Media Architecture in Knowledge and Innovation Districts: Designing a Canvas for Research, Culture and Collaboration

Niels Wouters[1,2], Tim Hunt[3], Olga Dziemidowicz[3], Rose Hiscock[2], Frank Vetere[1]

[1] School of Computing and Information Systems, University of Melbourne, Australia
{niels.wouters, frank.vetere}@unimelb.edu.au

[2] Science Gallery, Melbourne, Australia — rose.hiscock@melbourne.sciencegallery.com

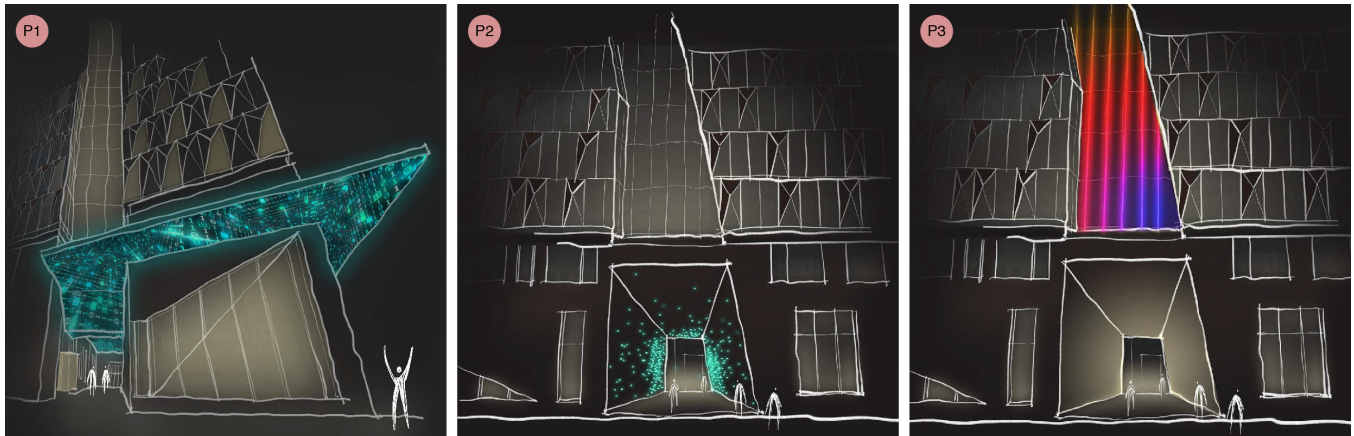[3] ARUP, Melbourne, Australia — {tim.hunt, olga.dziemidowicz}@arup.com

Figure 1: Artist impression of media architecture proposals for *Melbourne Connect*. Each proposal provides distinct engagement opportunities through the physicality of its façade section. Proposals include *Looking@You Looking@Me* (P1, left), *If These Walls Could Talk* (P2, middle) and *The Giving Hand* (P3, right).

ABSTRACT

Emerging economic and demographic trends stimulate universities across the globe to promote better connections with industry, governments and communities. By clustering within Knowledge and Innovation Districts (KID), they are able to respond more quickly to societal and scientific challenges. Architecture is crucial in driving their success by providing spaces that encourage convergence, connectivity and proximity. In this paper, we report on the design process of a media façade for a new KID within *Melbourne Innovation Districts*. We analyze our process through the lens of client and design team, and illustrate how vision and motivation translate into tangible design outcomes. Our insights reveal interesting future directions for media architecture practice and research, by way of (1) its synergies with KIDs, (2) evaluating the success of non-commercial media architecture, and (3) the opportunities for *media architects* as experts that coordinate media architecture projects from conception to delivery.

CCS CONCEPTS

• **Human-centered computing** → HCI theory, concepts and models; • **Applied computing** → *Architecture (buildings)*; *Marketing*;

KEYWORDS

Media architecture, media façade, design process, knowledge and innovation district, lighting design, project management

1 INTRODUCTION

Across the globe academic institutions have always sought partnerships with industry and government to better address scientific questions [15, 32]. These partnerships provide opportunities to collectively stimulate technological and economic development and to measure market response to outputs of academic research [8]. While partners often used to be geographically dispersed, today we witness the growing emergence of *Knowledge and Innovation Districts* (KID). They enable partners to physically cluster in close proximity and as a result, to leverage improved networking opportunities between academia, industry, government and adjacent communities, such as start-ups, incubators, accelerators, makerspaces and

residents [11, 27]. KIDs are unique in that they enable complex challenges that require multidisciplinary expertise to be pursued collaboratively, thereby maximizing performance, efficiency and responsiveness [2, 17]. Recent examples include Kendall Square[1] (Cambridge, MS, USA), Stockholm Life[2] (Stockholm, Sweden) and Quayside Toronto[3] (Toronto, Canada). As the success of KIDs relies on good connections with surrounding communities of interest, their architectural form aims to foster creativity and collaboration. For instance, KIDs typically reflect high degrees of transparency to avoid isolation and to stimulate connectivity, and provide an active public realm to enable creative engagement [26]. In fact, place-making qualities are vital considerations for KIDs, in an effort to catalyze innovation by bringing people together in pleasant, memorable destinations [25, 36]. KIDs also aim to externalize innovation, such as by transforming the district into a *living lab* that showcases new developments and enables in-situ studies of prototypes [21].

Alongside the development of KIDs, the integration of interactive lighting within architecture is gaining popularity as a novel means to enable interactions between people and places [22]. The globally emerging phenomenon, generally referred to as media architecture, is recognized for its place-making qualities [16, 23] and architectural relevance [12, 40]. The domain also attracts significant interest from academia, investigating related topics such as interactivity (e.g. [1, 10]), urban design (e.g. [4, 35]) and social aspects (e.g. [9, 31]). Over time, continuing developments in lighting and screen technology enabled the emergence of media façades, where building skins provide architectural canvases for digital media. Previous research investigated the design process of media architecture, highlighting the need to tailor design outcomes to their context [37] and the challenges that are introduced by the urban environment [6]. Insights were put into practice in the design of some of the most celebrated examples of media architecture across the globe (e.g. [7, 14, 19, 38]).

However, previous accounts of media architecture design processes typically start from well-defined design opportunities, such as commissioned design research, prototyping and visualization, and technical development. In most cases, these studies are silent on the initial client aims and ambitions, and how these have been creatively interpreted to inform media architecture design outcomes. In order to better understand the activities in the early stages of a design process, we investigated our own collaboration between client and design team on conceptualizing media architecture for *Melbourne Connect*, a new KID of The University of Melbourne, Australia that forms part of the *Melbourne Innovation Districts*. We review the process through the lens of client and design team to provide a holistic understanding of key decisions that influenced the process. While no final decision on the construction of media architecture has yet been taken, we gained valuable insights into the opportunities for media architecture within KIDs, the evaluation of future manifestations of media architecture with predominant social and cultural aims, and the coordination of new projects that aim to integrate digital media within the built environment.

Figure 2: Artist impression of *Melbourne Connect*, a new KID powered by The University of Melbourne, Australia. Science Gallery Melbourne will be located on the ground floor. The project is currently under development with completion expected in 2020. Image © LendLease

2 DESIGN CONTEXT

Based on the understanding that innovation emerges from collaborative environments that encourage people to share skills and ideas, The University of Melbourne is developing a new KID (see Figure 2)[4]. In this section, we provide background on the development of the KID and its main offering to the community. In addition, we establish an understanding of key stakeholders in the design of a media architecture concept that complements vision and form.

2.1 Melbourne Connect

The KID is centrally located in the city center, adjacent to the main university campus and public transport options, and in close proximity of a residential area. It will form part of the *Melbourne Innovation Districts*[5], a partnership between the City of Melbourne, RMIT University, and The University of Melbourne to develop urban innovations for the benefit of the whole city. Construction is currently underway with completion anticipated by late 2020. With a vision to combine assets and tools that enable the development of innovative solutions to major societal challenges, Melbourne Connect will provide workspaces for scholars at the School of Engineering and the Faculty of Business and Economics, and will support
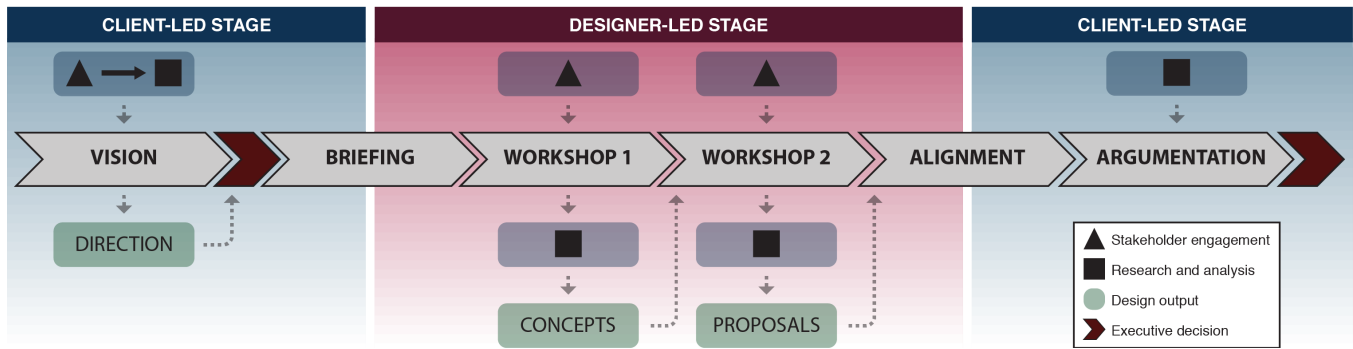

Figure 3: Model of primary stages in the design process of media architecture for *Melbourne Connect*. The model highlights the role of stakeholder engagement as well as research and analysis, in order to inform three design outputs, i.e. Design Direction (see Section 3.3), Concept Design (see Section 4.2) and Proposal (see Section 4.4).

commercial tenancy, retail spaces, co-working spaces, a fabrication workshop, business accelerator, research impact accelerator and student housing.

A flagship project for the KID involves the establishment of Science Gallery Melbourne, a permanent on-site exhibition space with a floor area of approximately 3,800sqm (40,900sqft). It aims to serve as a living lab that encourages collaborations between artists, academics, students, industry and citizens by delivering a regularly changing program of exhibitions, experiences and events. Part of the global Science Gallery network[6], the gallery is seen as a unique opportunity to attract people towards Science, Technology, Engineering and Mathematics disciplines (STEM) and make science more accessible. Through its architectural form and outward-facing character, the gallery is expected to fulfill a crucial role in the social and cultural activation of the KID.

2.2 Design Stakeholders

The design process was initiated and pursued by a University team (the *client*), primarily consisting of a design researcher with practical experience in the domain of media architecture, the gallery director and the project director for the KID. Throughout the process, the client reported back to University executives. Concept options for media architecture and a feasibility study were realized by the design team (the *designer*), consisting of architects, lighting designers, façade engineers and service designers, and led by the KID project management consortium. The design team is recognized for its prior experience in designing and delivering media architecture in various global projects.

2.3 Design Process

In the following three chapters we outline our design process. We particularly focus on unraveling the translation of client vision into final outcomes, as proposed by the designer. Our process is visualized in Figure 3.

---

[6]https://international.sciencegallery.com

3 VISION AND DIRECTION (CLIENT-LED)

With the architectural design of *Melbourne Connect* well underway, the client deemed the context sufficiently compelling to warrant an investigation of digital activation options. Based on previous analyses of context [35], the client identified that digital activation should (1) enable the architecture of the KID (*carrier*) to complement the experience of its immediate surroundings, (2) reflect the dynamics of its *environment*, continuously bustling with people from a wide range of socio-demographic characteristics and communities, and (3) deliver engaging *content* that is sourced from the community that inhabits the KID, as an opportunity to represent its academic and industry activities. By merging insights from lighting and wayfinding strategies, the client recognized that media architecture—as a creative, innovative and engaging mass communication medium—is well-suited to reflect the ambitions of KIDs as collaborative and networked environments [5, p. 1407]. A preliminary investigation proved a particular potential for an interactive media façade as a dynamic canvas to externalize activities within the KID that integrates seamlessly within the advanced stage of the architectural design process. The on-site gallery was identified as a suitable project lead, enabling them to liaise with the client, engage relevant design stakeholders and consider content strategy for the media façade as an integral part of their communication vision.

3.1 Media Architecture Vision

Based on the identified potential for media architecture to activate the KID, the client developed an initial vision that sought alignment with the long-term ambitions of the University. The vision outlined four conceptual themes that reflect the expected versatility.

Exemplify innovation. Design and functionality is envisaged to create a new benchmark in the realm of media architecture, community engagement and content curation. A key design requirement was for the media façade to be technologically, aesthetically and architecturally innovative to reinforce a cutting-edge identity. By embedding innovation within the built form, media architecture is seen to exemplify the client's vision onto research and development, and reinforce the notion of KIDs as places that generate knowledge, and attract business opportunities and academic collaborations.
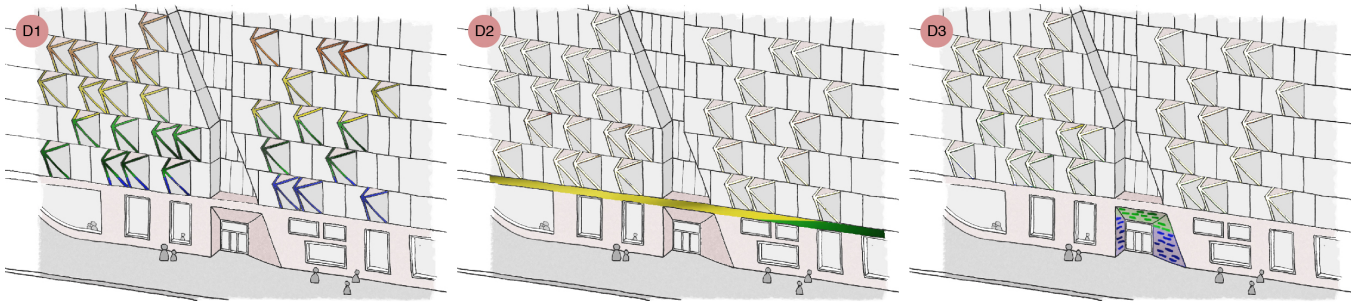
Figure 4: Artist impression of design directions identified by the client, i.e. activated prisms (D1, left), digital frieze (D2, middle) and activated bricks (D3, right). The proposed design directions illustrated the general intent but did not consider structural, financial or technical feasibility.

Enable community engagement. The media façade is expected to enable participation and involvement from the community, including stakeholders that are affiliated with the University (e.g. academics, students) and those who are not (e.g. commercial tenants, artists, school groups). Open participatory processes must provide a well-supported media infrastructure that aligns with the audience of the KID and enable unique curatorial practices, such as by inviting distinct communities to design unique visualizations for the façade.

Increase physical presence. Previous studies indicated the significant public benefits that media facades provide in terms of place-making, social cohesion and the shared use of public space (e.g. [3, 23]). As a result, the client required design responses to contribute to the public benefit (e.g. provide a pleasant experience), as well as provide benefits to KID tenants (e.g. enable personalized visualizations). In addition, media architecture is envisioned to provide a building-sized opportunity to create a unique day and night time experience for its surrounding context. Through its architectural integration, the media façade needs to be subtle and unobtrusive, while simultaneously contributing to the local fabric, such as by acting as a way-finding opportunity, cultural display, and reflection of the local history and culture.

Illuminate research. By way of its contextual relation with the scientific and cultural activities within the KID, media architecture was expected to deliver an opportunity for creative exploration and experimentation. In particular, it must be sufficiently compelling to contribute to ongoing efforts that aim to attract students to STEM disciplines and it must provide opportunities to serve as research infrastructure, such as for emerging interaction technologies to be connected to and support engagement with the media façade, and for new curatorial practices of content programming.

3.2 Application Scenarios

The vision enabled the articulation of a series of functional requirements. These were seen as application scenarios to support the long-term sustainability and useful integration of media architecture within the built form of the KID.

- *Wayfinding.* Through a range of preprogrammed or dynamic lighting configurations, media architecture supports pedestrian traffic to be directed to specific building entrances during KID events.
- *Real-time Data.* Sensor infrastructure within the KID is connected to the media façade, in order to enable the communication of live building activity to the surrounding urban environment.
- *Innovation Infrastructure.* Media architecture within the KID consists of flexible infrastructure that accommodates research endeavors, such as to investigate human responses to novel interaction modalities in public spaces.
- *Data Visualization.* A bespoke, creative framework enables scientific datasets to be converted into dynamic and engaging visualizations onto the façade of the KID.
- *Cultural Display.* The media façade must allow curation of content to align with significant academic, cultural, societal and industry events, ranging from business symposiums and major sporting events, to Lunar New Year and International Women's Day.
- *Hackathon.* With partners and tenants organizing events that explore the intersection between art and science, the community is able to creatively interpret datasets provided by the KID tenants and contribute to providing continuously changing and compelling content.

3.3 Design Direction

Based on the vision and application scenarios, the client identified three possible design directions for media architecture that honor previously approved characteristics of the KID architectural form. In order to convey design intent, each design direction was articulated by a hand-drawn sketch (see Figure 4, D1-D3), and described by way of the anticipated design opportunity, concerns and implications, estimated urgency within the KID development, and reference projects.

- *Activated prisms* (D1). The major tower curtain wall sections contain prism-shaped sunshades. Prism edges were envisioned to contain low-resolution, multi-colored linear lighting elements.
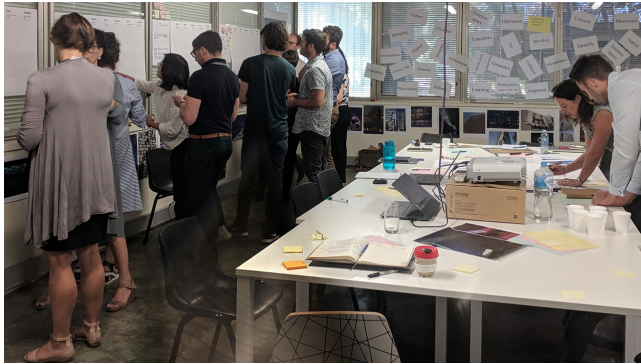
Figure 5: Consultation workshop with project development stakeholders and client representatives. Five groups of workshop participants reflected on personas and relevant user journeys for their interactions with the KID.

- *Digital frieze* (D2). A narrow brick portion of the building podium was considered suitable to hold a bespoke medium-resolution digital display that wraps around the major tower of the KID, including its external and internal faces.
- *Activated bricks* (D3). Brick-sized, high-resolution digital screens were proposed to let main building entrances stand out. Well-considered positioning of bricks would enable meaningful experiences for those close-by, as well as for those further away.

3.4 Decision: Designer Engagement

Vision, application scenarios and design directions were presented to University executives. Here, formal sign off was given to further consider media architecture as part of the KID, and to engage a specialist design team to refine the design opportunities. The development management consortium was commissioned to produce a return brief to develop and visualize suitable lighting design and media façade concepts through stakeholder engagement, resulting in a final report that documents their feasibility, provides a cost estimate, and documents user interaction opportunities.

4 DESIGN ARTICULATION (DESIGNER-LED)

As the design team was first briefed about the project, the client expressed the desire for a return brief that is based on outcomes of an inclusive participatory design process. In this project, intense participation from the client and its partners was considered vital, in particular because of the multiple stakeholders that the client represents, such as (future) students, academics, researchers and staff, and their differing expectations. Furthermore, designers were encouraged to embrace experimentation and challenge, both in their participation methods and design outcomes.

4.1 Consultation (Workshop 1)

Assembling the correct stakeholders to participate in the design process was the first step of the designer's involvement. This was largely facilitated by the client and further supported by the design team who provided specific cues on additional partners to involve.

A subsequent plenary consultation workshop brought together key project development stakeholders (architects, project management consortium, developer, service designers) and client representatives (University staff, academics and executives), some of whom had no detailed understanding of the KID building project. The workshop lasted three hours.

First, architects familiarized participants with the KID project. A large number of artist impressions of the future building were located across the room. In addition, the design team introduced the concept of media architecture, by way of photographs that display several global buildings with integrated architectural lighting and digital media in their façade. Even though the purpose of the workshop was not to discuss design options for media architecture, the concepts helped participants to think about the concept of digital activation and reflect on the digital touchpoints that future KID visitors may or should experience. This led participants to reflect on personas, i.e. the future audiences of the KID, and what their objectives and expected outcomes of interacting with a media façade may be. A collaborative brainstorm revealed five relevant personas:

- *Academic community*, e.g. academics, staff and (future) students that desire a "clever" experience of the building they use on a daily basis;
- *Global community*, e.g. partner universities, multinational corporations and venture capitalists that require the building to express trust, excitement and prestige;
- *Local partners*, e.g. commercial tenants, authorities and start-ups that aim to see a modern and innovative entity;
- *General public*, e.g. tourists, local residents and commuters that want to feel welcomed and that may want to share photos of the KID on social media;
- *Creative community*, e.g. artists that exhibit in the on-site gallery (and remotely) and 'disruptors' that seek creative engagement with media architecture.

Participants were then divided in five cross-disciplinary groups, assigned a persona, and asked to reflect on the user journey of that persona (see Figure 5). This prevented participants from focusing on their own, individual expectations and desires and instead resulted in balanced outcomes. User journeys encompassed the full extent of interaction with media architecture, ranging from first learning about its existence (e.g. reading articles in popular media) to short-term and long-term follow-up actions (e.g. sharing photos of individual interactions on social media and establish new business collaborations). While simultaneously acting as facilitator, creator and technical expert, the consultation session and articulation of user journeys enabled the design team to unravel the distinct motivations behind the project.

4.2 Concept Design

With the insights collected during the consultation workshop, designers independently developed a design response that sought to explore the suitability of the building façade to support bespoke media architecture that caters for the needs of personas. Designers recognized that the architectural form of the KID created a series of canvases that allow for lighting elements to be integrated. These consist of (a) the ground floor brick podium, (b) the canopies that penetrate through the whole KID, (c) the major tower curtain wall
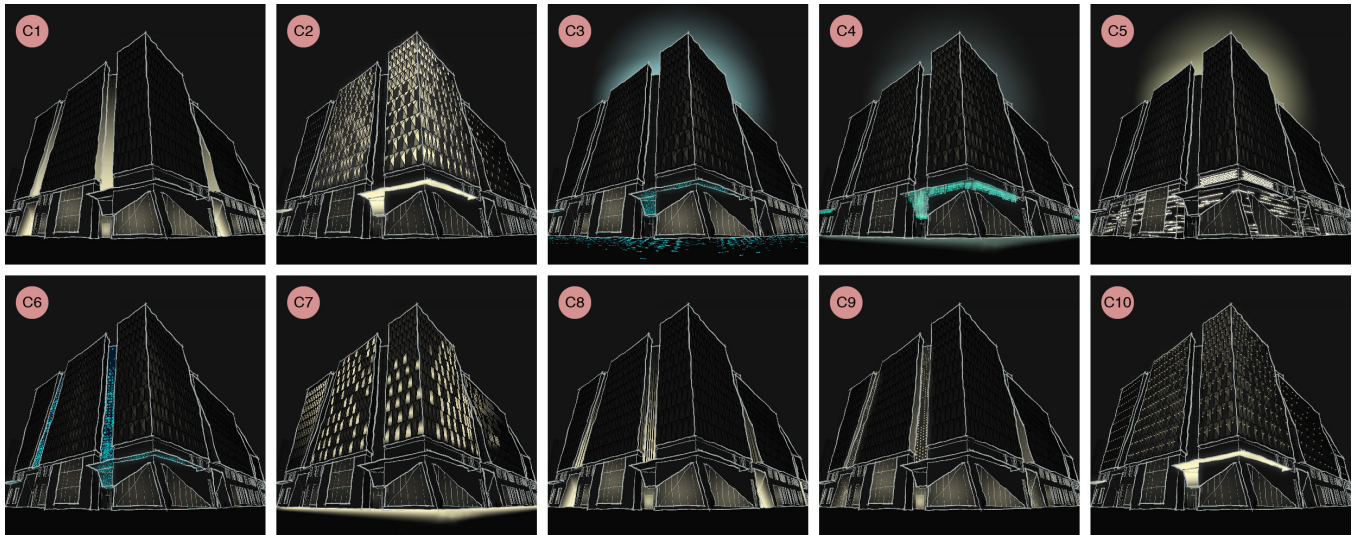
Figure 6: Artist impression of ten media façade design concepts. Each concept aims to respond to persona requirements identified in Consultation (Workshop 1) (see 4.1) by way of a bespoke integration of dynamic and architectural lighting within the KID building envelope.

sections, (d) the recessed curtain wall sections, and (e) the building parapet and top floor plant room.

By studying the individual and collective presence of these canvases, ten design responses emerged. Each of these complements the architectural expression and enables unique granularity of information (e.g. ranging from architectural lighting to high-resolution information), while also exploring opportunities to communicate with people within the KID, in close proximity or even far away. All proposed concepts are illustrated in Figure 6 (C1-C10).

4.3 Design Review (Workshop 2)

A group of stakeholders, similar to the participants of Consultation (Workshop 1), were shown the concepts developed by the design team, along with the articulated future user journeys. The design team paid particular attention to expressing why personas are given compelling opportunities to interact with the proposed media façades concepts rather than how the interaction would take place.

After workshop participants formed groups, they were asked to reflect on the concepts from the perspective of one of the previously defined personas. Consequently, participants were asked to illustrate the persona's preference for one of the design concepts and synthesize the underlying rationale. Feedback from all participants and personas revealed a strong preference for concepts that enable small-scale interactions with individual nearby people (e.g. C4, C5 and C8) rather than for concepts that elicit communication with the wider urban realm (e.g. C1, C3 and C10). In fact, participants agreed that while KIDs aim for widespread geographical impact through their contributions to research and innovation, their architectural form should instead be human-scaled in order to provide positive experiences for the communities within the KID. In addition, the involvement of project development stakeholders allowed for balancing objectives against key project constraints (e.g. timeframe, budget) during a plenary discussion.

While activation of the prism-shaped sunshades was considered unique and interesting in concepts C2, C7 and C10, lighting designers advised of the high risk and cost that was involved. Each of these concepts would require research and development of custom-designed lighting elements. As a result, favored concepts were those that integrated lighting within the ground floor brick podium and canopies, i.e. C3, C4, C5, C6 and C10. Both were considered canvases that enable positive contributions to the public experience due to their proximity to street-level activity. There was particular interest in concept C5 that proposed to replace a series of traditional bricks with "digital bricks" that effectively conceal high-resolution screens. The concept was favored for its unobtrusiveness and its high-tech reference to bricks as (1) a typical local building material; and (2) as a building material that otherwise remained largely unaffected by the digital revolution in architectural design and manufacturing.

4.4 Proposal

After analysis of workshop feedback and following an alignment meeting with client and designer, it was decided to further investigate three most suitable and best received concepts, i.e. C4 (excluding parapet lighting), C5 (excluding parapet lighting) and C6. Each of these was considered to reflect the workshop feedback and to provide a unique response to the design brief, facilitating a balanced choice by University executives. Concepts were subsequently further refined by the design team, in order to provide indicative cost ranges, coordinate technical feasibility, and suitability to address the client's anticipated application scenarios. Final proposals are shown in Figure 1 (P1-P3). We provide a brief conceptual and technical description for each proposal:

- *Looking@You Looking@Me* (P1). Individual light units are embedded within the structure of canopies, thereby creating a dynamic back-lit surface that enables a low to medium resolution display at night and that addresses all public spaces

within the KID. The concept is low-risk and cost-competitive, as it is able to cover 700sqm (7,500sqft) and uses standard architectural lighting products.

- *If These Walls Could Talk* (P2). The concept proposes to replace a selection of bricks around the main KID entrances with polished transparent glass bricks and have digital displays embedded behind them. The concept can be read at different scales, i.e. as individual pixels when observed from afar and as information screens when approached closer. As the concept needs bespoke lighting and screen technology, and research and development it introduces a high risk for cost increases and project delays.
- *The Giving Hand* (P3). Linear light units are integrated into the recesses of the main tower's curtain wall. This is complemented with dynamic architectural lighting around the main building entrances. The concept enables connections with the city, as it will be most visible from afar. As the concept allows for standard architectural lighting products to be used, it introduces low risk to the overall project.

The return brief provided visualizations of the three concepts and provided a detailed description of prototypical user journeys they facilitate, as well as technical requirements and implications of energy consumption on solar PV power supply. Estimated costs included supply of lighting elements, control infrastructure and fixings and supports, in addition to installation costs and contingency.

5 DESIGN DECISION (CLIENT-LED)

As the client received the final return brief an internal study and review process was initiated. With estimated costs within the client's intended budget range, proposals were evaluated against the envisioned application scenarios.

5.1 Argumentation

P1 and P2 emerged as the most suitable design options in terms of (1) best addressing all application scenarios; (2) creatively and innovatively reinterpreting the purpose and appearance of media architecture; and (3) enabling aesthetic integration within the architectural form of the KID. P3 was further deemed unsuitable because of its anticipated negative impact on the high sustainability rating the KID was meant to achieve.

The return brief was considered to be sufficiently complete to recommend to the University's executive committee to further engage the design team in a detailed design and development process, including a more thorough financial, technical and architectural appraisal of both proposals.

5.2 Decision

Based on the advice presented to the University's executive committee, the decision was taken to further investigate a hybrid design solution that merged the concepts behind P1 and P2. This would allow the client to achieve activation across the whole KID (P1) as well as enable the display of functional information, such as announcements and messages at key entrances to the KID (P2). In parallel, the client requested an investigation of funding and monetization strategies for the media façade to be undertaken (e.g. sponsorship and philanthropy). This work is currently underway.

Upon final approval of the media façade design and successful financial motivation, the design team will be commissioned to proceed down a formal detail development process. Besides producing architectural and façade construction documentation, the work will involve (1) development of a content strategy through further stakeholder engagement, (2) selection of control programs and input types to accommodate proposed content, (3) assessment of town planning requirements, (4) coordination with wayfinding and signage strategies within the KID, (5) analysis of energy consumption requirements and implications on sustainability targets of the building, (6) review of operational requirements to achieve a long-term operating agreement, and (7) a detailed cost assessment. The detail development process is foreseen to be completed by August 2018 to avoid slowing down the construction timeline of the KID.

6 DISCUSSION

Client and design team documented and analyzed the collaborative conception and design process that enabled the articulation of media façade proposals for *Melbourne Connect*. Though yet unbuilt, the process has been sufficiently revealing to posit three arguments for the future development of the media architecture discipline.

6.1 Integrating Media Architecture within Knowledge and Innovation Districts

The global emergence of KIDs has caused a shift in thinking about innovation systems. Typically situated within well-connected urban spaces, they are promised to stimulate economic growth in highly networked and collaborative environments. We identified that the opportunities provided by KIDs create compelling synergies with the ambitions and opportunities of media architecture.

Thriving on interdisciplinarity. Our work reflects the observation from previous studies and projects that the design, development and operation of media architecture relies on collaborations across a wide range of disciplines (e.g. [4, 14, 30]). We collaborated across disciplines such as architectural design, human-computer interaction, user-centered design, community engagement, lighting design and service design. This observation also accurately reflects the strategy of many KIDs as environments that physically bring together otherwise disparate disciplines and industries to encourage quick and efficient knowledge transfer. As most KIDs merge applied sciences with creative fields and advanced manufacturing facilities, they enable for the specialist knowledge and interdisciplinarity needed in design, engineering, prototyping, programming and evaluation phases of media architecture to become conveniently accessible.

Enabling a sense of place. Central to our work on the media façade for *Melbourne Connect* has been the articulation of its place-making qualities, such as by enabling the externalization of innovation, and supporting community engagement with the place, the media and its programming. Place-making is recognized as a key quality of media architecture to contribute to the long-term social, economic and cultural experience of cities [34]. However, place-making has also been recognized to support knowledge generation and innovation activities in KIDs [26], such as by providing an active public realm that is pleasant and that caters to various

needs and requirements, and by making innovation visible and public. The gallery in *Melbourne Connect* is expected to play a crucial role in the externalization of innovation, but the media façade will contribute significantly by becoming a dynamic wayfinding beacon within the urban environment and by providing an interactive canvas for the community within the KID to communicate their activities and innovations. We envision that, in terms of content, the curatorial role of the gallery will enable experimentation with visually engaging content and promote research on effectiveness of such content. As such, new curatorial practices for media architecture will become available, as artists, students, academics and visitors are invited to co-design new content and visualizations, such as through hackathons, master classes or even complete study programs.

Providing research infrastructure. Integrating media architecture within *Melbourne Connect* is a significant endeavor that comes with a serious financial commitment. Yet, we believe that if not only seen as canvas for communication but also as novel research infrastructure, media architecture helps the University achieve some of the objectives of the KID. This is not too dissimilar from how other academic institutions develop and operate bespoke technology environments to publicly showcase their capabilities and as a result, to enable new research initiatives. The formula has been successfully implemented in QUT's *The Cube* [28] and University of Oulu's *UBI-Hotspots* [24]. We argue for such knowledge-driven forms of media architecture within KIDs to be programmed so as to showcase innovation and attract new students towards STEM disciplines, but also support new knowledge to be generated through support from industry partners and contribute to urban culture and experience. For instance, there are unique opportunities for prototype technologies to be connected to media architecture control systems and to be evaluated in an ecologically valid environment. Other opportunities exist in, for instance, enabling scholars and students in media studies, design and art curatorship to co-develop new content programming initiatives and evaluate the subsequent behavior of people in public space. In broader terms, as media architecture forms connections with physical and technical assets of KIDs, it further supports the emergence of *living labs* that enable innovations to be co-developed by interdisciplinary teams and to be evaluated in a real-world environment. This observation aligns with the established idea of KIDs not only providing physical space for researchers, but also serving as a laboratory that enables innovations to be evaluated in-situ, in fields such as engineering, manufacturing, health care and design.

6.2 Designing Objective-Driven Media Architecture

Architectural and product design processes typically invite client participation to inform the outcome [41]. While forms of design participation range from expert autonomy to client-led self-decision, they all enable the designer to understand the client's expectations, to propose design decisions, and to agree on strategic directions [20]. In contrast, traditional architectural lighting design projects are typically only driven by an architect, engineer or developer; and rarely does a client actively participate [33, p. 26].

In recent years, a significant body of work in the domain of media architecture articulated the benefits of end-user participation to improve the quality of design outcomes and to ensure stakeholder alignment (e.g. [13, 39]). The findings reveal why media architecture is different from architectural lighting design: as lighting increasingly abandons its static character in favor of interactive and dynamic properties, new opportunities arise to stimulate unique experiences, to create empathy and to promote interactions between people, places and spaces. Here, stakeholder involvement is crucial in order to reveal and articulate the objectives of media architecture, in terms of addressing particular audience profiles and answering to their distinct needs and expectations. In a similar fashion, our engagement of a specialist design team enabled various stakeholders from across the University community to voice opinions, ideas and concerns to enable a fine-tuned design response to be formulated. Pending the selection of a final design direction, we recognize the need to continue our engagements with a wide range of stakeholders.

We also shared the overall vision and key application scenarios that were developed by the main stakeholder, The University of Melbourne. This overarching direction should be considered the strategy that underpins the media façade business model, including its programming, functionality, research application and integration within the KID. Similar to digital signage, media architecture operates on underlying business models that require clear outlooks on costs versus benefits [18]. While commercial forms of media architecture most likely aim to achieve an economic benefit (e.g. encourage sales, increase visitor numbers) their cost recovery model (*return on investment*) also provides straightforward answers in the form of tenant's rental rates, advertising income or royalties from event programming. In contrast, media architecture that fulfills cultural, societal or academic purposes is typically confronted with similar design, development and maintenance costs but with complicated cost recovery options.

We believe that these forms of media architecture are best evaluated by their *return on objectives*, a metric to evaluate the success of project goals rather than cost recovery [29]. The metric seems particularly useful for non-commercial media architecture deployments, where goals may be hard to quantify, such as enhanced brand image, improved urban experience and civic engagement, increased interest from visitors, students and staff, cultural engagement, or uplift in industry collaborations. However, there is a need to better understand the impact of the metric on the appreciation of media architecture's usefulness for complex scenarios. We argue for sharing and investigating the goals of media architecture more publicly to help (future) clients, operators and project coordinators build a case for non-commercial media architecture and generally encourage the uptake beyond common scenarios of commercial advertising.

6.3 Sharing the Design Processes Behind Media Architecture

Analogous to our argument for sharing the objectives that drive media architecture projects, we argue for more design processes of large-scale media architecture projects be documented and shared. Widespread access to the learnings from past design processes will

help develop a better understanding of the forces at play, such as relevant and required project stakeholders, their agendas, and successful stakeholder engagement strategies. And ultimately, we envision that better access to design processes will stimulate the uptake of media architecture within the architectural design discipline and promote endeavors that go beyond the traditional notion of rectangular and screen-based formats that solely focus on commercial advertising.

In support of this argument, we believe that the media architecture community now also needs to (1) investigate the building metrics of media architecture; and (2) support the emergence of media architects as interdisciplinary experts that advise and assist architects in the design process.

Understanding media architecture metrics. Design processes of media architecture are influenced by significant architectural, urban, technical and strategic challenges. Exposing the design processes and the methods that are employed to address these challenges will help practitioners and (future) clients better recognize the full scope of media architecture design and the stakeholder engagement in the process. Notably, we believe that promoting wider access to accounts of design process ultimately helps to gain a better understanding of metrics that are not typically addressed in media architecture research yet dominant in the building and construction industry, such as replacement and maintenance models for media architecture components, impact on architectural appeal, effects of urban and dynamic lighting on public health, and comfort and energy ratings.

Establishing a profile for media architects. We collaborated with property developers, university executives and the academic community, architects, lighting designers, façade engineers, product designers, service designers and builders. While this may be a representative group for most media architecture projects, we recognize that the specific characteristics of other projects may require the involvement from additional stakeholders, such as marketeers, investors, homeowners and residents, and policy makers. Notably, as global media architecture projects keep growing in number and in complexity, we feel encouraged to introduce the notion of *media architects*; experts in the field of media architecture that coordinate projects from conception to delivery, such as by providing strategic advice to clients, liaising between architects, lighting designers, property developers, façade engineers and project stakeholders, articulating client expectations into objectives and metrics, and enabling unique curatorial practices around the proposed media architecture. Through their holistic perspective on the digital, architectural and urban implications, media architects should also advise on suitable design direction of concepts and proposals, audience profiles, costs versus benefits, management strategies and, potentially, monetization models or funding and sponsorship opportunities. Moreover, the academic involvement of media architects may help strengthen the notion of media architecture as an expertise that is interdisciplinary in nature and that requires continuous engagement with related fields to investigate emerging trends and recent innovations.

7 CONCLUSION

We documented and reviewed the design process of media architecture as part of *Melbourne Connect*, a new KID in Melbourne, Australia. We described the design process, ranging from the client's formulation of vision and design direction, to the design team's analysis, stakeholder engagement process and subsequent articulation of design proposals.

By reflecting on our process through the lens of client and design team, we recognized a unique capacity for media architecture to be embedded within the built form of KID developments. While media architecture seems to provide an ideal building-sized medium to externalize research activities and provide engagement opportunities, we observed additional exciting synergies between KIDs and media architecture in terms of (1) their interdisciplinary nature, (2) mutual place-making qualities, and (3) opportunities to provide living labs that enable studies in real-world environments. Noting that our case involved media architecture for non-commercial purposes, we illustrated the need for novel metrics that enable the assessment of media architecture's return on objectives (in addition to its return on investment). We argue for more openly sharing these objectives of global projects, so as to support future clients and practitioners in assessing the suitability of media architecture for their intended purposes. We believe that wider access to those objectives enables new research initiatives that unravel the social and cultural marketing qualities of media architecture. Once these qualities gain wider recognition, we envision an uptake in media architecture in cultural contexts, rather than remaining predominantly popular in environments with unambiguous returns on investment.

Our contribution highlights the notion that media architecture is a developing discipline that benefits from a deeper understanding of design processes. While these may often remain unreported to protect intellectual property, we believe their common knowledge may motivate further adoption of media architecture within the architectural and building development chain. We recognize an opportunity for media architects to emerge; domain experts that deliver strategic advice to clients and coordinate projects from conception, through design, to delivery, ultimately warranting the capacity of media architecture to create cultural meaning. Further research should enable the articulation of the professional profile of media architects. For instance, should they be qualified architects or lighting designers, technologists, construction managers or communication specialists; which related fields should they be familiar with; and how do they best manage a 'typical' design process? Answering these questions will ultimately also reveal how clients—including those who may be unaware of the capabilities of media architecture—are best convinced of its usefulness and added quality to the experience of the urban environment.

REFERENCES

[1] Carmelo Ardito, Paolo Buono, Maria Francesca Costabile, and Giuseppe Desolda. 2015. Interaction with Large Displays: A Survey. *ACM Comput. Surv.* 47, 3 (2015), 1–38. https://doi.org/10.1145/2682623

[2] Angelo Battaglia and Diane-Gabrielle Tremblay. 2011. 22@ and the Innovation District in Barcelona and Montreal: A Process of Clustering Development between Urban Regeneration and Economic Competitiveness. *Urban Studies Research* 2011, 6 (2011), 1–17. https://doi.org/10.1155/2011/568159

[3] Moritz Behrens, Ava Fatah gen Schieck, and Duncan P Brumby. 2015. Designing Media Architectural Interfaces for Interactions in Urban Spaces. In *Citizen's Right to the Digital City*. Springer Singapore, Singapore, 55–77. https://doi.org/10.1007/978-981-287-919-6_4

[4] Martin Brynskov, Peter Dalsgaard, Tobias Ebsen, Jonas Fritsch, Kim Halskov, and Rune Nielsen. 2009. Staging Urban Interactions with Media Façades. In *Proceedings of the IFIP TC13 International Conference on Human-Computer Interaction (Interact '09)*. Springer, Berlin, Heidelberg, 154–167. https://doi.org/10.1007/978-3-642-03655-2_20

[5] Cosgrave, Ellie, Arbuthnot, Kate, and Tryfonas, Theo. 2013. Living Labs, Innovation Districts and Information Marketplaces: A Systems Approach for Smart Cities. *Procedia Computer Science* 16 (2013), 668–677. https://doi.org/10.1016/j.procs.2013.01.070

[6] Peter Dalsgaard and Kim Halskov. 2010. Designing Urban Media Façades: Cases and Challenges. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems 2010*. ACM, New York, NY, USA, 2277–2286. https://doi.org/10.1145/1753326.1753670

[7] Peter Dalsgaard and Kim Halskov. 2017. Designing Media Architecture: Methods and Tools. In *Media Architecture: Using Information and Media as Construction Material*, Alexander Wiethoff and Heinrich Hussmann (Eds.). De Gruyter, Berlin, Boston. https://doi.org/10.1515/9783110453874-009

[8] Pablo D'Este and Markus Perkmann. 2010. Why do Academics Engage with Industry? The Entrepreneurial University and Individual Motivations. *The Journal of Technology Transfer* 36, 3 (Feb. 2010), 316–339. https://doi.org/10.1007/s10961-010-9153-z

[9] Ava Fatah gen Schieck and Shaojun Fan. 2012. Connected Urban Spaces: Exploring Interactions Mediated Through Situated Networked Screens. In *Proceedings of the 8th Space Syntax Symposium (SSS '12)*. PUC, 8201–8209.

[10] Patrick Tobias Fischer and Eva Hornecker. 2012. Urban HCI: Spatial Aspects in the Design of Shared Encounters for Media Facades. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12)*. ACM, New York, NY, USA, 307–316. https://doi.org/10.1145/2207676.2207719

[11] Richard Florida. 2003. Cities and the Creative Class. *City and Community* 2, 1 (2003), 3–19. https://doi.org/10.1111/1540-6040.00034

[12] Claude Fortin, Steve DiPaola, Kate Hennessy, Jim Bizzocchi, and Carman Neustaedter. 2013. Medium-Specific Properties of Urban Screens: Towards an Ontological Framework for Digital Public Displays. In *Proceedings of the Conference on Creativity & Cognition (C&C '13)*. ACM, New York, NY, USA, 243–252. https://doi.org/10.1145/2466627.2466629

[13] Claude Fortin, Carman Neustaedter, and Kate Hennessy. 2014. The Appropriation of a Digital Speakers Corner: Lessons Learned from the In-the-Wild Deployment of Mégaphone. In *Proceedings of the Conference on Designing Interactive Systems (DIS '14)*. ACM, New York, NY, USA, 955–964. https://doi.org/10.1145/2598510.2598534

[14] Kim Halskov and Tobias Ebsen. 2013. A Framework for Designing Complex Media Facades. *Design Studies* 34, 5 (Sept. 2013), 663–679. https://doi.org/10.1016/j.destud.2013.04.001

[15] Sachi Hatakenaka. 2004. *University-Industry Partnerships in MIT, Cambridge, and Tokyo: Storytelling Across Boundaries.* Routledge, New York, NY, USA. https://www.taylorfrancis.com/books/9781135938659

[16] Luke Hespanhol and Martin Tomitsch. 2015. Strategies for Intuitive Interaction in Public Urban Spaces. *Interacting with Computers* 27, 1 (2015). https://doi.org/10.1093/iwc/iwu051

[17] Bruce Katz and Julie Wagner. 2014. *The Rise of Innovation Districts: A New Geography of Innovation in America.* Brookings Institution, Washington D.C. https://www.brookings.edu/essay/rise-of-innovation-districts/

[18] Keith Kelsen. 2012. *Unleashing the Power of Digital Signage: Content Strategies for the 5th Screen.* Routledge. https://doi.org/10.4324/9780240813035

[19] Henrik Korsgaard, Nicolai Brodersen Hansen, Ditte Basballe, Peter Dalsgaard, and Kim Halskov. 2012. Odenplan: A Media Façade Design Process. In *Proceedings of the Media Architecture Biennale Conference (MAB '12)*. ACM Press, New York, NY, USA, 23–32. https://doi.org/10.1145/2421076.2421081

[20] Bryan Lawson. 2005. *How Designers Think: The Design Process Demystified.* Architectural Press, Oxford, UK. https://www.elsevier.com/books/how-designers-think/lawson/978-0-7506-0268-6

[21] Gideon D Markman, Donald S Siegel, and Mike Wright. 2008. Research and Technology Commercialization. *Journal of Management Studies* 45, 8 (Dec. 2008), 1401–1423. https://doi.org/10.1111/j.1467-6486.2008.00803.x

[22] Malcolm McCullough. 2004. *Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing.* MIT Press, Cambridge, MA, USA. https://mitpress.mit.edu/books/digital-ground

[23] Scott McQuire. 2008. *The Media City: Media, Architecture and Urban Space.* SAGE Publications, London, UK. https://doi.org/10.4135/9781446269572

[24] Timo Ojala, Hannu Kukka, Tomas Lindén, Tommi Heikkinen, Marko Jurmu, Simo Hosio, and Fabio Kruger. 2010. UBI-Hotspot 1.0: Large-Scale Long-Term Deployment of Interactive Public Displays in a City Center. In *Proceedings of the International Conference on Internet and Web Applications and Services (ICIW '10)*. IEEE, 285–294. https://doi.org/10.1109/ICIW.2010.49

[25] Surabhi Pancholi, Tan Yigitcanlar, and Mirko Guaralda. 2015. Place Making Facilitators of Knowledge and Innovation Spaces: Insights from European Best Practices. *International Journal of Knowledge-Based Development* 6, 3 (2015), 215. https://doi.org/10.1504/IJKBD.2015.072823

[26] Surabhi Pancholi, Tan Yigitcanlar, and Mirko Guaralda. 2017. Societal Integration that Matters: Place Making Experience of Macquarie Park Innovation District, Sydney. *City, Culture and Society* (Oct. 2017). https://doi.org/10.1016/j.ccs.2017.09.004

[27] Michael E Porter. 2016. Location, Competition, and Economic Development: Local Clusters in a Global Economy. *Economic Development Quarterly* 14, 1 (July 2016), 15–34. https://doi.org/10.1177/089124240001400105

[28] Markus Rittenbruch, Andrew Sorensen, Jared Donovan, Debra Polson, Michael Docherty, and Jeff Jones. [n. d.]. The Cube: A Very Large-Scale Interactive Engagement Space. In *Proceedings of the International Conference on Interactive Tabletops and Surfaces (ITS '13)*.

[29] Jimmy Schaeffler. 2008. *Digital Signage: Software, Networks, Advertising, and Displays: A Primer for Understanding the Business.* Focal Press, Oxford, UK.

[30] Michael Schmitz, Dominik Scholl, Julian Saraceni, Pascal Klein, Carsten Blaser, Jorge Olmeda, Soenke Zehle, and André Miede. 2015. Spheres of Play: Designing Games and Interfaces for Media Architectures. In *Proceedings of the International Conference on Entertainment Computing (ICEC '14)*. Springer, Cham, Cham, 490–495. https://doi.org/10.1007/978-3-319-24589-8_45

[31] Ronald Schroeter, Marcus Foth, and Christine Satchell. 2012. People, Content, Location: Sweet Spotting Urban Screens for Situated Engagement. In *Proceedings of the Conference on Designing Interactive Systems (DIS '12)*. ACM, New York, NY, USA, 146–155. https://doi.org/10.1145/2317956.2317980

[32] Peter Schulte. 2007. The Entrepreneurial University: A Strategy for Institutional Development. *Higher Education in Europe* 29, 2 (Jan. 2007), 187–191. https://doi.org/10.1080/0379772042000234811

[33] Gary Steffy. 2002. *Architectural Lighting Design.* John Wiley & Sons, New York, NY, USA.

[34] Martin Tomitsch, Ian McArthur, M Hank Haeusler, and Marcus Foth. 2015. The Role of Digital Screens in Urban Life: New Opportunities for Placemaking. In *Citizen's Right to the Digital City*. Springer Singapore, Singapore, 37–54. https://doi.org/10.1007/978-981-287-919-6_3

[35] Andrew Vande Moere and Niels Wouters. 2012. The Role of Context in Media Architecture. In *Proceedings of the International Symposium on Pervasive Displays (PerDis '12)*. ACM, New York, NY, USA, Article No. 12. https://doi.org/10.1145/2307798.2307810

[36] Julie Wagner and Dan Watch. 2017. *Innovation Spaces: The New Design of Work.* Brookings Institution, Washington, DC, USA. https://www.brookings.edu/research/innovation-spaces-the-new-design-of-work/

[37] Alexander Wiethoff and Sven Gehring. 2012. Designing Interaction with Media Façades: A Case Study. In *Proceedings of the Conference on Designing Interactive Systems (DIS '12)*. ACM, New York, NY, USA, 308–317. https://doi.org/10.1145/2317956.2318004

[38] Alexander Wiethoff, Marius Hoggenmueller, and Eva Hornecker. 2014. Orkhēstra: On the Design of Interactive Media Architecture for Public Environments. In *Proceedings of the Nordic Conference on Human-Computer Interaction (NordiCHI '14)*. ACM Press, New York, NY, USA, 1077–1080. https://doi.org/10.1145/2639189.2670280

[39] Niels Wouters, Sandy Claes, and Andrew Vande Moere. 2015. Investigating the Role of Situated Public Displays and Hyperlocal Content on Place-Making. *Interaction Design & Architecture(s) - IxD&A Journal* 25, Summer 2015 (2015), 60–72. https://doaj.org/article/a9c8b63158b448709de762af09b5b2bb

[40] Niels Wouters, Koenraad Keignaert, Jonathan Huyghe, and Andrew Vande Moere. 2016. Revealing the Architectural Quality of Media Architecture. In *Proceedings of the Media Architecture Biennale Conference (MAB '16)*. ACM, New York, NY, USA. https://doi.org/10.1145/2946803.2946808

[41] Fredrik Wulz. 1986. The Concept of Participation. *Design Studies* 7, 3 (July 1986), 153–162. https://doi.org/10.1016/0142-694X(86)90052-9