

**SELECTION
PRESSURES
+
VALUE
ENGINEERING
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DESIGN
ADAPTATIONS**

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Museums today face many challenges. Rising costs due to inflation and supply-chain issues negatively impact new initiatives, while visitors expect exhibitions to be increasingly interactive. Nationally, natural history museums are considering how they can become more integral to STEM education and research, while also improving the accessibility of their content. In this spirit of self-reflection, the Delaware Museum of Nature and Science (DelMNS) recently completed a museum-wide, eight-year planning and renovation project supported by a capital campaign called “Museum Metamorphosis: Connecting Delaware to Our World” (Metamorphosis).¹ The Metamorphosis project was the largest renovation ever completed at DelMNS, ultimately encompassing 20,000 square feet, and including the reimagining of all gallery spaces plus building upgrades. The \$10.8 million budget was about five times annual operating expenses.

When DelMNS opened in 1972 (as the Delaware Museum of Natural History), the gallery themes were Land, Sea, and Sky, with traditional diorama-based exhibitions offering glimpses of diverse

global environments. Interpretation was primarily didactic, focusing on facts about the mammals, mollusks, and birds populating these environments.² A 2005 renovation improved circulation through and entry to the museum, replacing an underutilized but expansive boardroom with an open atrium, two multipurpose rooms, and a permanent exhibition space.

BIG RENOVATION, SMALL BUDGET AND STAFF

When Metamorphosis began, DelMNS had 16 full-time and three regular part-time staff, and hosted approximately 66,000 guests each year. The museum was firmly established as a great place to go with young kids, and programming focused primarily on K–3 students. To continue to grow, we needed to expand our audience and to become a central place for learning about topical scientific issues.

Renovation planning started with strategic visioning (2014–15), followed by market research (2016), and exhibit master planning (2016–17). Early in strategic visioning, the museum decided to rebrand itself as the Delaware Museum of Nature and Science

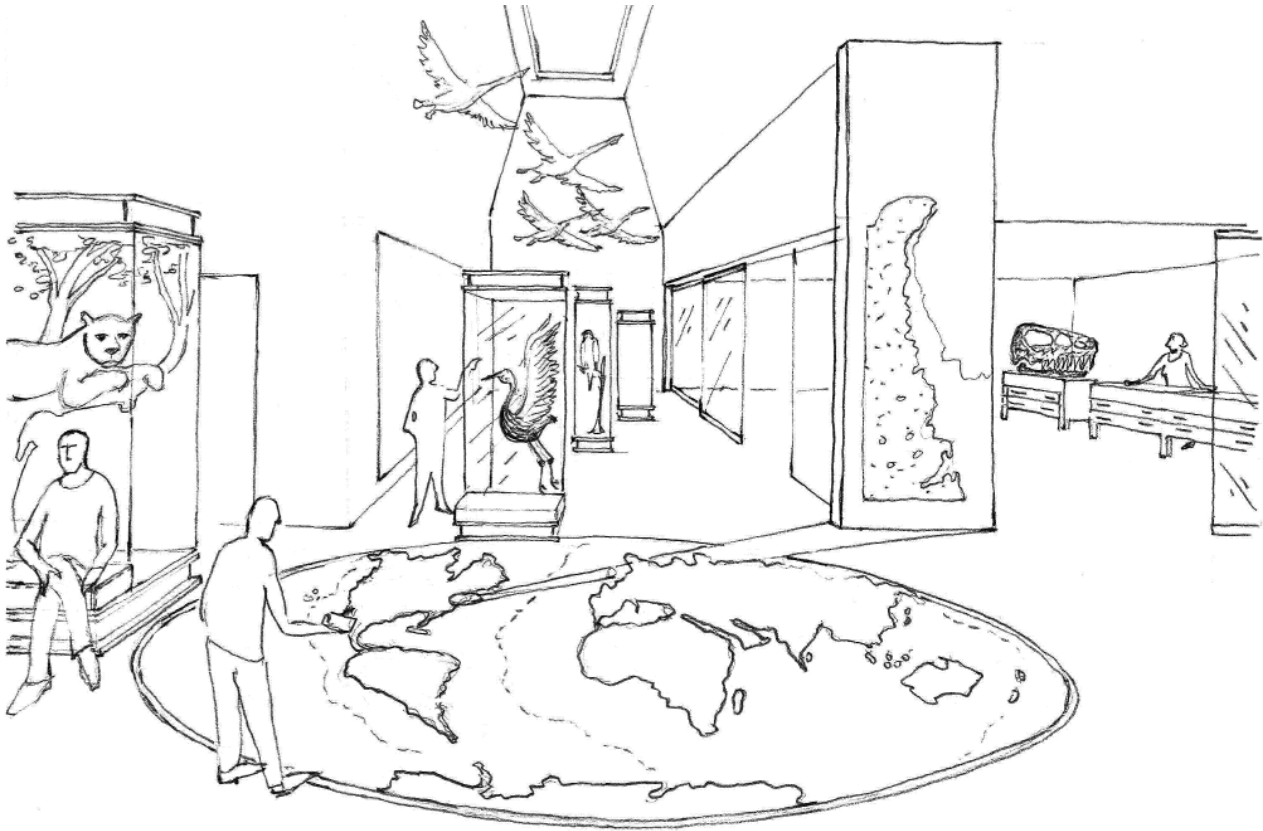


Fig. 1. The original concept for the Atrium highlighted “Biodiversity in a Changing World,” with a focus on vignettes of charismatic animals, images of biodiversity, and a giant world floor map.

to encompass all STEM topics (Science, Technology, Engineering, and Mathematics).³ This name change informed decision-making throughout the process but was not officially implemented or publicized until the reopening in 2022. Market research emphasized the public’s desire for more interactive elements and to learn more about current topics in science and technology.⁴

Based on these conversations, we arrived at the interpretative theme, “We Are All Connected.” We hoped to reveal not only that people are connected to one another and to other animals, but also the ways in which diverse ecosystems are interrelated and rely

on one another. As the subtitle of the capital campaign, “Connecting Delaware to Our World,” suggests, we wanted to demonstrate that what happens far away can have a local impact and that what we do locally can have a global impact.

With our interpretive goal in place, we began work on the exhibitions. Our goal here was to create a cohesive physical journey through diverse current and past ecosystems, highlighting the biodiversity within and exploring the physical features (e.g., fire, temperature, daylight, depth) shaping each one. The Exhibit Master Plan established Regional, Global, and PaleoZone galleries

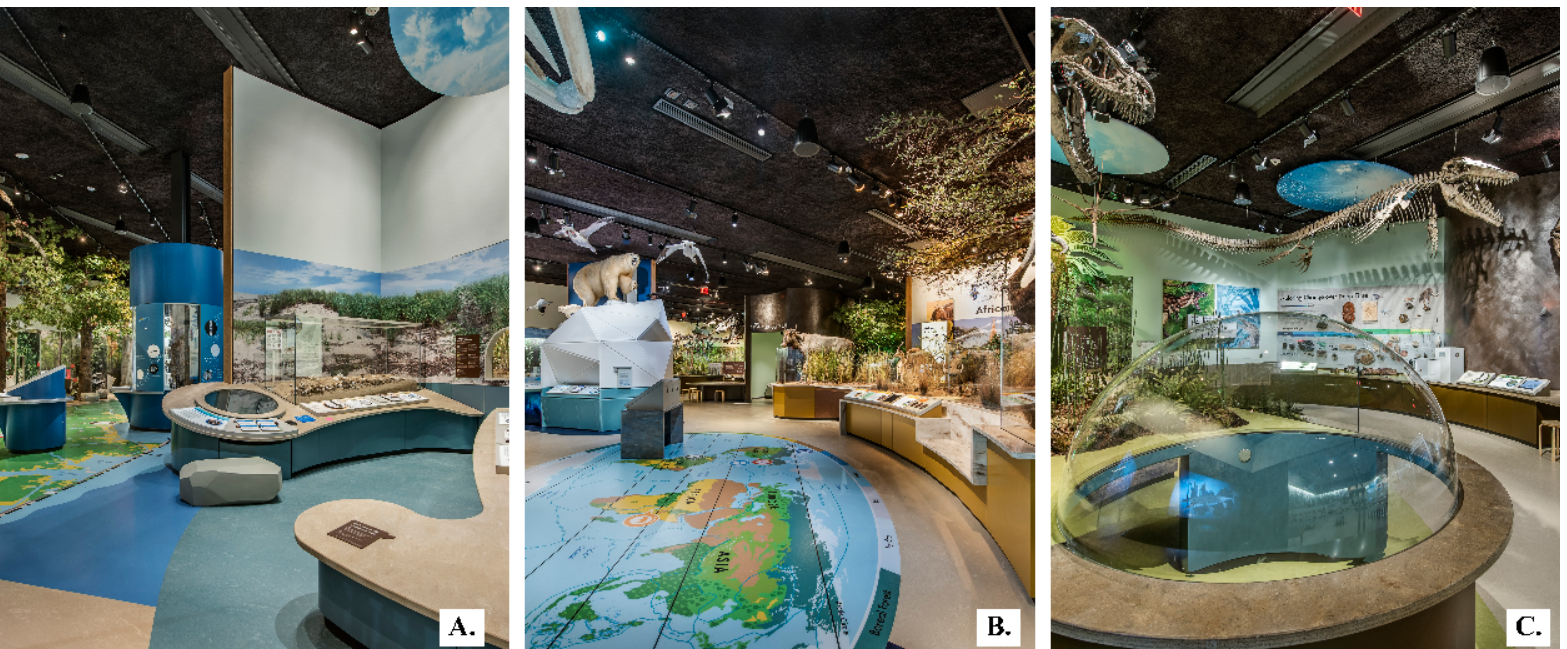
connected by the Skylight Atrium, which was envisioned as a multifunctional gathering space. Originally, we had planned to use this space to highlight the concept “Biodiversity in a Changing World” through vignettes of charismatic animals, images of biodiversity, a giant world floor map, and a dramatic overhead mobile (fig. 1).⁵

In October 2019, after a two-year pause to focus on fundraising, the renovation restarted with design workshops in which staff and key stakeholders discussed concepts, specimen selection, and layout. In these workshops, the Regional, Global, and PaleoZone galleries were revised and tweaked, but their original concepts remained intact (fig. 2). The Atrium, however, was completely reconceptualized during this phase of the project, its emphasis

shifting to “Connectivity.” Images of biodiversity were replaced with images and videos demonstrating how life is related, and biodiversity vignettes were replaced with exhibit cases explaining the fundamentals of evolution.

In March 2020, the COVID-19 pandemic forced a change from in-person workshops to weekly design meetings during which a core project team (CPT) further fine-tuned each exhibition. The CPT was comprised of nine senior DelMNS staff from across all divisions (representing almost 50 percent of full-time staff in 2019) and three senior staff from the external design company, Reich & Petch Design International (R&P). These 12 people were all involved from the beginning of the project and fell into four overlapping conceptual categories regardless

Fig. 2. The final Regional Journey (A.), Global Journey (B.) and PaleoZone (C.) galleries reflect the original concepts developed in the master plan.



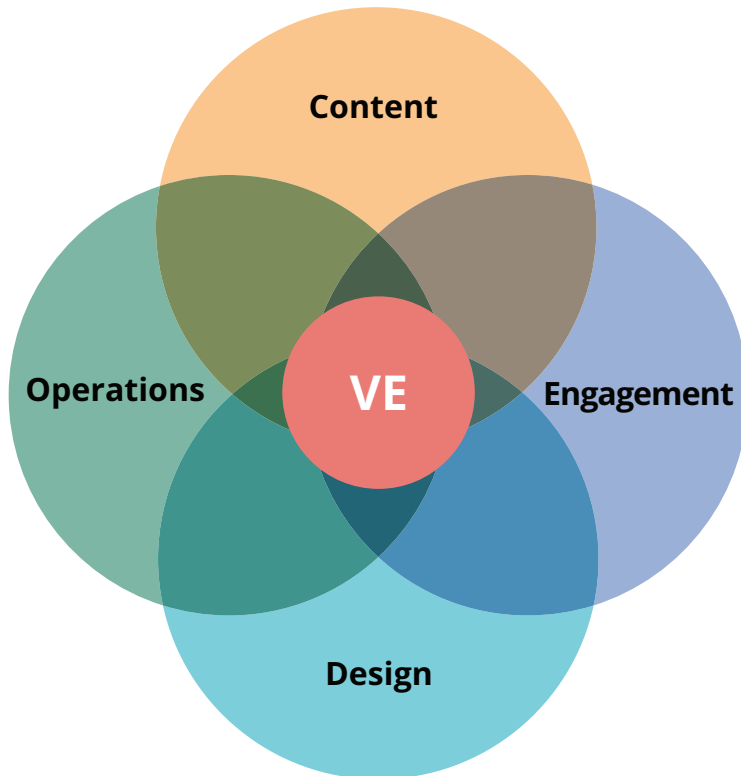


Fig. 3. A Venn diagram of overlapping conceptual areas that interacted during DelMNS's Metamorphosis project. Individual staff roles and responsibilities may be represented by one or more of these areas. All value-engineering decisions took place at the intersection of these four areas.

of their actual job titles: Design, Content, Engagement, and Operations (fig. 3).

SELECTION PRESSURES: NOT ENOUGH RESOURCES

As the design and build phases progressed, money and time became increasingly scarce. In a biological context, money and time can be considered *selection pressures* – external factors that create differential outcomes in a population where some organisms are lost and others survive. In this case, these selection pressures pushed the CPT to work quickly to reduce costs while maintaining content and experiential goals to provide a successful outcome. Navigating these selection pressures is also known as value engineering (VE).⁶

Each VE discussion and decision involved a complex interplay across the competing goals of Content, Design, Engagement, and Operations.

Value engineering started in fall 2020, after an updated estimate revealed a 25-percent cost overrun (\$1.7 million). Consequently, 20 months before reopening and while the design and build process was already underway, VE became a focal point of CPT discussions. Each VE discussion and decision involved a complex interplay across the competing goals of Content, Design, Engagement, and Operations. Decision-making was ultimately grounded in the team's answers to the following questions:

1. Is the exhibition, model, or specimen essential to understanding that we are all connected?
2. Is the information or concept duplicated elsewhere?
3. Can the design change without conceptual or experiential losses?
4. Would a different material or fabrication method lower costs?⁷

Outcomes fell into three categories. First, the team deleted certain models/specimens, exhibits, or even entire ecosystems from the plan. These deletions happened early in the VE process and led to major cost and time savings but equally large content and design losses. Second, there were shifts of responsibilities, with staff taking on additional responsibilities as “owner’s work,” including sourcing images or purchasing furniture. Finally, the team worked to adapt exhibits or concepts that were too important to lose. Some adaptations were easy to implement and financially consequential – for example, decreasing the footprint of scenic casework by a few inches along their perimeters saved over \$325,000 – while others were time and resource intensive, such as reimagining the Atrium.

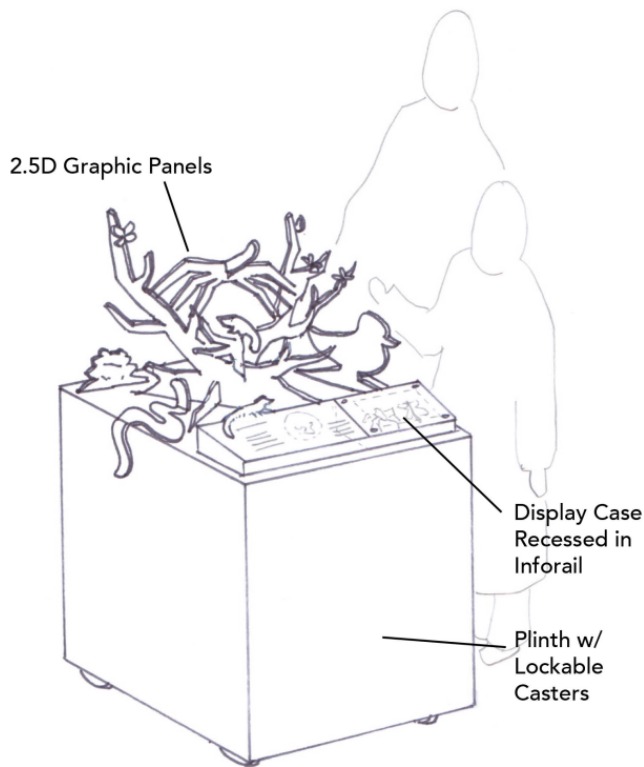
EVOLUTION OF THE ATRIUM

The Atrium is both an exhibition and event space. So, in addition to compounding time and money constraints, there was the added selection pressure of mobility because many of the exhibition elements would have to be able to be moved regularly and safely.

The first VE conversation assessed whether topics slated for the Atrium exhibition were duplicated elsewhere in the museum and whether complementary topics could be blended. We found one duplicate concept and two topics that could be combined, which together resulted in cost savings of about \$17,000. A shift away from media-based exhibits toward printed graphics saved \$42,000, and a further shift from encasing individual specimens in plexiglass to reusing an existing floor-to-ceiling glass enclosure saved another \$18,000. Staff also agreed to take on more owner’s work for mount-making and specimen installation.

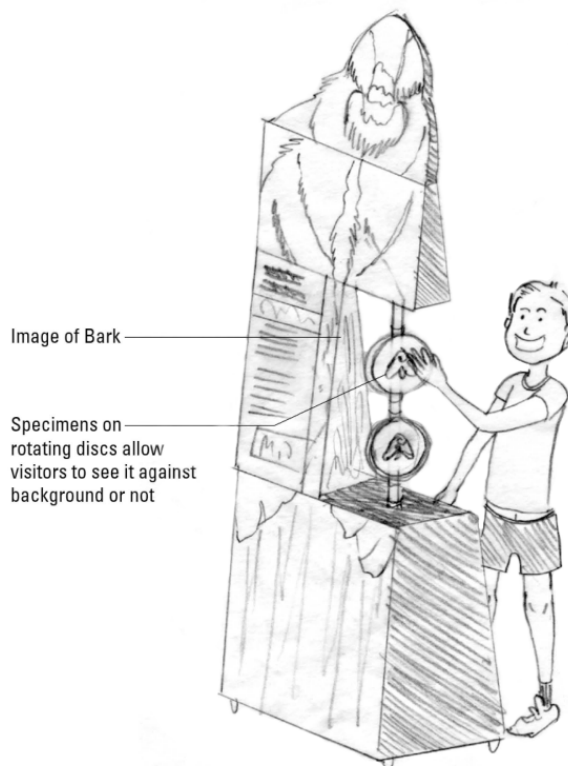
And yet, these changes were not enough to offset the cost of planned custom casework. In January 2021, with 18 months until reopening, the CPT began a complete redesign and rewrite of the Atrium’s content. Once Design, Engagement, Content, and Operations identified their requirements for a positive outcome, a subset of the CPT, including Content and Design, worked through multiple rapid design iterations with our fabricator.

The first design proposal called for 2.5D exhibits on custom exhibit plinths for each of the five remaining topic areas. These custom cases were soon replaced with three different kiosk types: one with an insert for specimens, another with a mechanical interactive, and a third with only graphic panels. Although this approach maximized Content, Engagement, and Design goals, the kiosks were not standardized and thus costly to design and build. We ultimately agreed upon a single kiosk type that satisfied all needs: moveable and with a small footprint, these wooden kiosks included front and back panels for text and graphics, a front-facing acrylic window



SELECTION Sketch

A.



B.

covering a modest specimen display case, and a mirror on their backs. (fig. 4).

In this compromise, the kiosks were moveable and costs were greatly decreased (though not driven to zero); a specimen case was retained but explanatory text was scaled back; the design changed but maintained visual interest by focusing on contour-cut specimen images; and finally, engagement and interactivity were addressed by the mirrors – opportunities for visitor self-reflection and group discussion of content-related questions such as, “How will you protect endangered animals?”

In retrospect, Atrium VE took place in three stages: optimizing and standardizing kiosk design (revising for price and production speed), maximizing the impact of specimens and interpretative materials (revising for content), and finding the most economical

materials (revising for price). The resulting kiosk design met our budgetary goals and provided the unexpected benefit of establishing a template that can be used to integrate future small-scale exhibitions into this new design language (fig. 5, p. 40).

REFLECTIONS AND CONCLUSIONS

The eight-year museum renovation brought about a radical physical metamorphosis in a very short time. We attribute our success to an experienced, engaged, and resilient staff with diverse skill sets, a history of collaborating, and low turnover, which resulted in consistent interpretation of our original design and exhibition goals.

An experienced staff can participate fully in open, rapid, and sometimes painfully honest communication. Staff representing each concept area had to articulate the minimum

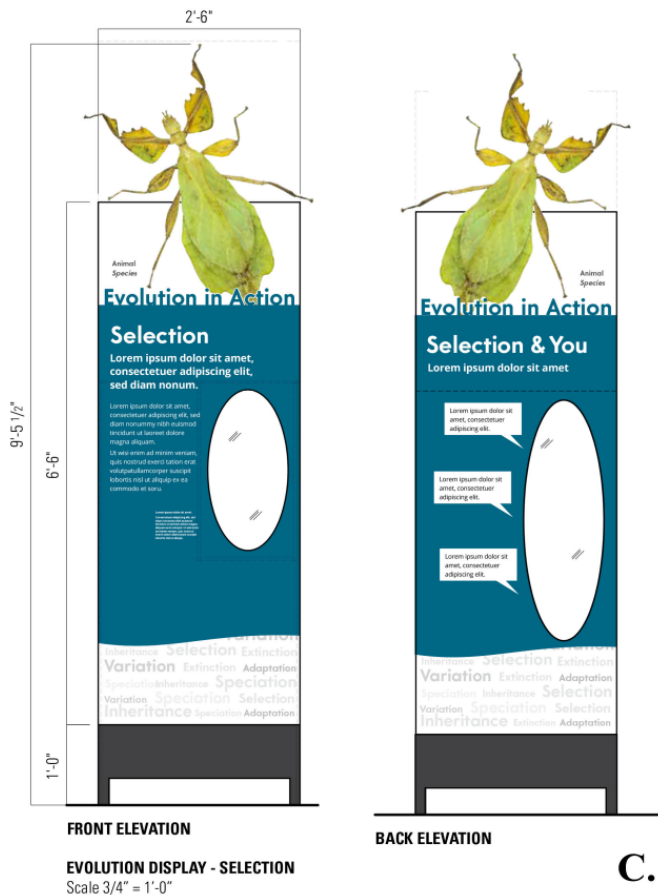


Fig. 4. Evolution of the Evolution cases. In each example, the topic is “Selection”:

- A.** A 2.5D case-based design. In this early iteration, 20 animal images were to be arranged on tree branches to demonstrate how camouflage helps animals survive.
- B.** A proposed evolution kiosk with mechanical interactives.
- C.** A graphic rendering of the final kiosk with a front-facing inset case for specimens and a back-facing mirror for visitor engagement.

acceptable outcome and feel comfortable advocating for and defending their point of view. In our case, quick decision-making was possible because of ongoing, positive working relationships both within the CPT and with our fabricator, who provided rapid insight into what changes could be implemented quickly with lower labor and material costs.

An engaged staff can find and troubleshoot problems before they get unwieldy and expensive. Although not specifically related to value engineering, the engagement of DelMNS staff helped contain costs associated with time delays during both the preparation and the execution of the project. DelMNS CPT members were on-site and available every day for walk-throughs and consultations. We built close relationships with each new team as they arrived on-site, so questions and concerns could be addressed immediately.

Staff representing each concept area had to articulate the minimum acceptable outcome and feel comfortable advocating for and defending their point of view.

A resilient staff can withstand radical change. The CPT was prepared for the renovation process to be creative and chaotic but was not prepared for the radical reorganization of life and business practices brought about by a global pandemic. Our resiliency was tested twice – once by COVID-19 and then by an unanticipated staffing loss. In both cases, we were able to reorganize and redistribute



Fig. 5. The new Atrium at DeIMNS. The mobile kiosks are set up according to the design layout. Over the course of the first six months, the kiosks have been set up in three different configurations to accommodate regular operations, small rentals, and a whole museum rental.

work quickly because the CPT had a depth of professional experience and had worked together collaboratively for so long.

Finally, in retrospect, we noticed that the amount of content loss varied depending on when VE was conducted. The earliest VE decisions were blunt actions that excised large bodies of content or scenic work, including three whole environments, but also resulted in extensive cost savings. We expect to be able to reintroduce these concepts and content areas later, once fundraising targets have been met. The second round of VE was more exacting and required us to look across exhibition areas to find cost savings. For example, replacing media-based exhibits with printed graphics or purchasing less expensive furniture. Although we recognize that these changes resulted in some lost visitor-engagement opportunities, they allowed us to maintain the overall cohesiveness of the design plan.

During this eight-year museum metamorphosis, we learned that selection pressures (time, money, and mobility) will inevitably force changes throughout the process, but that judicious value engineering can mitigate loss. And finally, this process helped us recognize that experienced, engaged, and resilient staff are essential to harnessing these stressors to drive positive design adaptations.

EPILOGUE

DelMNS reopened to the public on May 23, 2022, exactly 50 years and 10 days after the Delaware Museum of Natural History first opened in 1972. We are now

beginning to assess how well the renovation has delivered on our interpretive goal. Thus far anecdotal feedback is positive, and people are eager to visit. According to internal records, attendance is up 22 percent over the same period in 2019 (the most recent year with reliable, non-COVID-19 compromised data); membership sales are up 54 percent; and net store sales are up 112 percent.⁸ More formal, grant-supported assessments will begin soon. ■

1 Delaware Museum of Natural History, “Evolve: Re-imagine the Delaware Museum of Natural History—bold changes are afoot!” accessed December 1, 2022, <https://delmns.org/evolve>.

2 John E. du Pont, “The Delaware Museum of Natural History—Prototype for Future Museums?,” *Curator: The Museum Journal* 16, no. 2 (1973): 99–102.

3 Delaware Museum of Natural History, “Strategic Plan: Part II,” September 5, 2014.

4 Schultz & Williams, “Delaware Museum of Natural History Market Research Study Report,” May 2016.

5 Reich & Petch Design International, *Delaware Museum of Natural History Exhibit Master Plan* (2017).

6 Julien Parsons, “Capturing the essence: a client’s reflections on surviving the value engineering of a museum redevelopment project,” *Museum Management and Curatorship* 29, no. 3 (2014): 226–40, DOI: 10.1080/09647775.2014.919169.

7 Richard J. Park, *Value Engineering: A Plan for Invention* (Boca Raton, FL: St. Lucie Press, 1999).

8 These figures are drawn from the Delaware Museum of Nature and Science’s attendance summaries for 2019 and 2022; its 2022 membership analysis; and QuickBooks report for store sales.