

Sound Strategies: Life's Principles in Acoustic Panels

A Biomimicry Analysis

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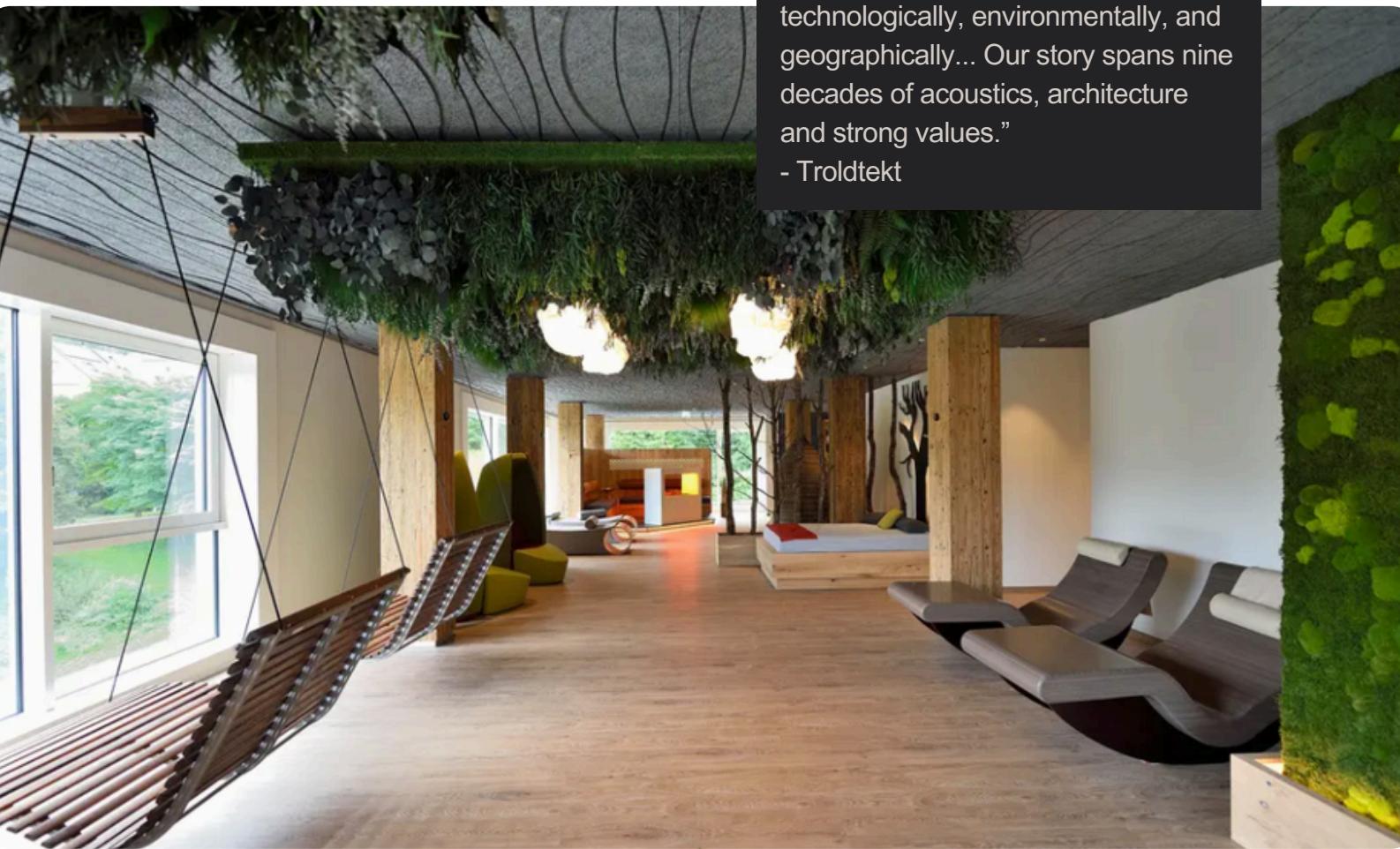
Faced with escalating climate instability and scarcity of materials and energy, today's designers are working to not only produce cutting-edge products but also to integrate their designs harmoniously with the living world. By asking the question, "What if our human designs behaved more like living systems?" we defer to nature's genius to solve our most pressing human design challenges. This biomimetic approach to design offers us an opportunity to leverage design principles that have been tried and tested by nature for 3.8 billion years. Biomimicry 3.8, the world's leading nature-positive design initiative, recognizes the deep patterns that define nature's successful strategies and articulates them as ***Life's Principles***, a framework through which living systems, and the human designs that emulate them, can solve problems while creating conditions conducive to life. The ***Life's Principles*** toolkit offers us a metric to guide the design of life-friendly solutions and assess how innovations fit into our planetary ecosystem. This review uses Life's Principles to assess a specific design: Troldekt® Acoustic Panels, an award-winning eco-conscious product line, offers a multi-functional and aesthetically appealing solution from the intimacy of personal homes, studios to sports halls, and office buildings.

Being ***Locally Attuned and Responsive*** promotes compatibility with surroundings. Troldekt sources ***readily available*** Danish sustainable timber and connects to local materials (i.e., gypsum, limestone) for manufacturing. The timber is sourced from PEFC or FSC-certified forests, a renewable resource with more trees planted than logged. A diverse product range allows panels to be combined into customized arrangements, thereby allowing designers to reconfigure the design in response to their surrounding environment and spatial needs. The company ***cultivates cooperative relationships*** with responsible lumber providers, through two-way material flows with cement manufacturer, Aalborg Portland, and with Sønderup Montage, who repurposes discarded panels. Additionally, over 90% of manufacturing electricity comes from ***harnessing freely available energy*** of local wind power.

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Along the way, we have successfully combined function and aesthetics while adapting to the trends - technologically, environmentally, and geographically... Our story spans nine decades of acoustics, architecture and strong values.”

- Troldekt





The design is **Resourceful with Material and Energy** by **fitting form to function** – exploiting panel shape, composition, thickness and pattern to impart functional acoustic qualities. Traditional cement manufacturing produces high CO₂ emissions, while FUTURECEM™ technology reduces carbon emissions by 26% compared to Troldekt's original grey cement manufacturing process. Their mindful process **recycles all materials**, returning some to the biological cycle as bedding and ground cover. Other materials are reclaimed and returned to industrial cycles to reduce landfill waste. Additionally, the panels' optimized **multi-functional design** allows them to direct and dampen sound, perform fire and humidity resistance, and serve aesthetic functions - making them versatile in a variety of spaces.

The acoustic panels **Adapt to Changing Conditions** to maintain functionality in dynamic conditions, such as the risk of fire, the high humidity environments of indoor swimming pool halls, thermal variations and adapting to different sound outputs. The design **incorporates diversity** by leveraging a variety of forms, densities, thicknesses, textured finishes, and optional added materials, such as non-woven fleece liners, for very low sound frequency contexts. These aggregate to form tailored responses to interact with the external environment.





Choosing to **Use Life-friendly Chemistry**, Troldtekt's design **uses a small subset of materials** (wood, limestone, clay) to create panels that contribute to a healthy indoor environment and are made of materials that easily decompose, **breaking down into benign and useful constituents**, such as carbon, oxygen, and calcium carbonate, at the end of the product life cycle. The design's natural materials and non-toxic byproducts earned the Danish Indoor Climate Label by eliminating volatile organic compounds (VOCs), formaldehyde, and carcinogenic substances from their production process. Their Cradle to Cradle Gold certification highlights a commitment to material circularity in both biological and technical flows. FUTURECEM is a positive step in cement manufacturing, reducing CO₂ emissions in an industry with high impact to biochemical cascades.

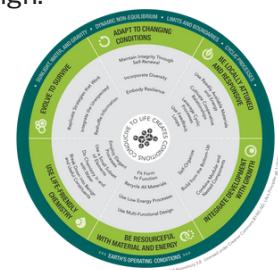


We recognize that Troldtekt misses several opportunities to foster more of **Life's Principles**. All species **Evolve to Survive** by incorporating information to create new possibilities with variation offering flexibility and enduring performance. It begs the question, has Troldtekt's 90-year legacy of manufacturing crafted a plan to reconcile with future uncertainties?

Our suggested design improvements to strengthen alignment with **Life's Principles** include **replicating strategies that work** by adding carbon capture in the cement manufacturing process to emulate *Biomineralization* by mimicking natural enamel building, and applying a safe, breathable *Lime-wash coating* turning panels into a CO₂ sink. Or incorporating *Structural Color* to further **fit form to function** by adding a *Photonic Crystal Film* to produce brilliant colors via refraction, without the use of paint.

Furthermore, life flourishes intelligently to **Integrate Development with Growth**, a natural balancing act to ensure expansion is adequately supported. This could be achieved by investing in gradually assembled units that are **built from the bottom up**, and syncing interconnected components by **self-organization**. While the design reflects the strategy of a *modular approach*, this principle could be improved. We suggest **combining modular and nested components** by embedding a membrane layer of compostable, carbon-negative *Biochar* in panel cores to purify air, mitigate moisture and sound, and by incorporating *Piezoelectric discs* to adeptly convert absorbed sound waves into electric energy.

The final biomimicry question: does this **Create Conditions Conducive to Life?** Though we identified opportunities for deeper alignment with **Life's Principles**, Troldtekt's dedication to sustainable resource management and manufacturing promotes the health of people and the planet, showing commitment to life-friendly design.



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Troldtekt Resource Hierarchy Diagram, 2024

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