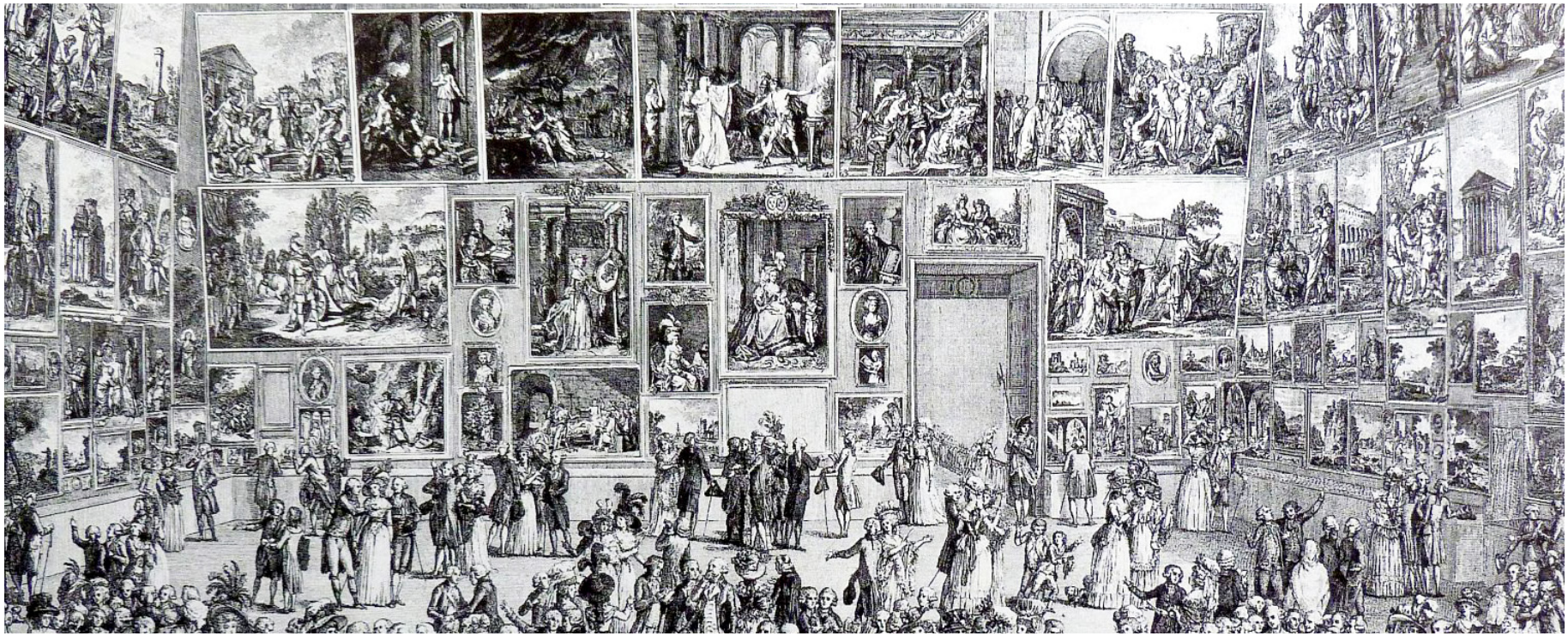
Northumbria University Architecture Portfolios

NBS FUTURE BUILDINGS
EXHIBITIONS IN THE DIGITAL AGE

Ben Couture

Northumbria University NEWCASTLE



Front cover

Fig. 01 _ NBS Future Buildings exhibition, Couture. B.

Above

Fig. 02 _ Illustration of Exposition au Salon du Louvre, 1787

1.Project Details

Principal Researcher	**Ben Couture**
Title	**NBS Future Buildings**
Output type	**Built Artefact / Realised Design**
Venue	**NBS, Old Post Office , Newcastle Upon Tyne**
Exhibition Designer	**Jardine Couture**
Function	**Exhibition**
Location	**Newcastle Upon Tyne**
Client	**NBS (RIBA Enterprises)**
Practical completion	**June 2018**
Funding source	**Newcastle Gateshead Initiative (NGI)**
Budget	**£40k**
Area	**56m2**
Collaborators	**Coffee Design / NBS**
Co-exhibitors	**Autodesk + 10 local practices**
Support/acknowledgements	**NBS, Gateshead College, Northumbria University**
URL	**www.northumbriaarchitecture.com/research**

Fig. 03 _ Augmented Reality showing 3D model of an example project at Future Buildings exhibition

1. Summary

"We are concerned with the ways in which design is conceptualised and seek to expand limiting notions of design as a technical process of display or building, to a far more expansive notion of design as a significant strategic resource to be harnessed by museums in their drive to shape truly visitor-centred experiences and institutions which have the potential to positively impact the larger society." *(Suzanne MacLeod. The Future of Museum and Gallery Design, Purpose, Process, Perception, 2018)*

The Future Buildings exhibition (commissioned by global leading technology platform NBS) is unique as an exhibition that explores, demonstrates and engages around the subject of digital technology for the architecture and construction industry.

The project served as a test-bed for advancing traditional design and build processes for exhibition making, and was informed by research into both historical notions of exhibitions as accepted social events and current theory and practice in exhibition design and delivery (using a combination of book-based research, attendance at industry seminars and first-hand observation at exhibitions worldwide).

The design team developed and applied innovative approaches throughout the project lifecycle. Novel codesign processes enabled by social media platforms and digital resources for collaboration created new working dynamics that gave equal footing to multiple viewpoints among stakeholders, students and cross-discipline designers. Multiple methodologies were used at the design stage to investigate and shape outcomes. Use of Computer Numerical Control, 3D models and modular build techniques enabled fabrication in sections offsite for faster, smoother assembly. Original user interface and interaction methods combining digital touch-points (augmented reality, interactive touchscreens & 'CAD for children') with sensory stations (video, 3D-printed models, 2D magnetic building games) created an immersive exhibition experience that could engage a broad and international cross section of visitors, from technologically literate industry professionals to children as young as seven.

Future Buildings achieved its purpose as an invaluable platform for demonstration and discussion between NBS and wider industry (in person and through social media outreach) to advance the state of the art across the sector. It directly influenced the design process, working methods and delivery approach of all actors involved in its creation, and allowed the 10 local practices who exhibited to effectively showcase their strengths. More broadly it stimulated broader understanding among 5000 international visitors; and fostered potential for future sector leaders among over 160 school groups.

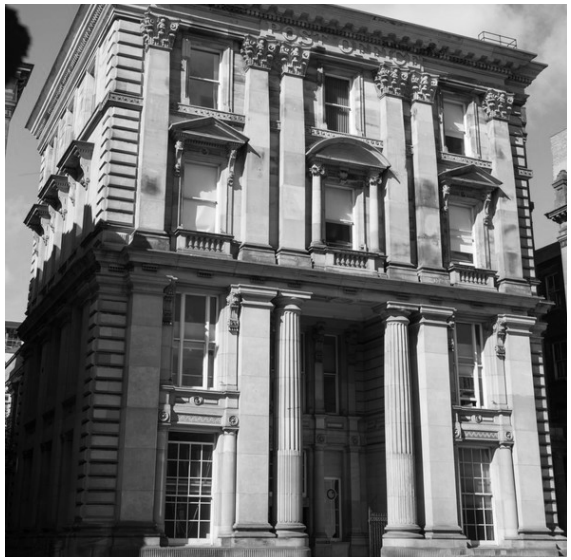


Fig. 04 _ NBS headquarters, Old Post Office Building, Newcastle Upon Tyne

2. Statements

Significance

Fig. 05 _ NBS Annual BIM Report 2020

The intersecting industries of architecture, engineering and construction are undergoing significant transformations, influenced by the biggest global challenges of our time. Digital technology and products such as BIM offer a large part of the solution to address issues such as sustainability, quality and efficiency in production of the built environment. NBS are a global leader in this area.

Future Buildings exhibition brought this subject into mainstream view, to the global audience who experienced the event, and over 160 school groups who were able to be inspired and educated around digital innovations and the potential of STEM subjects.

The exhibition provided an invaluable platform for demonstration and discussion between NBS, wider industry and exhibition visitors - ultimately leading to greater understanding of the subjects and fostering potential for future leaders in this important area.

The widely-visited built exhibition provides a benchmark that demonstrates how specialist businesses can engage with both public (new audiences) and industry, in a 3D spatial environment - enabled and accentuated by digital experiences and interfaces.

Additionally, in the field of Museum and Exhibition Design, the realised artefact highlights the relevance, value and efficiency of using 3D CAD/CNC methods of production for creating high-quality spatial environments, over more widely-practiced traditional methods of space-making.

The original research and new insights had a direct influence on the design methods, working practices and delivery approach apdoped by the multi-disciplined design team for the project.

Future Buildings exhibition received over 5000 visitors (adults and children) over 80 days, whilst also raising funds for Maggie's Centre, Newcastle. The exhibition was a key part of The Great Exhibition of the North, resulting in economic impact of £126m generated for the region, with over 10k contributors working on the core programme of events.

Through exploration and development of narrative approaches, and subsequent creation of conceptual proposals, the project was match-funded as part of UK Govt. Northern Powerhouse fund, delivered through the Newcastle Gateshead initiative.

Statements

Rigour

A wave of innovative exhibition design has graced our museums in recent years. What are the keys to holding the viewer's gaze?

Fig. 06 _The Art Newspaper
'How museums are stepping up exhibition design'

This research, and the resulting built exhibition sits at an important intersection, drawing on the wide body of research surrounding the key themes:

Exhibition Design in the Digital Age

Digitally-Enabled Co-Design

Use of 3D CAD and CNC (off-site) in Exhibition Making

In the context of the Future Buildings exhibition, owing to the nature of NBS and their relevance to broader themes, this research provides an important contribution to the wider subject of *BIM and Digital Methods in Architecture* and how these specialist subject strands are disseminated and engaged with.

Evaluation and analysis of both historical context and cutting-edge precedents underpins this research. This foundation facilitated exploration of the possibilities of digital technology, whilst maintaining a coherent and principled approach to the exhibition narrative and design

A thorough investigation into this specialist area began with research around the earliest notions of exhibitions as accepted social events, dating back to 1667. Further research took place into contemporary precedent projects - focussing on modern-day exhibitions engaging directly with new technology and digital innovations.

Online articles, books and journals provided up-to-date insights and reflections. In addition to this, greater analysis of the exhibition design process was undertaken through review of books and development of new design methods (tested during the project).

During the research period, it was possible to make visits to a number of exhibitions internationally, leading to new first-hand observations into the effectiveness of technological devices, in particular around *User Interface* and *Interaction*.

Additionally, the research builds upon previous experience of using 3D design and CNC fabrication methods, using the project as a test-bed for advancing traditional design and build processes for exhibition making.

A number of seminars, including *'Exhibitionists: Designing Great Exhibitions'* at V&A Sackler Centre, April 2018, provided in-depth knowledge of design processes and new methods of engagement by world-leading museums such as V&A, and international design agencies such as Pentagram Design.

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Statements

Originality

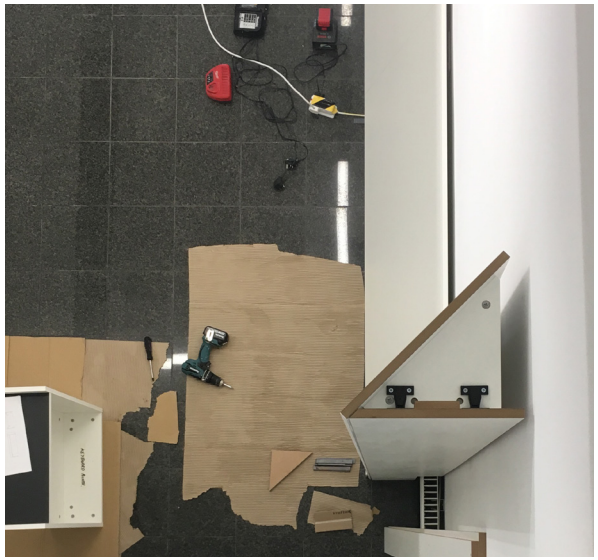

Fig. 07 _ Site photography, knock-down assembly of CNC production parts

Future Buildings is unique, as an exhibition that explores, demonstrates and engages around the subject of digital technology for the architecture and construction industry - whilst using innovative digital methods as the platform for *User Interface* and *Interaction* within the physical environment.

The research brings forward questions around, and pushed new processes of, exhibition design - by using multiple methodologies to investigate and shape outcomes. The research has informed design practices within the context of a realised public exhibition.

The project afforded the unique opportunity to develop methods of co-design - involving stakeholders, students and cross-discipline designers - enabled by social media platforms and digital resources for collaboration. New working dynamics gave equal footing to multiple viewpoints, integral to the overall impact of the exhibition.

A multi-layered, universally-accessible approach to user experience was possible, through considering the wide range of technology available, and aligning the potential with the key narrative strands along the user journey. By questioning the relevance and impact of each digital intervention, the design approach was able to identify the importance of analogue/hands-on interactions as part of the story.

As a result, it was possible to create an immersive exhibition experience that could engage visitors regardless of age, ability or industry-specific knowledge, interweaving digital touch-points, (AR, interactive touchscreens & 'CAD for children') with sensory stations, such as moving image (video), 3D-printed models and 2D magnetic building games. ◘

3. Research Context

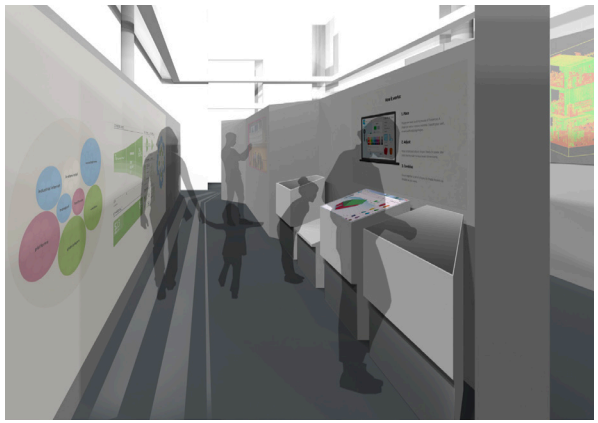

Fig 08 _ Illustration of Exposition au Salon du Louvre, 1787

Fig. 09 _ 3D computer visualisation of early concept proposal for Future Buildings exhibition

"Museums and exhibitions belong to the sensory agencies of modernism. They are places involved in the representation and construction of cultures." *(Korff, Gottfried: Museumsdinge. Deponieren – exponieren. Wien _ Vienna: Bohlau, 2002.)*

The 1667 Paris Salon of the Academie des Beaux-Arts, Louvre Palace, was the first widely-accepted example of a public exhibition. What became a world-famous annual event after 1737, the 'Salon' was, in basic terms, a display of works by more than one artist, assembled in a wall-hung format within a large room – to attract visitors and collectors. The event itself was a new notion, with a simple spatial premise that was without need for consideration towards many of the complex challenges faced by modern-day exhibition-makers.

Today, as a formally-taught and globally-practiced discipline, the more rigorous examples of exhibition design engage with a plethora of methodologies and techniques, including narrative development, interpretation, public consultation, storyboarding, spatial design, graphic design, digital & UX design, lighting design, as well as conservation.

The rise of digital technologies has opened up new opportunities and prompted new areas of discussion around the purpose and relevance of technology in physical exhibitions. Museums, which once had a very clear role in society – to preserve and present culture – are undergoing seismic changes to affirm their purpose and relevance to the digital age.

This research focusses in on a specific strand of this change, not confined to Museum buildings, but looks at the exhibition experience wherever it may occur and the design processes leading to new exhibitions. Research is centred on insights from Future Buildings exhibition, 2018, which, owing to the nature of the project, made wide use of digital technology both as the main subject matter and also as a means of display/interaction.

As familiarity and availability of digital technology spreads across all areas of life and industry, it is inevitable that new questions will be raised as it intersects with design, construction and user interface (UX). There is much being written about the relevance of Museums, their place in modern society and how they will evolve to meet demands of future (tech-savvy) audiences.

Multiple factors feed into the area of discussion, such as altering expectations and attention-spans of visitors, and the shift towards a new exhibition design approach, where digital or media interventions/ integration becomes an inevitable inclusion amongst physical objects and textual information.

As such, stakeholder and design teams are becoming increasingly multi-faceted, being made up of diverse contributors and multi-disciplinary professionals.

A range of technological tools can now also be employed to facilitate and empower the co-design process – both in terms of digital space for teams to share and collaborate, and with cutting-edge visualisation methods such as Augmented Reality.

Relevant to the increasing use of digital design and fabrication, this research also tests and reports on the success of using such methods for the process of exhibition-making. This approach is not widely used for the design and build of exhibitions; however, the outcomes demonstrate the validity and benefits of new methods over traditional techniques. ◘

4. Research Questions

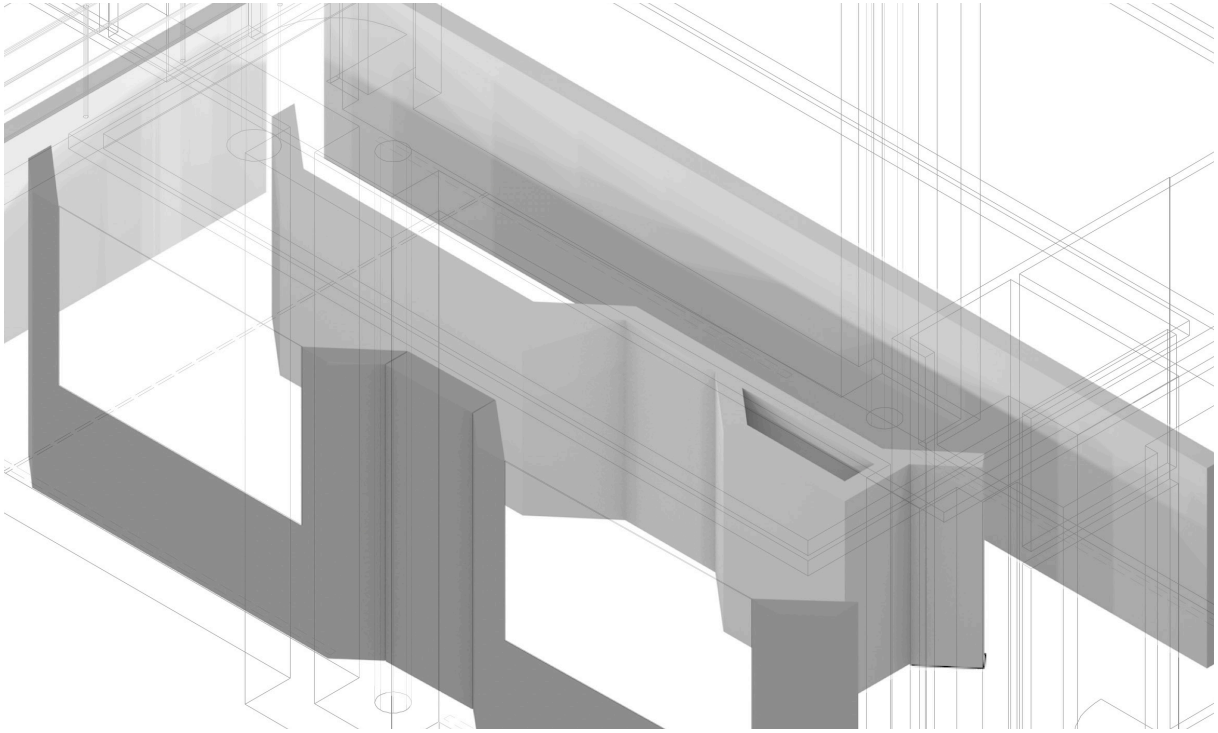

Fig. 10 _ Wireframe spatial concept model for Future Buildings exhibition

1.
What is the nature of exhibition design in the digital age?

2.
How to engage a broad range of stakeholders in the exhibition design process to maximise its impact?

3.
How to make effective use of use digital design and off-site fabrication in delivery of spatial exhibition environments?

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5. Research Methods

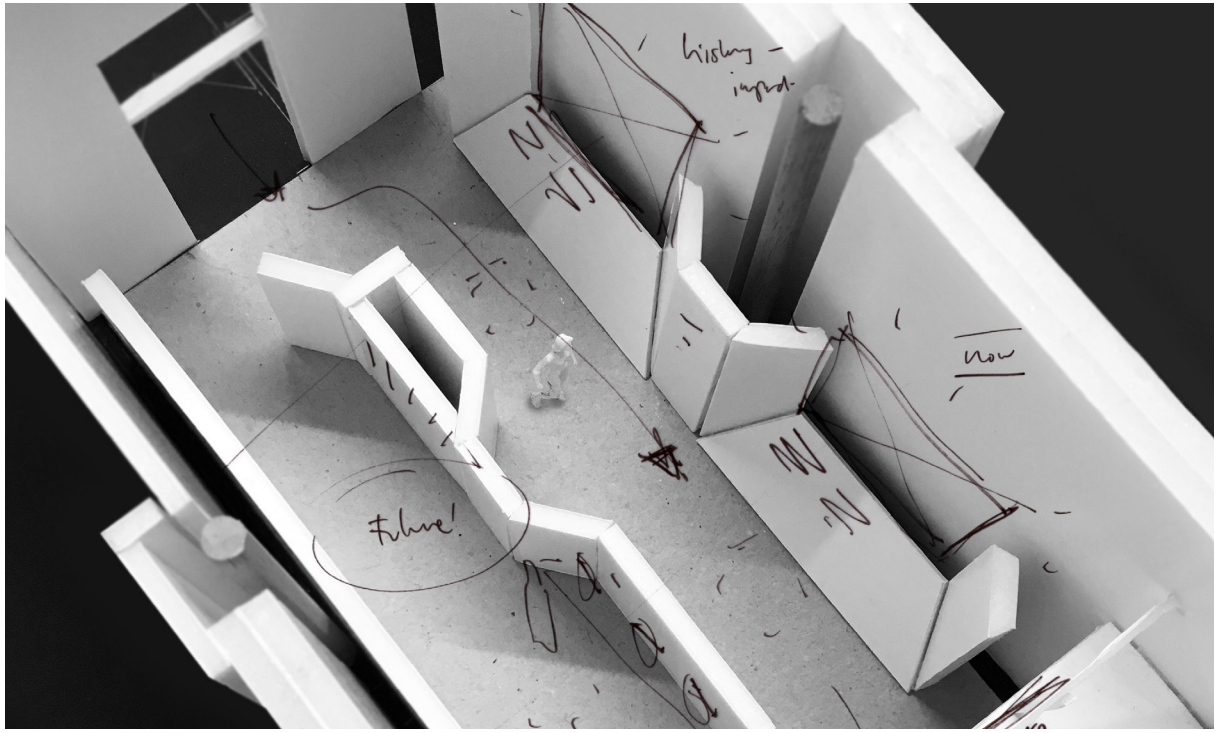


Fig. 11 _ Spatial concept model for Future Buildings exhibition, sketched over during design discussions

Taxonomy

Conceptual design iterations
Drawing
Model-making
Construction methods
Spatial analysis
Participatory activities
Text-based research
Phenomenology
Theoretical research
Fieldwork
Photography
Topographic survey
Design research
Trial and error experimental design processes
Design-led research
Historical research
Typology research
User experience
Diagramming
Interviews/user consultation
Scale modelling
Digital fabrication methods
Site analysis/study
Visiting similar building types

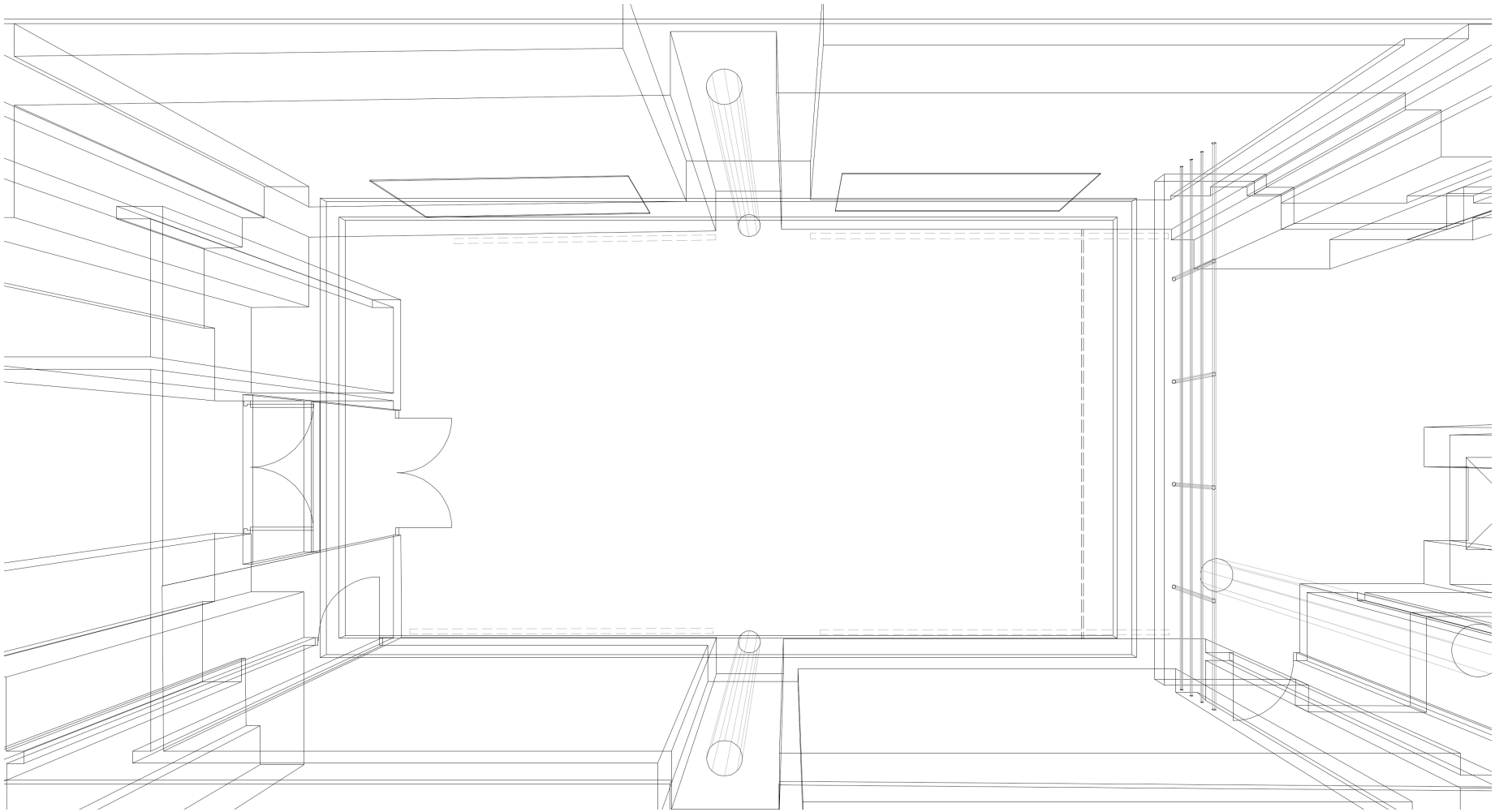
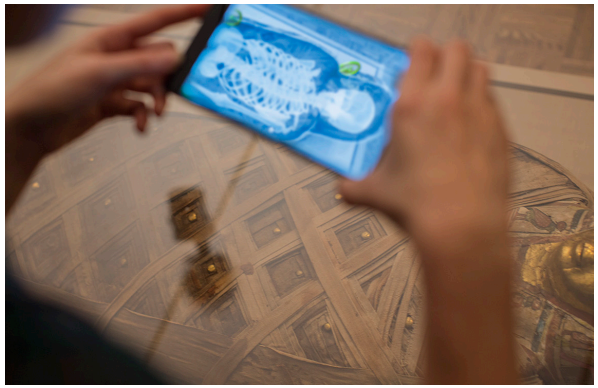


Fig. 12 _ Perspective plan view of gallery envelope, 3D wireframe model

Methodology Q1



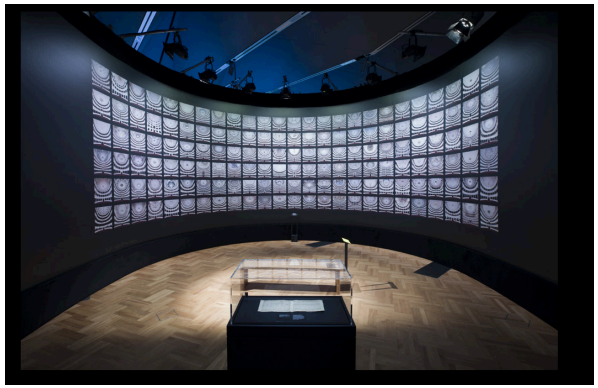


Fig 13 _ Detroit Institute of Arts – Lumin AR Tour, 2017, Augmented Reality in use

Fig. 14 _ 'Opera - Passion, Power, Politics' exhibition at V&A, London, 2018

Q1: What is the nature of exhibition design in the digital age?

Methods: Research into design, precedent analysis, historical research, exhibition visits, evaluation of writings with similar themes (text-based research)

"The outside world must not come in, so windows are usually sealed off. Walls are painted white. The ceiling becomes the source of light. Works of art are mounted, hung, scattered for study. Their ungrubby surfaces are untouched by time and its vicissitudes. Art exists in a kind of eternity of display [...]. This eternity gives the gallery a limbolike status; one has to have died already to be there." *(Inside the White Cube, Brian O'Doherty, 1976)*

Using a range of methodologies, the question of exhibition design in the digital age has been explored in this research, bringing to light observations on the impact and relevance of technology in this context. Using historical research and analysis of precedent projects, it has been possible to build a clearer picture of this important subject area, and develop new insights that directly impacted the exhibition design process (and subsequent impact of Future Buildings exhibition).

To facilitate research, numerous exhibitions were visited first hand, including those at Design Museum, London and Denmark, Wellcome Collection, London and V&A, London. Smaller exhibitions were also experienced, in lesser well-known institutions to gain a broader perspective.

First hand *research into design* lead to attending a number of conferences organised by Museums Association, including 'Exhibitionists: Designing Great Exhibitions' at V&A Sackler Centre, April 2018.

In doing so, understanding was gained towards the V&A exhibition design process, including the inclusion of '4D experience' as part of the planning process, which integrated digital user experience into narrative planning. Project inception follows a clear 4-step methodology, with *Interactives* cited as a major element:

Editing - Planning - Interactives - Research & Evaluation

Text-based research including journal entries and online articles provided a greater foundation for understanding the level of both opportunity and complexity that exhibition designers face, with the ever-growing list of specialist areas with are today intertwining with exhibition design, such as Interaction Design, User Interface (UI), User Experience (UX), Sound Design, Virtual Reality (VR), Augmented Reality (AR) and Artificial Intelligence (AI).

As examples become more widespread, there will typically be cases where digital technology is introduced as 'must have' or without wider consideration of relevance, purpose or impact. However, research has highlighted many examples where technology has enriched and enhanced project, particularly when technology is woven into the overall narrative, or used to facilitate an idea – rather than be the idea.

Successful examples such as the Detroit Institute of Arts – Lumin AR Tour, 2017 use Augmented Reality on handheld devices to give visitors a richer experience of sculptures and artefacts, including the ability to 'x-ray' an ancient mummy to reveal bone structure and objects inside the tomb. Such applications give greater potential not only for engagement, but also learning and exposure. The tour connects seven areas of the gallery, allowing user to navigate using the same handheld device.

Fig. 15 _ 'Internet of Things' interactive touch screen at Future Buildings exhibition

One key element in the Future Buildings exhibition focusses on the Internet of Things (IoT) – interconnected 'Smart' devices that have recently begun to infiltrate homes (by way of Alexa and Hive, for example).

The scope is seemingly far-reaching for the potential application of such user-friendly tech in the exhibition design arena, as an increasingly common element (in one guise or another) to exhibitions irrespective of theme, scale or budget.

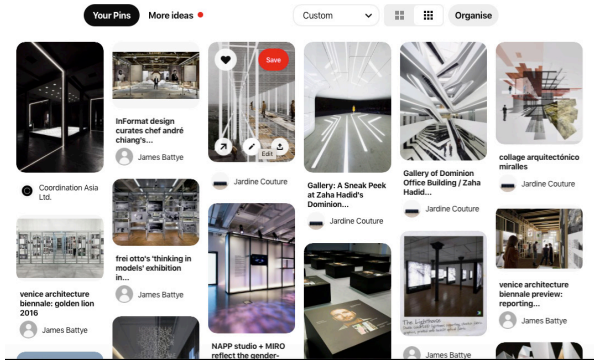
As outlined by official reports, the cultural sector is undergoing major changes due to shifting modes of audience engagement - being driven by digital technology. Younger generations, in particular, are witnessing this transformation, with higher levels of expectation for digital content and technological experiences.

"Audiences are no longer simply passive receivers of cultural content. They are selecting on-demand content, controlling interactive experiences, instantly sharing and distributing content and co-creating artwork itself." *(Culture is Digital Report, Dept for Digital Culture, Media & Sport, 2018*

Despite this increased demand, and subsequent digital influx, research suggests that the most effective uses of technology stem from a system of considering ideas first, centred on human user experience, and developing the technology to facilitate the idea.

To this end, despite the increasing availability and potential of technological advances, the fundamental process of designing an exhibition around user experience remains essential. There are, however, emerging methods of design practice that can use technology to facilitate a co-design process, and furthermore lead to more effective, inclusive and sustainable models of producing the built spatial environment of an exhibition, as this research demonstrates. ◘

Methodology Q2



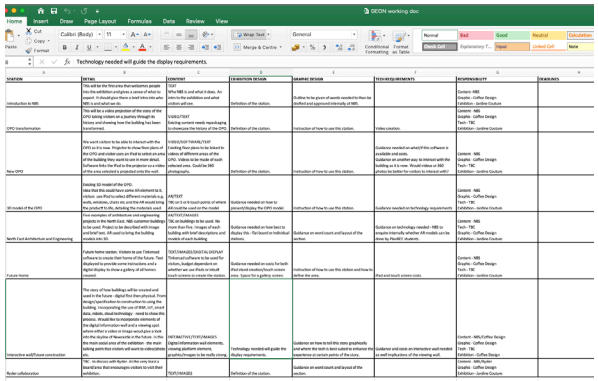


Fig 16 _ Pinterest 'ideas board' for shared precedent projects and images

Fig. 17 _ Google Docs in use for remote design team and stakeholder collaboration

Q2: How to engage a broad range of stakeholders in the exhibition design process to maximise its impact?

Methods: Research through design, use of cutting-edge technology (Augmented Reality), co-design, participatory methods, brief definition, scoping, making, modelling, 3D CAD, establishing programme

Critical to the success and resulting impact of the Future Buildings exhibition, co-design as a collaborative approach extended beyond the traditional client-designer relationship, reaching out to school and FE groups from the local community, as well as a joined-up approach from design disciplines (exhibition/spatial + graphic + UX)

In directing the early-stage design discussions for the project, precedent projects provided key reference and the basis for dialogue. Collated specifically to demonstrate an expansion of a specific theme or conceptual approach, these tools afforded opportunity to share benchmarked work by others, aiding essential debate around key topics, in turn leading to formulation of a shared ambition and vision for the project.

Online resources such as Pinterest and social media applications such as Instagram give team members and collaborators highly-accessible platforms to search, discover, save and share inspirational and relevant project images. These resources were widely used and gave greater fluidity to the co-design process for the Future Buildings exhibition.

Through early production of a 3D computer model of the gallery space, it was possible to test a range of spatial possibilities and provide walk-through models for discussion and review. Models of the concept design were developed digitally, allowing stakeholders to immerse themselves into the spatial exhibition environment and provide crucial feedback which could further define ideas.

Furthermore, the research undertaken highlights the importance of online project management tools. In particular for projects where stakeholder and co-design teams are not located together, giving greater access to communication and shared resources. Once a programme for the project was established Google Docs provided the platform to keep remote team members engaged and up-to-date, and align tasks with relevant resources.

NBS as Key Stakeholders (and client) brought a range of specialisms to the team - from marketing and digital knowledge, to customer engagement and in-house technical expertise.

Lead researcher, Ben Couture, acted as overall exhibition designer and producer, as part of Jardine Couture, with a remit of concept design and research, narrative development, detail & spatial design and build/delivery. Working alongside Coffee Design (copywriting, graphic and digital design) all areas were collaboratively discussed and shaped by the co-design team.

Additionally, NBS brought in vital industry partnerships who contributed to the exhibition content, including AutoDesk and 10 prominent North East architecture and engineering practices.

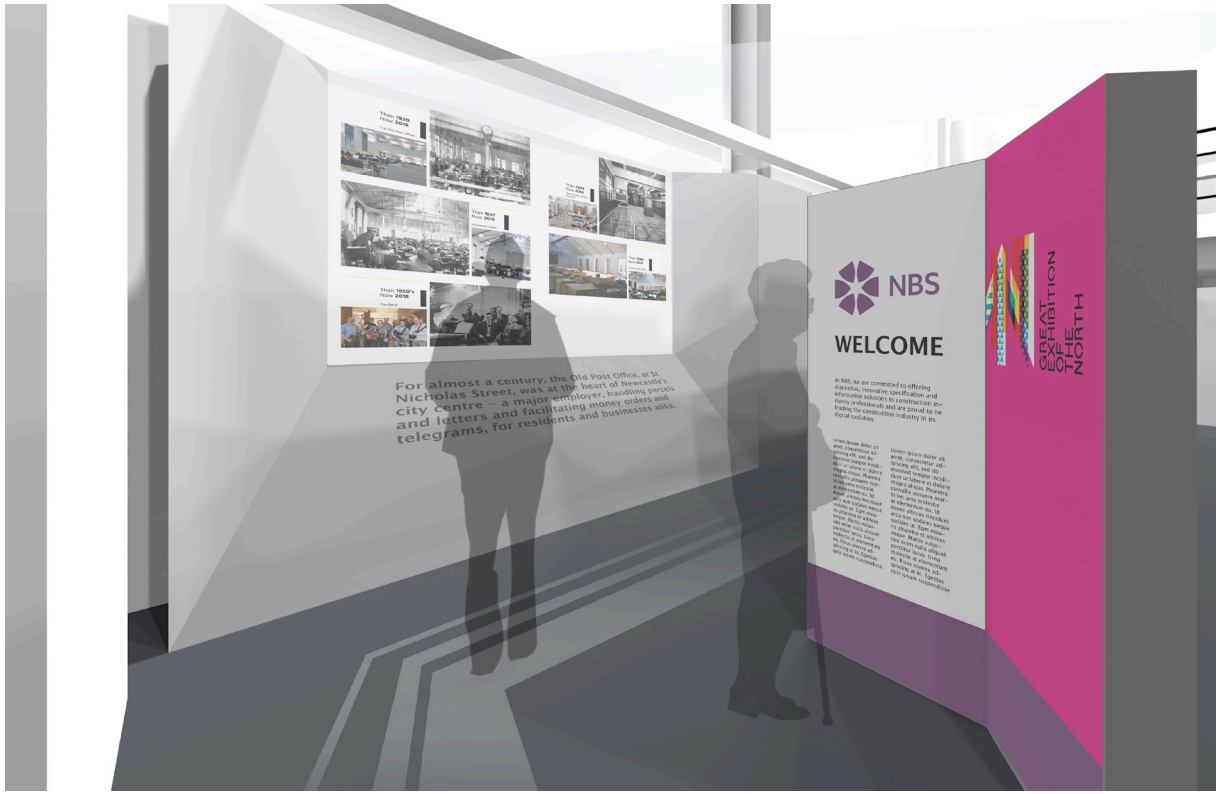


Fig. 18 _ Visualisation of concept design for early stakeholder engagement and funding

Fig. 19/20 _ Social media posts for Future Buildings exhibition using dedicated hashtag

In adopting a method of *research through design* (Savic & Huang, 2014) it was possible to bring together multiple viewpoints and considerations, from specialists and stakeholders, leading to greater capacity for a rich, multi-faceted exhibition experience. Through progressively focussing-in and setting principles of agreed ideals, a clear narrative structure around the layout of the space was developed based around themes of past, present and future.

With new knowledge of future-facing exhibition design methodologies (such as those presented by V&A exhibitions team) and analysis of varied means of technological interventions, it was possible to measure the most appropriate digital tools against the principles of the narrative structure - to provide effective and engaging user interaction for each zone.

In addition, critical to the success and dissemination of the exhibition was the building-in of engagement into the design discussions – allowing outreach beyond the physical space, through social media and online publications. The creation and use of a dedicated hashtag #futurebuildings prompted and enabled social sharing, broadcast and dissemination.

In doing so, digital technology enabled a consistent thread of engagement - from design team and stakeholders, to visitors of all ages. ◘

Fig. 21 _ Future Buildings exhibition completion prior to opening. Couture, B.

Methodology Q3

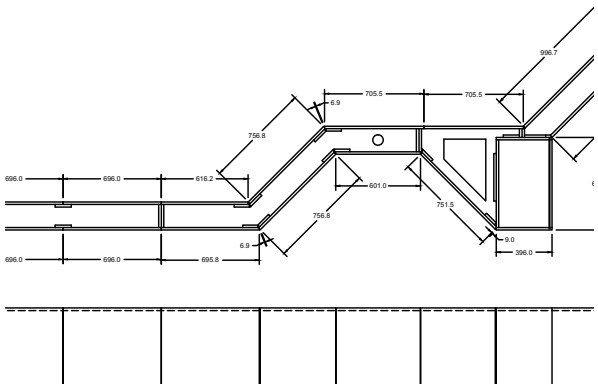


Fig 22 _ Wall component drawings for CNC fabrication

Fig. 23 _ On-site assembly of CNC parts, assisted by students

Q3: How to make effective use of use digital design and off-site fabrication in delivery of spatial exhibition environments?

Methods: Practice-related activities including making, modelling, 3D CAD, surveying, prototyping, material testing, CNC cutting, assembly

A range of exploratory exercises were carried out early on in the life of the project, using practice-related methods of sketching and model-making, in addition to research-led discussions around quality of spatial environment vs budgetary constraints. Examples of first-hand experience with testing methods of 3D design and fabrication on projects such as Mansio Touring Exhibition, 2014 and Time Machines, Design Museum, 2012 were discussed and analysed – highlighting the success of implementation against the traditional route of exhibition building (a set-building or scenography approach of walls and bespoke fixtures made on site by tradespersons).

A range of panel-based materials were considered for fabrication of the structures, measuring their properties against a series of requirements including:

- Suitability as a substrate for graphics
- Handling & ease of installation
- Weight & rigidity
- Aesthetic value
- Cost
- Availability
- Sheet size & yield

It was possible to define and narrow the search by cross-referencing and prioritising the material choices by their range of possibilities for CNC off-site machining and suitability for knock-down (KD) fittings. The material that was selected, and would create the new spatial structures to all areas of the exhibition was Kronospan Melamine-Faced Medium Density Fibreboard (M-F MDF)

A 3D computer model of the gallery space provided an accurate picture of the physical envelope, allowing the proposed spatial environment to be fully tested prior to any production. Additionally, dimensions taken from the CAD models provided data by which to produce test models from card, in a trial-and-error fashion, developing the structure and build-up of the bespoke elements.

Following studio tests and factory prototypes, the resulting kit-of-parts was machined off-site and assembled in situ. This provided opportunity for volunteers and students to be involved in the hands-on creation of the exhibition. As no trade skills were required for the majority of the assembly, this became a collaborative process. Once the key zones were set out with markers on the floor, each part of the internal structure could be assembled using only basic hand tools and lifted into place before joining.

The CNC-production approach also facilitated the use of KD fittings, allowing the structure to be fully installed but with face panels removed - allowing lighting, power and data to be installed in a clean environment. It also enabled each area to be easily-accessible for future maintenance of any technology for updates. ◘

Fig. 24 _ Off site fabrication, CNC of panels at i4Detail Ltd

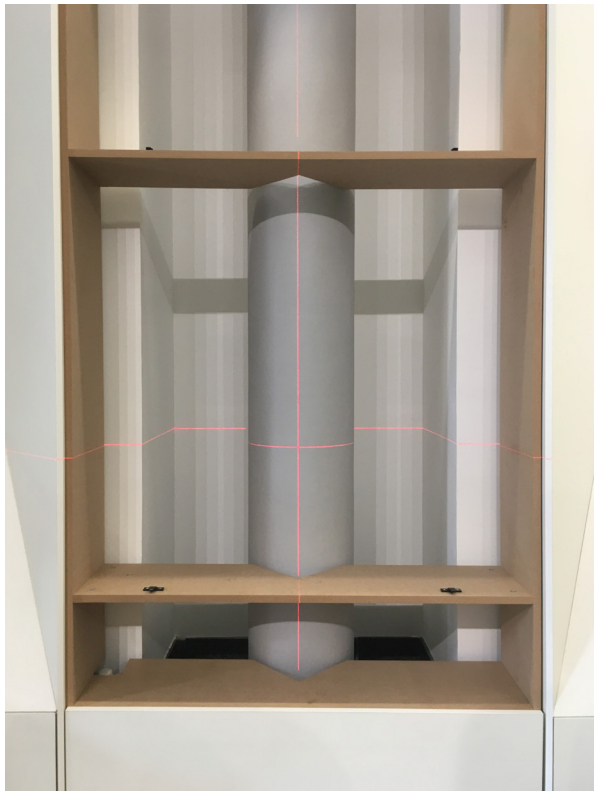


Fig. 25 _ On site photograph, kit-of-parts fitted around existing structure of NBS gallery space

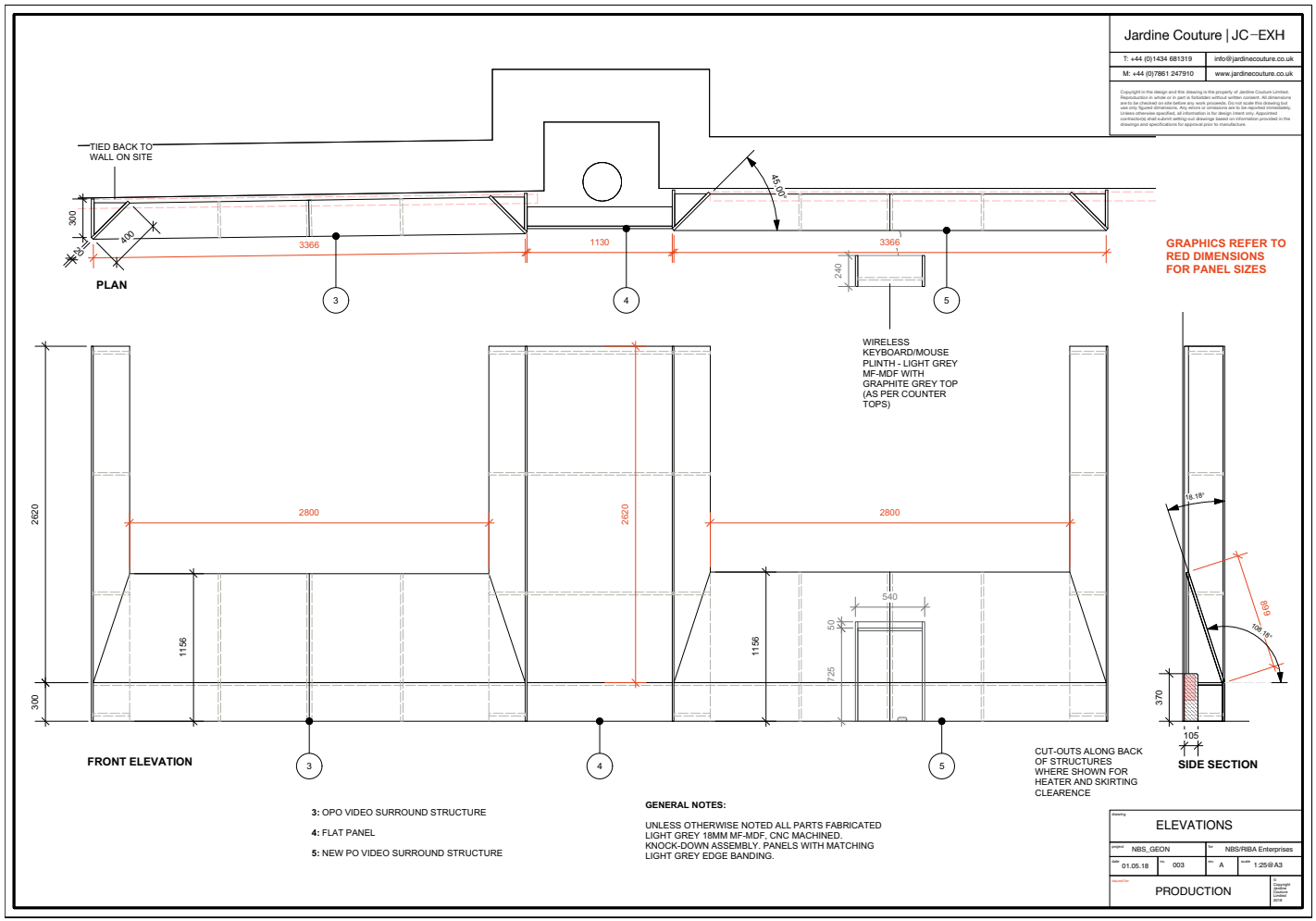


Fig. 26 _ Sample drawing from detail drawing pack for Future Buildings exhibition

6. Outcomes

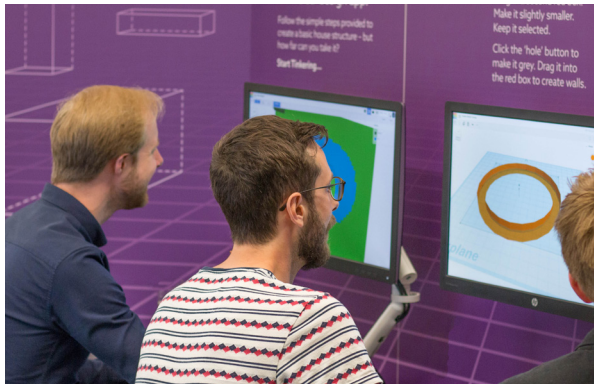


Fig 27 _ Autodesk 'TinkerCAD' stations allowing users to experience entry-level CAD for all age ranges.

Fig. 28 _ Visitors engaging with analogue hand-on elements in the exhibition

The original research has posed questions around, and developed new processes of, exhibition design - using multiple methodologies to investigate and shape outcomes. The research has informed design practices within the context of a realised public exhibition, which received match funding from Newcastle Gateshead Initiative based on proposal, design concepts and project delivery.

The live exhibition opened to the public as part of The Great Exhibition of the North, increasing public awareness of BIM, digital technology, roles and potential of STEM subjects. The realised exhibition also acted as fund-raising catalyst for Maggie's Centre, Newcastle, generating donations for the duration of the event.

Through simultaneous evaluation and analysis of both historical context and cutting-edge precedents, it was possible to explore the possibilities of digital technology, whilst maintaining a principled approach to the exhibition design, based on a coherent narrative structure.

A multi-layered, universally-accessible approach to exhibition user experience was possible, through considering the wide range of technology available, and aligning the potential with the key narrative strands along the user journey. By questioning the relevance and impact of each digital intervention on the overall user experience, the design approach was able to identify the importance of analogue/hands-on interactions as part of the story.

As a result, it was possible to create an immersive exhibition experience that could engage visitors regardless of age, ability or industry-specific knowledge. Digital touch-points, including Augmented Reality, interactive touchscreens and 'CAD for children' were interwoven with more traditional sensory stations, such as moving image (video), 3D-printed models and 2D magnetic building games.

By building-in the use of technology into the co-design process, direct benefits were seen in the working dynamic, which in turn resulted in the exhibition being delivered on budget and to be completed before the deadline.

As aforementioned, by setting up a working dynamic that gave equal footing to multiple stakeholder viewpoints, and developing an agreed vision for project, it was possible to deliver a multi-layered visitor experience – which was integral to its overall impact.

With the position of NBS as a leader in digital technology for the construction industry, it was important that the spatial exhibition experience was reflective of the future-facing nature of the business. Early discussions identified the need for the space to be aspirational and aligned with the visions of NBS – in both aesthetic and operational (UX) terms, this would be a key driver in capturing the imagination of school groups and setting the tone of the exhibition for laypersons.

In adopting cutting-edge techniques afforded by digital design and fabrication, it was possible to create a spatial environment in a non-traditional manner, which was assembled with the help of untrained volunteers. As an outcome, this approach resulted in a quality of space that could not have been delivered on budget by traditional exhibition design and build methods.

The exhibition was set as a key destination as part of The Great Exhibition of the North Innovation Trail – with the Summer-long event receiving 3.8m visitors from around the world over 80 days.

Fig. 29 _ 3D printed model of Old Post Office building, on display (angled mirrors for 360 view)

Fig. 30 _ visitors using AR devices at Future Buildings exhibition

7. Economic and Societal Impact

Fig. 31_Opening event, Great Exhibition of the North, Newcastle-Gateshead quayside

Digital technology and products such as BIM offer a large part of the solution to address issues such as sustainability, quality and efficiency in production of the built environment. NBS are a global leader in this area.

Future Buildings exhibition brought this subject into mainstream view, not only to the global audience who experienced the event, but to over 160 visiting school groups who were able to be inspired and educated around digital innovations and the potential of STEM subjects.

The exhibition provided an invaluable platform for discussion and demonstration, ultimately leading to greater understanding of the subjects and fostering potential for future leaders in this important area.

As a key part of The Great Exhibition of the North, Future Buildings exhibition played part in the programme with International reach, resulting in economic impact of £126m generated for the region, with over 10k contributors working on the core programme of events.

Over 200 new partnerships were formed with cultural organisations, businesses, education, local authorities and universities, stimulating ongoing collaborations beyond the duration of the festival.

Future Buildings exhibition received over 5000 visitors over 80 days, whilst also raising funds for Maggie's Centre, Newcastle. The exhibition was a key part of The Great Exhibition of the North, resulting in economic impact of £126m generated for the region, with over 10k contributors working on the core programme of events.

The original research and new insights developed had a direct influence on the design methods, working practices and delivery approach that lead to the success of the exhibition.

Through exploration and development of narrative approaches, and subsequent creation of conceptual proposals, the project was match-funded as part of UK Govt. Northern Powerhouse fund, delivered through the Newcastle Gateshead initiative.

8. Dissemination

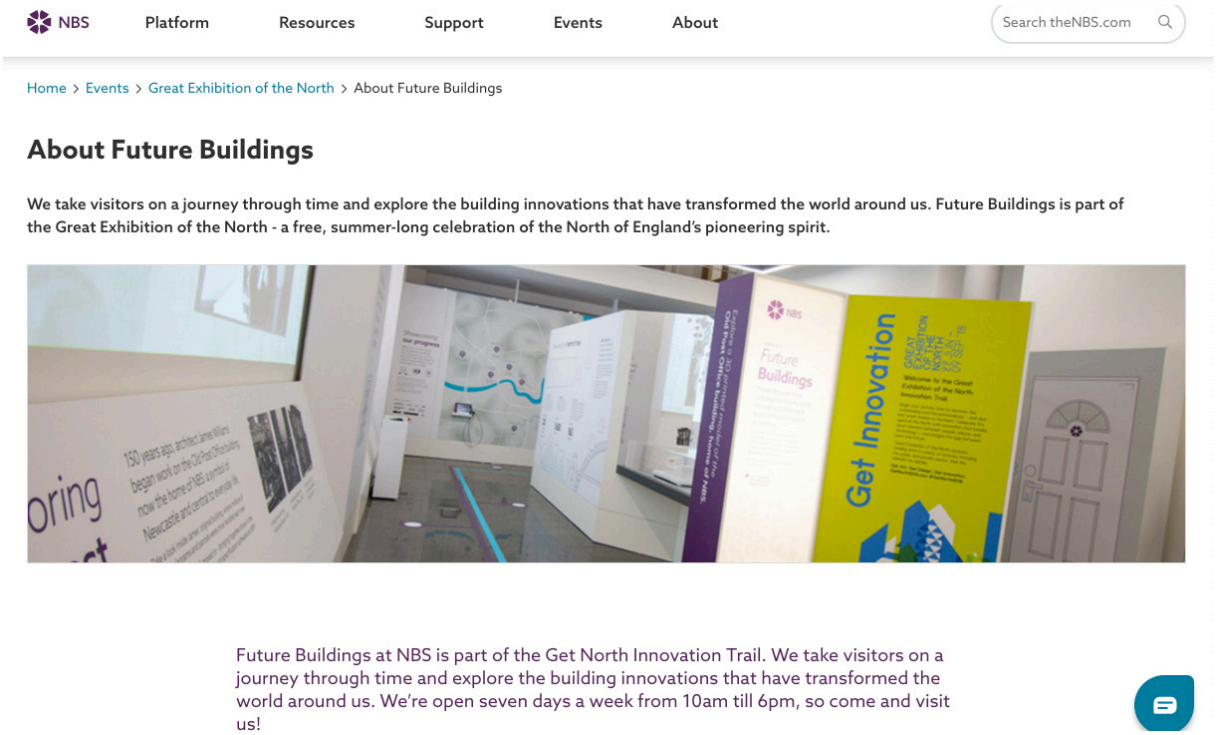


Fig. 32 _ Article about the exhibition, NBS website

Fig. 33 _ Twitter post using the #futurebuildings hashtag

NBS Future Buildings was widely published online on NBS and Great Exhibition of the North websites, in addition to multiple online construction journals.

Social media sharing was promoted and encouraged across digital platforms such as Twitter using the dedicated *#futurebuildings* hashtag.

The exhibition received over 5000 visitors over 80 days, and in the run up and open period was able to involve a large number of volunteers.

Over 160 school group visits were organised, promoting STEM subjects through demonstration, education and inspiration. In addition, the event was used as an opportunity to generate funding for Maggie's Centre, Newcastle.

The match-funded project took it's place as key marker and destination on the Innovation Trail as part of summer-long Great Exhibition of the North festival - in turn receiving 3.8m visitors from across the world. ◘

9. Related Publications

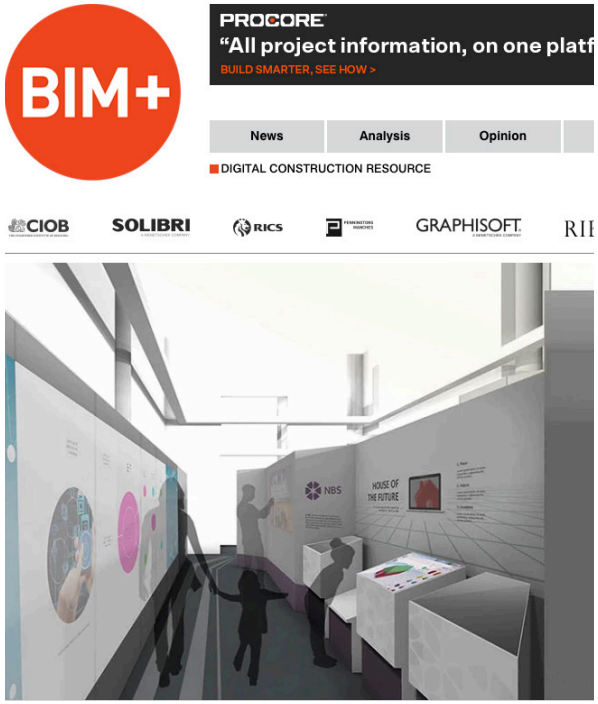


Fig.34 _ Article feature on BIM+ website, bimplus.co.uk

NBS Future Buildings

Article, BIM+ website: http://www.bimplus.co.uk/news/nbs-and-ryder-team-events-great-exhibition-north/

Article, NBS website: https://www.thenbs.com/events/great-exhibition-of-the-north/about-future-buildings

Article, Spark Sunderland: https://www.sparksunderland.com/2018/05/12/augmented-reality-at-the-great-north-exhibition/

Article, NBS website: https://www.thenbs.com/events/great-exhibition-of-the-north

Post, NBS Twitter feed: https://twitter.com/thenbs/status/1011179722003439617

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Article, North East Times: https://netimesmagazine.co.uk/news/nbs-team-up-with-cancer-charity-maggies-for-design-competition/

Article, Construction Code Blog: http://constructioncode.blogspot.com/2018/06/come-and-visit-nbs-at-great-exhibition.html

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Article, Generator website: https://generator.org.uk/newsroom/digital-union/nbs-to-bring-iconic-north-east-buildings-to-life-with-augmented-reality-technology/

Article, Lord Lawson Academy: http://www.lordlawson.org.uk/great-exhibition-of-the-north-innovation-trail/

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Article, Gateshead Council: https://www.gateshead.gov.uk/article/9405/Great-Exhibition-of-the-North-2018-engages-millions-

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