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Sustainable Strategies and Practical Research in Innovative Structural Packaging Design

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Abstract. This paper aims to examine the paradigm shifts that structural packaging design is currently facing in terms of sustainability exposing the key changes that address not only consumer's behaviour, but also the manufacturing process from early stages of the design with radical approaches to incremental solutions, that are contributing on a large-scale ecological transformation. The paper presents 4 case studies as practical innovative research resulted from complex design processes and methodologies analysis displaying viable solutions in various packaging sectors such as cosmetics, food, and beverages.
Keywords: *packaging, design methodologies, sustainability, innovation*

Paradigm shifts and innovative premises

By its nature, packaging design has possessed an *oxymoronic* function: in the first stages of the life cycle is crucial because it protects the content before consumption, but it becomes completely useless immediate after discharge. It is a known fact that packaging sector is corelated with high levels of plastic consumption which is causing concerning pollution to the environment, due to its low recycling rate. However, examining the current context in comparison with other areas from the design field, it is by far noticeable that structural packaging design is currently facing one of the biggest transformations in comparison with furniture design, for example, where small incremental progress is noticed (excepting aesthetic improvements, a series of new materials are introduced and tested without ground-breaking structural innovations). According to statistics, around 40% plastic consumption is resulted from the packaging industry, while the plastic waste that ends up in the landfill is almost 23%.

Designing a multipurpose packaging and offering the possibility of conversion to a second life could represent, in some cases, a user-oriented solution to avoid unnecessary consumption of material (beside recycling it entirely or designing it from a dissolvable material that would eventually disappear) and thanks to a statistic research study made by Datamontier on sustainable packaging we already know that around 48% of end users are adjusting the consumer expectations and would seek alternative products that avoid excessive packaging. Another key factor to consider beside the consumer choice is legislation and ethical responsibility of governments to impose design standards in the choice of materials (and their recyclability) and the methods of manufacturing to obtain material reduction.

Often seen as a mirror that reflects the content, the role of packaging is divided in 2 main areas of interest that refers on one hand, to the storing of the interior by protecting and portioning it into portions/units and, on the other, to the communication of brand values and informing the end customer on technical data (like ingredients, quantity etc.). Structural packaging confronts with the provocation of fundamentally reinventing itself and the alteration is generated by the overall ecological context that constrained manufacturers to identify new solutions to optimize the process of designing containers which address one of the two main issues: firstly, packaging that contain water as a quantitative primary ingredient and secondly, packaging that can be used/filled/refilled [1] several times and could not be discarded after the content is consumed.

From sustainable printing using ink-based inks (instead of the one made from oils), lighter plastics with fewer colorants, the usage of less materials on the containers[2] and on labels (or none)[3], the simple choice of using recycled materials (paper being the most common) or avoiding the transportation of water based-products, these simple incremental measures would contribute substantially when implemented on a global scale. One of the latest and most impactful trends in structural packaging is reconsidering the basic idea of transporting water-based products[4] from a location to another, especially in areas which do not confront themselves with water shortage (the water quantity varies depending on the product category between 60% to 95%). In this regard, some manufacturers from the cosmetic sector opted for water-free solutions (solid products which in combination with tap water become effective), which implied that products like shampoo bottles where rapidly replaced by solid bars, shower gels were sold as solid versions, soaps as dry sheets and so on, while others reinvented the distribution system proposing a main container (which is not disposable) and plastic pouches for filling the primary packaging[5]. In the beverages sector, manufacturers invested in personalized brand soda streams (a home appliance that converts tap/filtered water into sparkling) or proposed small that concentrated formulas that are later combined to obtain the final beverage.

Thus, from a sustainability point of view, the solution for the packaging sector consists in systemic, incremental improvements and should be focused not only in the design of the package *per se*, but also on designing the logistics with implications in all the stages of the life cycle (manufacturing, transportation, distribution, retail and at the customer) in order to obtain industrial ecology, that should be regulated by government guidance through measures such as Extended Producer Responsibility assign the responsibility not the state, but to the manufacturers.

Practical research. Study cases.

Aiming to implement **s**ustainable methods to identify solutions to improve the degree of sustainability on packaging design, several projects where developed that address the issue in several manners. All the practical research projects were subjected to a rigorous design process including a research phase (which contains a competitive market analyses), a creation stage (where multiple possible solutions were debated) and a refinement of the final proposal with renderings, models, and CAD technical drawings.

Designed by product designer Alexandra Ghioc together with mechanical engineer George Amurăriței for the international competition „Disruptive Plastic Packaging Challenge", the innovative shampoo and conditioner packaging proposal consists in a single body container which integrates dividing interior walls that separate the two liquids offering a 2 in 1 multi-purpose product packaging. Inspired by the succession of functions (the usage of shampoo first and conditioner afterwards) and the

[1] In 2010, Mor Cosmetics launched a product body line that was refillable and its main container is made from wood
[2] In 2010, product designer Yves Behar creates for international brand Puma "Clever Little Bag"-a smart packaging for shoes that reduced the cardboard usage by 65%
[3] In 2021, laundry detergent company Omo was awarded with Pentawards in sustainability category for presenting a packaging design where all the graphic elements were embossed instead of printed
[4] This has a significant impact on numerous areas such as beverages, cosmetics, or cleaning products
[5] The first pouches recognized as the first flexible packaging design implemented was patented in 1968 by the French manufacturer Thimonnier for the Doyen stand-up "W" fold version

specific geometry typology of each container, the packaging proposal consists in two caps (one at the bottom and one on the top) and a main container (divided between 400 ml shampoo and 200 ml conditioner). The final package is obtained through coating the transparent container for shampoo and conditioner maintaining two vertical areas for the visibility of the interior liquid.

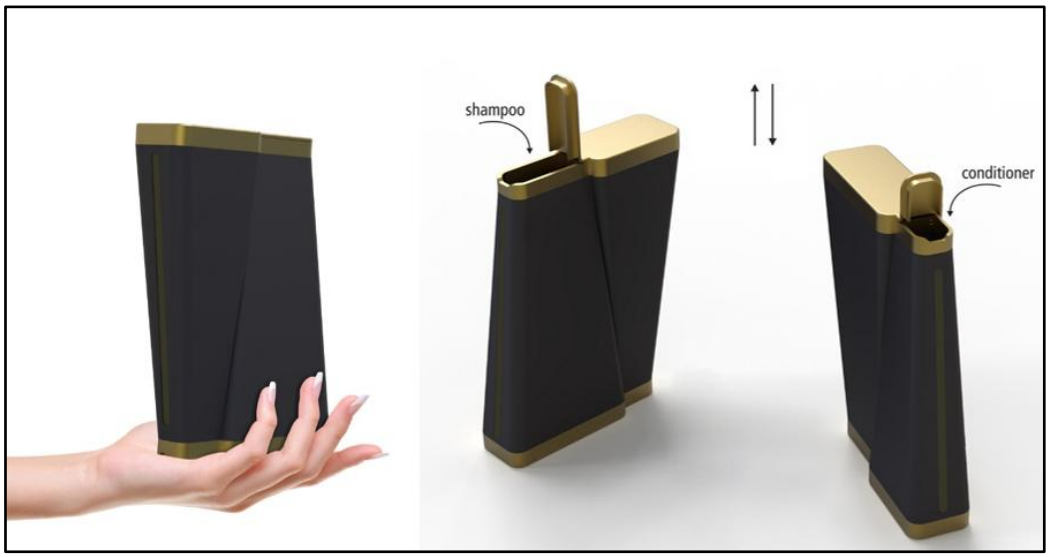

Figure 1. Innovative Shampoo and Conditioner Packaging

The proposal is sustainable not only through the usage of recycled plastic as the main material, but also by reducing the quantity of used packaging, the implied resources from the manufacturing process (producing, manoeuvring, storing, filling etc) and assures the manufacturer the acquisition of 2 products simultaneously. The innovative packaging questions the need for manufacturing two separate containers, when they are produced by the same brand and offers a premium aspect in comparison with the competitive market.

Figure 2. Innovative Shampoo and Conditioner Packaging (structural details)

Created in 2019 as a proposal for an internationally known brand, The Tuna Salad Packaging aims to redesign the concept canned food (namely vegetables and fish) as a standalone meal and tries to promote it as an idea of healthy option by offering a new packaging structure that allows the end-user to visualize the ingredients that are used in the preparation. Designed for 190 grams as a "to go" meal the packaging is divided in 2 parts: the bottom, which contains tuna and will be used as the main plate and the upper part, which consists in the detachable lid that contains individually sealed compartments (the number can vary between 3 to 6) for vegetable groups, seeds or cereals. In the bottom part, the packaging has also an assigned place for a napkin and *sfork* (a tool that combines a fork with a spoon) helping the user to have a to go meal.

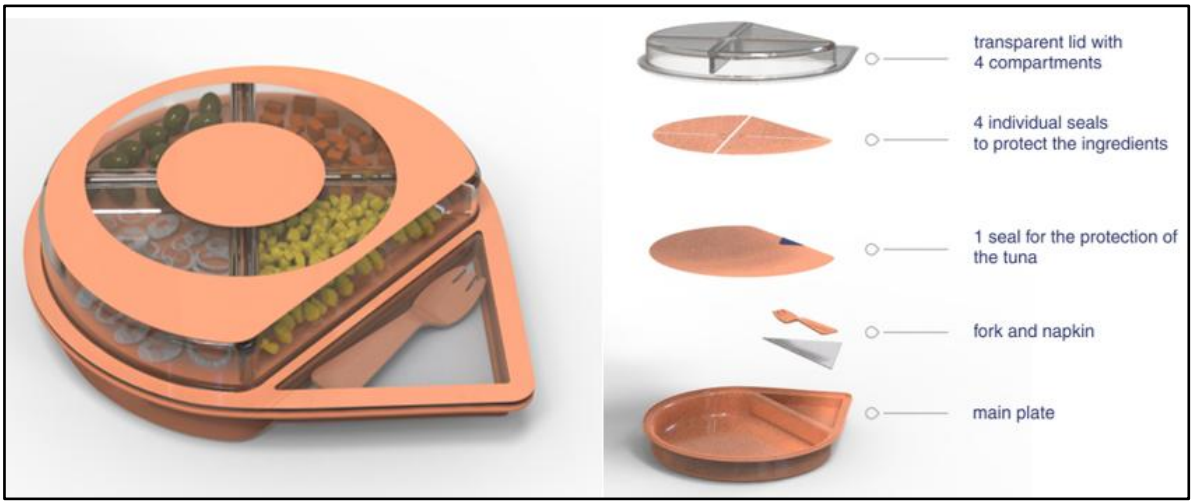

Figure 3. Innovative Tuna Salad Packaging

Thus, by designing a 2-compartment recycled plastic packaging (with one transparent and one opaque), the proposal solves to main issues: firstly, the visual problem (fresh food is often presented in transparent containers, while fish is considered unappealing and is recommended to be stored in opaque ones) and secondly offering the user the possibility to choose which ingredient he/she prefers to mix into the salad (avoiding allergies or taste preferences).

By creating a new packaging typology, the manufacturer can switch without any additional costs the ingredients and create new mixes and culinary options, making it an attractive option, that would stand out on the shelf through diversity, but also through its innovative and sustainable approach.

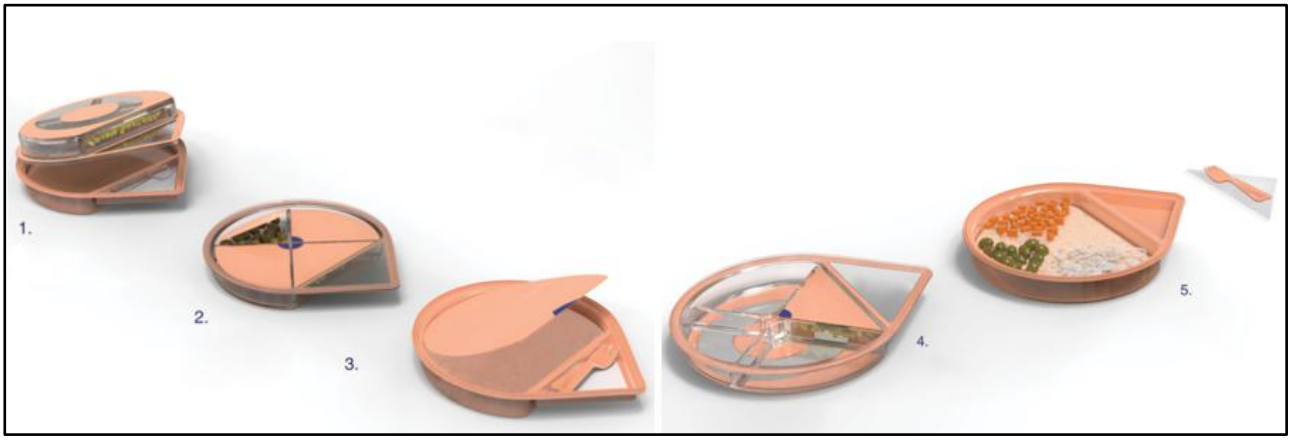

Figure 4. Steps of usage for the Innovative Tuna Packaging

Created in 2023 by product designer Alexandra Ghioc in collaboration with engineer Dragos Mititelu, the proposal consists in a new mechanical typology of nebulization which is based on squeezing a deformable volume/part of a container (without using any gas). The aim is to reduce a liquid into small particles that pass with high speed (using pressure created by air jet) though a very narrow construction. The eco-friendly proposed nebulizing system consists from 4 parts: the cap (1), the ring (2), the pipe (3) and the actual container (4) that the user squeezes. The cap, the ring and the pipe are designed as an assembly that is fastened to the body (container) by threading which allows the packaging to be (re)filled.

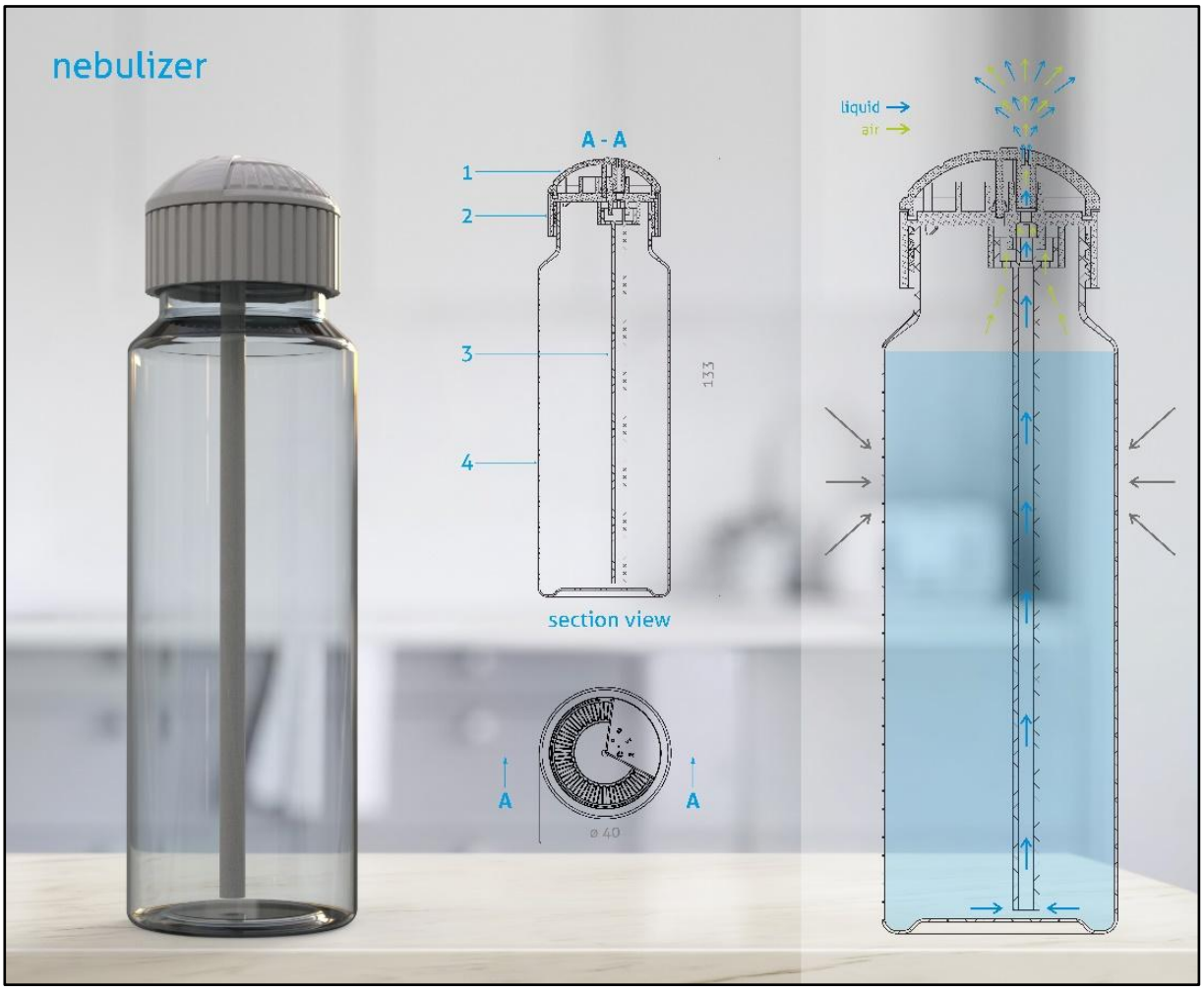

Figure 5. Innovative 4-part nebulizing system. Section views

The innovation of the system consists in the possibility of adjusting the quantity of droplets sprayed. The user presses the cap (1) which is clipped to the ring and rotates it to the desired position (0= OFF, 1 for medium spraying, 2 for high spraying).

However, the holes from the cap can be resized according to the density of the liquid. All of the parts can be manufactured through injection moulding, from recycled PE or PP. The assembly is designed for 500 ml, is versatile for multiple industries (cosmetics, food, and hygiene sectors), prevents spillage, works upside down and can be used with one hand.

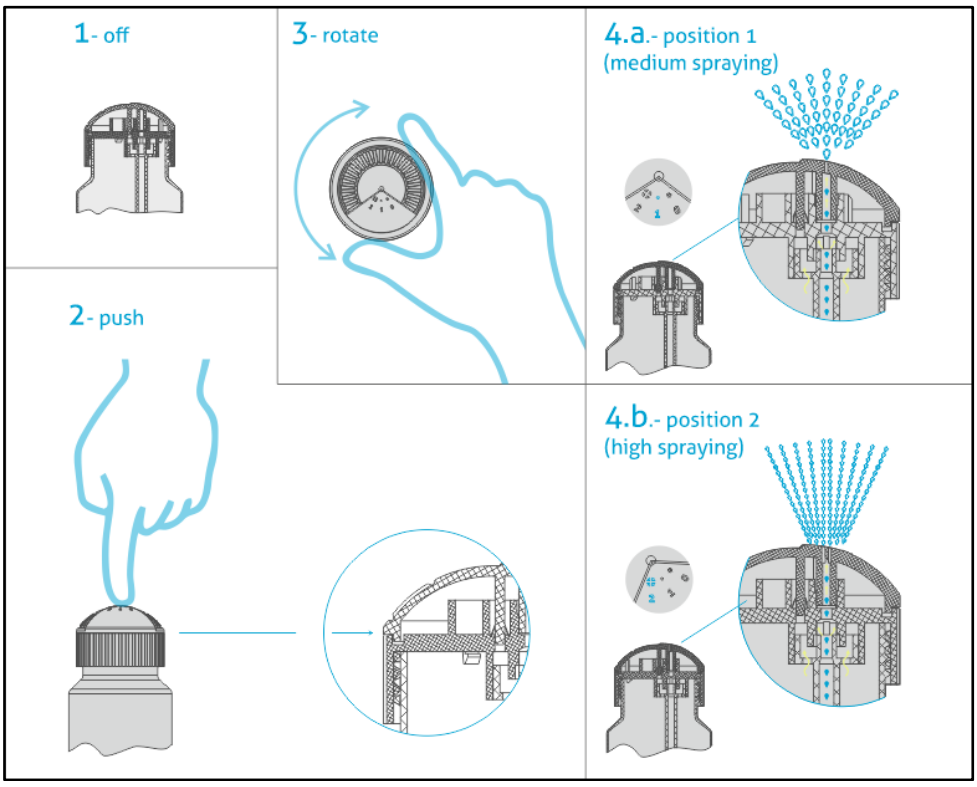

Figure 6. Steps of usage of the 4-part nebulizing mechanism

Designed by Alexandra Ghioc together with visual artist Radu Carnariu as a premium bottle, ”Star Brasil” packaging combines the essential elements that define the identity of Brazil from a cultural stand point and uses as an inspiration starting point Brazilian traditions, the instrument caxixi, urban mosaic installations, multiple geometric patterns and iconic elements. The packaging proposal aims to create a celebratory bottle as an identitarian tribute to Brazilian complex culture that joins harmoniously its diversity, customs, and modernity in an urban mosaic.

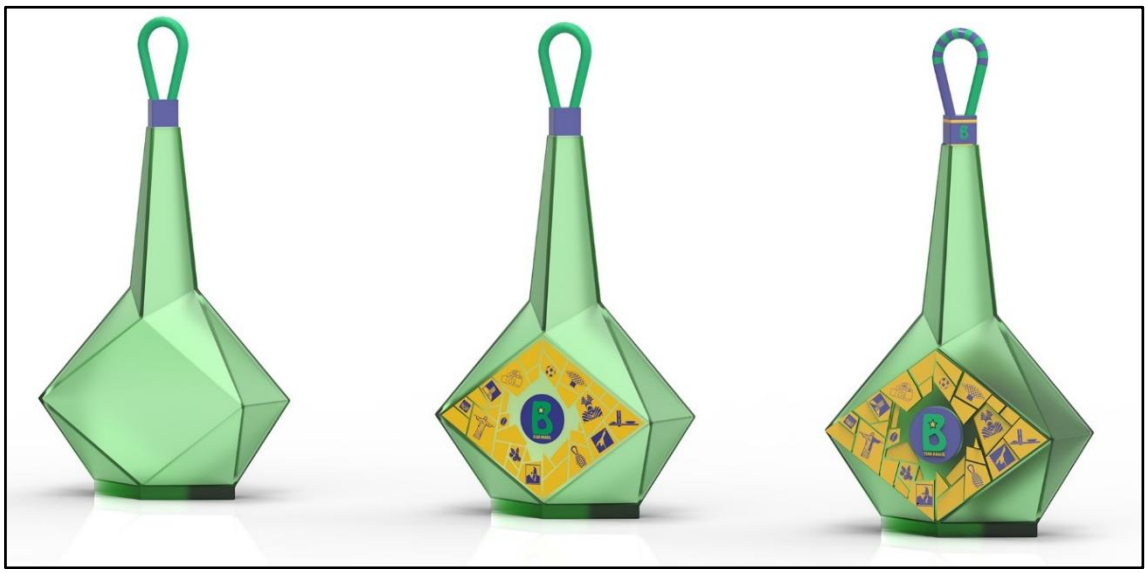

Figure 7. Star Brasil- celebratory bottle packaging

The starting point of the main recycled-glass container is the rhombus shaped-like flag of the country, the label is divided like in a mosaic of small icons (that illustrate emblematic crafts, fruits, music instruments, iconic buildings, authors, or customs) and the cap is a reinterpretation of the instrument caxixi. Through the dynamic and creative interpretation of these motivational sources of inspiration and the vivid conceptual process in designing this both cultural and industrial product, the packaging can be repurposed as a vase, offered as a trophy, or refilled.

Figure 8. Star Brasil- celebratory bottle packaging (chromatic options)

The case studies presented above exhibit a series of examples based on practical research resulted after applying the design process framework. Thus, although sustainability might be considered a non-achievable goal from a macro perspective, small changes presented through actual or possible products could provide small, incremental changes, which, if implemented on a large scale, would represent valid solutions towards an improved ecological context.

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