin.

People are understandably reticent about how data about them, captured by digital twins in the built environment is used. One of the worlds most ambitious smart city projects planned by SideWalk Labs, in Toronto was canned this year. Although this decision was financially driven. It previously faced pushback from Canadian leaders, concerned about safeguards to protect residents and visitors from the kinds of ubiquitous and intensive sensor-laden infrastructure that was envisaged.

During the Covid-19 pandemic, implementation of big brother style 'track and trace' technology may have blasted away some of these fears. People have been forced to compromise on privacy for the benefit of health and well-being.

Up until now digital twins have largely been the domain of industry and manufacturing, whose facilities and processes have limited interaction with people. The technology is coming of age, but are we ready to start seeing digital twins play a bigger part in controlling the buildings and spaces we actually inhabit? ●

Network of
Systems

System

cess

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PURE RESEARCH:
Global Tourism –
The Environments and Potential

We have worked closely with Professor Terry Stevens for a number of years, looking at various projects across the globe. These have mostly been tourism, or more accurately cultural-tourism led. The Covid-19 pandemic has stopped leisure travel in its tracks, and the prognosis for the tourism and hospitality industries has been well documented and the immediate outlook, grim. With governments opening and closing borders overnight, air bridges collapsing and local lockdowns being imposed as mini-epicentres of infection breakout, how can our environments accommodate such rapid shifts in human requirements and statutory regulation?

This article by Professor Terry Stevens and Scott Brownrigg Board Director, Neil MacOmish looks at the constraints, but more positively, the opportunities that may arise from these difficult times and circumstances.

'Dweller of the Threshold' is the title of a song by Van Morrison. In the foreword to Lit Up Inside (the selected lyrics of Van Morrison) the great Scottish writer, Ian Rankin says,

"In this song Van is talking to all of us, poised throughout our lives between what we have already experienced and what may lie ahead."

ABOVE
'The Gehry Effect' - architecture spurring regeneration in Bilbao, Spain. Photograph by Jorge Fernández Salas.

How prescient for all of us today and a fine call-out as to how architects and designers can help us all in making this transition across the real threshold we currently face. Never before in the history of tourism has there been a more important, moment in time for different disciplines and interests to collaborate to find hybrid solutions, involving hybrid thinkers to drive the recovery of the industry. It is clear, that we are entering a period of unprecedented experimentation where the post Covid-19 challenge will be to find new ideas that balance economics with safety concerns of visitors.

The architecture and design professions have a proven track record of creative and innovative thinking. It is now the time to elevate and celebrate these talents to bring forward a new generation of empathetic, relevant and intelligent solutions to all dimensions of re-thinking tourism. This must go way beyond the simple application of ideas to create buildings and landscapes – however inspiring and full of wonderment. These talents and skills need to permeate a new way of thinking in the tourism industry. The extraordinary tourism visionary, Claus Sendlinger (Founder of the Design Hotel Group and now the curator of Scorpios Mykonos and other playful projects) once said,

"Tourism needs hybrid thinkers and hybrid solutions. The problem is that the tourism industry is insufficiently innovative and creative to meet this challenge."

So, tourism needs a new way of thinking. It might be about radical simplicity. It might be about intuition or based on a philosophical or attitudinal paradigm shift. What is for certain is that old business models and traditional ways of thinking and doing business have become less relevant, even obsolete, in
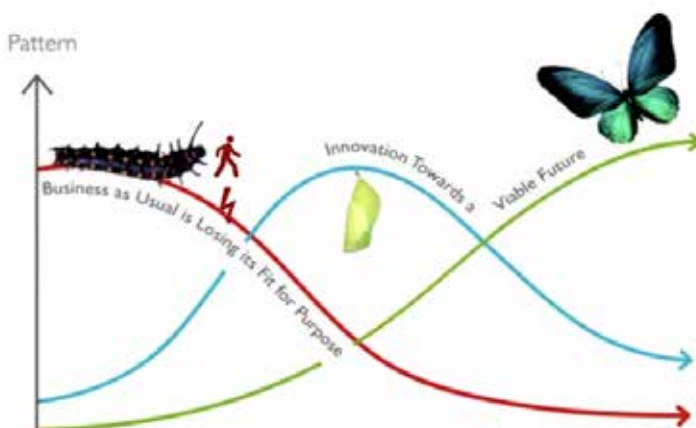
the new world we are entering. Clocks don't go backwards. Can architects and designers step up to the plate?

In the decade pre-Covid it was increasingly clear that tourism leaders were beginning to recognise the importance of quality as an essential component in all aspects of tourism service and experience delivery at the destination level. This was reflected in the growth of interest in applying high quality design to physical spaces and in the architecture of hotels and visitor centres. Some observers were of the view that it was getting difficult to discuss tourism without discussing architecture. It was becoming a commodity for tourists' consumption, it was a destination's cultural capital and enhanced sense of place.

Across the exemplar destinations there was an obvious trend towards the encouragement of investment and the patronage of star-architects producing exciting, innovative, architecture and quality visual interventions as a means of enhancing the overall visitor experience. The obvious indicator of this was the 'Gehry effect' as evidenced in the Basque Country. Bilbao has embraced leading architects in one form or another to acclaimed success since the city first invited Gehry to design the city's Guggenheim in 1993. San Sebastian, the Basque Country's centre for gastronomy and film has followed suit. South of Bilbao, in Elciego, the Marqués de Riscal Winery has created the City of Wine by Gehry with the chairman of the company stating that the €66m investment far exceeded their →

ABOVE
The metamorphosis of tourism

Wellness Tourism $639b

ABOVE
Tourism plays a huge role in 'The Global Wellness Economy' | Source: The Global Wellness Institute

32

expectations taking 'no place' to a world class, competitive destination. In 'Architecture Attracts Visitors' by Pla'tou (the Platform for Architecture in Tourism established in Austria in 2007) to promote: *"The topics of architecture, culture of construction and design are capturing the attention of the public"* asserts that:*"the innovative potential which lies within contemporary architecture is still hardly used in the tourism industry"*, their research showed that success and enhanced profitability were directly correlated to the use of contemporary architecture. Copenhagen, Aarhus, Oslo, Liverpool, Zurich, Bilbao, Barcelona, Montpellier, Abu Dhabi, Dubai, Chicago, Denver, Singapore, Melbourne are taking full advantage of these opportunities.

In rural destinations there are two outstanding examples of destinations where contemporary architecture is now driving tourism. In Bregenzerwald (Austria) a rural area with a once flagging agricultural economy has developed a global reputation as a world class destination by using the power of architecture. In the second example, is the story of Norway's tourist routes (Gustavsen, 2016), which started in 1994 as a trial project to offer motorists an alternative to main roads that gave them access to stunning architecture along their routes. There are now 18 National Tourism Routes (NTR) in Norway, all of which will be completed by 2025. Running along the coast and fjords, through countryside and mountains the routes offer world-class scenery and architectural installations.

For me the new challenge is for architects to be in the vanguard of driving cross-fertilisation of ideas between sector. For example, how can hospitals and the health services learn from how hotels and restaurants are organised and designed and, equally, how can the hospitality sector learn from the hospitals and health sector? After all, hospital and hospitality are derived from the Latin hospes, meaning "host", "guest", or "stranger". By metonymy the Latin word 'Hospital' means a guest-chamber, guest's lodging, an inn. Hospes/hostis is thus the root for the English words host, hospitality, hospice, hostel and hotel.

There have been huge environmental benefits that have been documented as a collateral consequence of the pandemic. Is there a way in which we can keep the climate benefits at the same time as opening up the world for global leisure travel again and re-invigorate local communities and economies?

Whilst other parts of this addition of iA deal with the pragmatics of safe travel, here we try and focus on the actual places (and genius loci) of the destination. One idea we have promoted is that of the 'dispersed hotel'. This is not a silver bullet solution to all typologies and whilst the examples offered here are situated in a rural, pastoral or landscaped environment, there may still be pointers to appropriate considerations to urban, more dense locations.

BELOW
Concept sketch: Architecture in the tree canopy

ABOVE
Concept to reality: Karearea Hotel, Rotorua - by Scott Brownrigg

LEFT TOP
Ihenga Hotel, Rotorua - by Scott Brownrigg

LEFT BOTTOM
Ihenga Hotel Plan

In our project in Rotorua, New Zealand as well as two secret locations in Ireland and Scotland, there are central service buildings with bedrooms conceived as individual units or pods. Even where these rooms are closely joined, circulation is single-sided to promote air flow not only to the movement spaces, but also to the bedroom themselves. As we know, the combination of UV light and natural (passive) ventilation are key contributors to the reduction of spread of infection, but equally critical to the environmental and well-being criteria to any project. Each room has access to a balcony or terrace, or the room itself becomes an inside/outside space from the modernist tradition. These techniques can be equally valid and relevant to dense urban situations if applied in a considered way.

The dispersed hotel has added community benefits. It affords the opportunity to allow guests to migrate beyond its own boundaries – creating the chance to immerse in the local community and culture – rather than the depressing 'all-inclusive' offering where one never ventures outside and the experience is limited to only what the facility wants you to have and all that endless queuing to enjoy bland, universal, tepid buffets. They are also about promoting community or local circular economies, with all of the environmental, social and economic benefits that this entails.

All of the above indicates that there will be, through the demands of the next and future generations, different and perhaps more authentic experiences for travellers to have in their search for new places, spaces and environments to be enjoyed in a new, sustainable way ●

FOOTNOTE

Terry has three books being published this month that develops some of these ideas and allows the reader to explore different aspects of the future of tourism. Two of them focus on the art and science of destination management and place-making the other is for armchair travel and dreaming about destinations that you will soon be able to visit as global travel recovers.

The books are:

1.   Wish You Were Here - The stories behind 50 of the world's great destinations, published by GRAFFEG.

2.   Wish You Were Here – The art and the science of destination management (ebook only available via Apple and Amazon) published by GRAFFEG. Both can be ordered via www.tourism-futures.com

3.   Tourism Facing a Pandemic: From Crisis to Recovery published by the University of Bergamo and available direct from Terry Stevens (terry@stevensassoc.co.uk)