International Journal of Manufacturing Economics and Management
ISSN 2784-1278 ISSN-L 2784-1278, Vol. IV, No. 2 / 2024
https://doi.org/10.54684/ijmem.2024.4.2.73

INNOVATION BY DEVELOPMENT OF PRODUCT: FROM SENSORY MARKETING TO SENSORY DESIGN

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Abstract: To maintain market leadership, companies must continually develop new products that align with consumers' needs and preferences. The objective of this study is to assess a novel product design and identify its sensory attributes that significantly influence consumer choice. Amidst a competitive and evolving market landscape, the manufacturing department faces the challenge of effectively meeting consumer demands and preferences. This study proposes a multi-sensory design approach that integrates various scientific and technological disciplines to create products that are "intelligent", "reliable", and "ecological". Central to this approach is placing the end-users at the forefront of design thinking, ensuring their needs, expectations, and characteristics are considered at every stage of the innovation process. Addressing this overarching challenge necessitates a comprehensive examination of the emotional, sensory, ergonomic, sociocultural, functional, technical, ethical, and aesthetic aspects encountered by individuals across diverse life situations. By the unic design proposed, at the heart of this endeavor lies a newly proposed product, offering the opportunity to compare the newly developed product design with its predecessor.

Key words: Design, manufacturing, sensory, innovation.

1. INTRODUCTION

In order to maintain their position at the forefront of the market, businesses must consistently innovate by developing new products that meet the needs and desires of their customers. The objective of the task outlined in, [1] is to evaluate a new product design. The key findings highlight the sensory attributes of the ideal product that influence consumers' purchasing decisions. In a fiercely competitive and rapidly expanding market, the manufacturing department faces the challenge of effectively meeting customer demands.

This article emphasizes the importance of the human component in product development. There is compelling evidence of a strong correlation between key components of the product development process, such as the human factor, ergonomic principles, equipment, and environment.

A product, whether it's a process, an object, or a service, is conceived and developed by humans to fulfill a specific need. Industrial products, uniquely, are manufactured by industries—groups of individuals operating within social, economic, and technical constraints. The physical manifestation of industrial products is a response to client needs and usage requirements. Businesses then implement these solutions. One method involves analyzing a virtual solution using a digital model before it becomes physical. This approach allows for the examination of a system as a study model for functional and technical analysis.

The project aims to develop a product that is both functional and aesthetically appealing. The design process may involve various levels, [4]. The level at which the proposed product is categorized is known as 'product design,' which involves conceptualizing the product while simultaneously addressing technical engineering aspects. This phase requires collaboration between designers and marketing specialists, integrating mechanical engineering activities. The product is planned throughout the entire project cycle, from studying components to product release. From a creative standpoint, technical solutions are tailored specifically for this product rather than being generic solutions for other products.

New product launch: Introducing new items into the market is a costly endeavor that requires careful handling. By the time a product is introduced, it has undergone a thorough process. This process starts with identifying an unmet need, progresses through product development, packaging, and naming,

culminates in the creation of a communication plan, and includes analyzing appropriate positioning, [5].
As the demand for innovation increases, generating new products poses significant challenges, with only a small percentage of concepts proving successful in the market. Research is paramount before embarking on any marketing initiative. Conducting a comprehensive study of all elements and variables influencing the success of an endeavor is essential before launching a product, devising a marketing strategy, or venturing into new market segments [6]. In this context, research efforts are concentrated on introducing a new product. It's crucial to understand in advance the required resources, consumer perceptions of the new product, and its projected profitability.

2. MATERIALS AND METHODS: PRODUCT MODELING

The initial step in product design involves creating sketches to outline the desired design. One effective approach to realizing the desired concept is to produce multiple small-scale iterations. These iterations aim to refine the desired form and explore various approaches to the intended product. A practical method for generating these rapid variations is to divide a single sheet of paper into four or more sections, allowing for the exploration of numerous solutions, [4, 7].

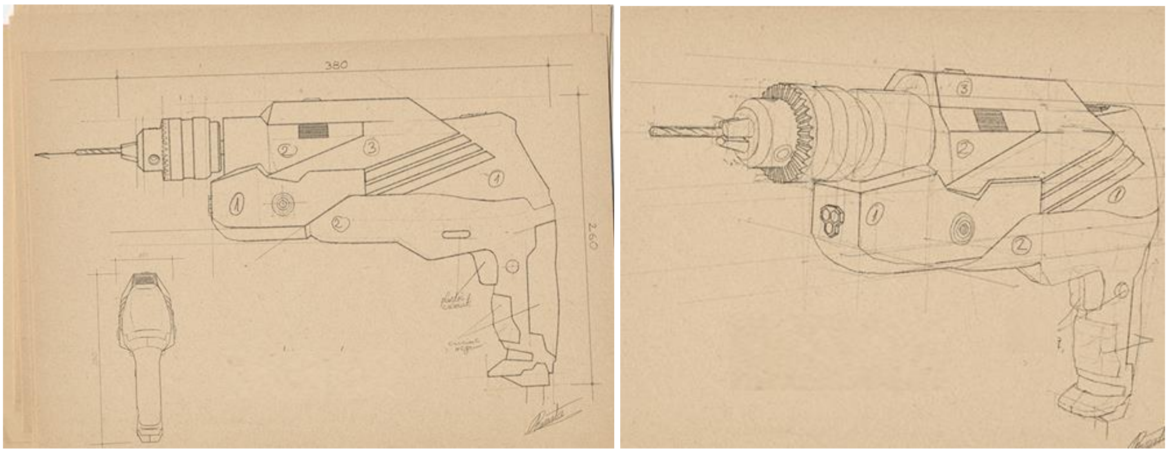

Fig. 1. Orientation sketches / Volumetric perpective

Following the completion of a series of variants, a more comprehensive schematic will be developed, considering each variant and the potential to combine elements that showed promise in earlier versions. To create detailed sketches, it's recommended to proceed step by step, starting with the main forms using dotted lines and progressively adding details, figure 1. Subsequently, specific elements can be highlighted using dashed lines to enhance the clarity of the form.
In the illustration of figure 1, the dimensions of the product are calculated, applying a series of template coefficients and considering the functionality and ergonomics of its component parts. This stage also involves contemplating the materials to be used in manufacturing the desired product. In contrast, the objective of this project was to design intelligent gardening vehicles with a futuristic appearance inspired by weapons from science fiction movies and video games. These dimensions serve as initial guidelines and may undergo minor adjustments during the planning process.
The subsequent step involves creating a volumetric perspective of the product to facilitate a deeper understanding and examination of the foundational forms in this design. This design was illustrated in Figure 1 using a two-point perspective, aiding in the future creation of a 3D model. In some instances, this perspective can even serve as a substitute for a 3D model, simplifying the design process.
The design process involved encapsulating the constituent elements within basic geometric shapes, which were then refined into the desired elements [8]. Similar to a detailed sketch, supportive lines and constructive elements were incorporated, while curved lines were utilized to delineate and accentuate the volume. The drilling machine and its components were designed to fit snugly into a shipping box using the procedures mentioned earlier [9]. Similarly, the box was designed to be modern, compact, lightweight, portable, easily accessible, and highly durable. This goal was achieved by ensuring the drill's secure placement, accessibility, and compatibility with all necessary attachments. The design process began with a rectangular parallelepiped, to which simple geometric shapes were added and subtracted. Considerations were made for the transport handle, which folds down for efficient compactness, and the placement of fastening components such as hinges and

safety clips when the box is not in use. The three-dimensional modeling software Autodesk 3D Studio Max was utilized to construct the 3D model. Although the method used is similar to the one previously described, in this case, multiple sketches were utilized to visualize the concept's appearance. Therefore, there was no need to frame the elements in simple geometric shapes, as was done previously. Initially, the engine and main body were modeled, as they house the majority of the internal machinery. To streamline the modeling process, the design allowed for modeling only half of the product along a symmetry axis (the 'X' axis) [10]. The symmetry function was then employed to replicate the geometry along the axis. A small-scale plan was created and manipulated through extrusion and positioning to achieve the desired forms for the main body, Figure 2.

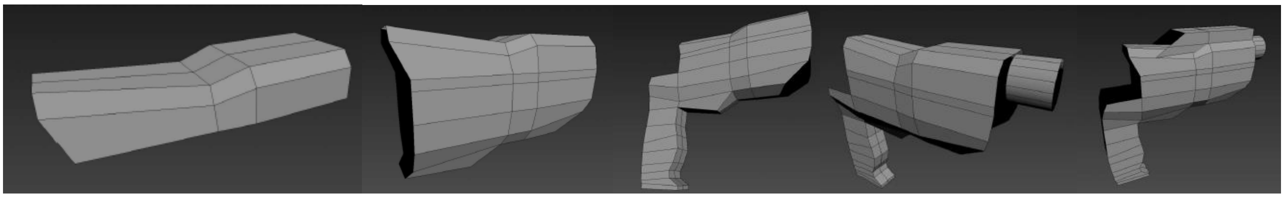

Fig. 2. Main body – modeling progress 1

Continuing from this shape, the modeling process extended to create the three openings at the front. This iterative process was repeated until a tubular body capable of housing internal components was formed. Extruding a portion of the lattice enabled the desired cylindrical shape to be achieved, figure 3. This involved extruding a volume in the opposite direction and then dividing it into seven segments to replicate the desired shape of the handle.

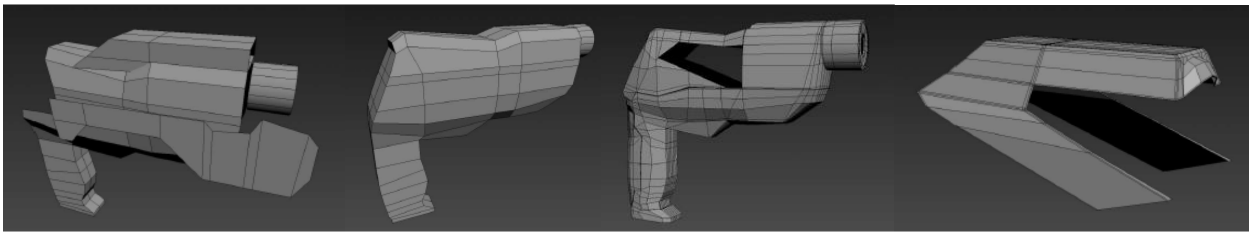

Fig. 3. Main body – modeling progress

To create the front component attaching to the chuck, a cylinder with erased covers was used. It was positioned at the center of the symmetry axis, allowing half of the cylinder's shape to be removed to achieve symmetry. It's often recommended to address each component gradually when modeling. Switching between various elements in the basic form's outline helps the viewer's eye to relax, preventing overemphasis on any single feature that might lead to overlooking important details or modeling errors. The next component modeled was the machine's top, or viewfinder [11], achieved by duplicating the main body layout and extruding its parts.

Using the latest process, a portion of the model's front has been created, where most of this device's electronic components will be located. Proceeding to the main body, geometric shapes were finalized for parts that required straight lines to achieve the desired shape. The main body, a critical component of this model, was segmented extensively to achieve the desired result. On the side facing the viewer, the vein connecting to the mandible was integrated into the entire body. To achieve this, it was necessary to divide the line geometry (edges) in a manner that aligned with the cylinders, enabling proper blending.

The rear component was the first to be separated from the main body. It underwent several modifications, initially being divided to remove a significant portion. This created additional space intended for ventilation in the area where the engine is located. Additionally, the back of the handle was extruded and separated from the remaining geometry to match the attached portion of the handle, as it will be made of a different material. The next step focused on the viewfinder, which will have a metallic construction with crisp, hard edges. While duplicating certain lines to achieve sharper edges and a chamfer effect, the modeling process remains consistent with that of other components. The outcome of this procedure depends on the distance between lines. For instance, a chamfer appears sharper when lines are closer to an edge and smoother when they are farther away. As the process continues, the desired forms gradually emerge in the pattern.

The last component requiring meticulous attention is the front portion, which combines rounded shapes with numerous sharp angles, figure 4. Throughout the model's development, it was recognized that this piece needed to serve as a connecting element between other components while also being spatially ergonomic, strategically positioned, and housing internal sensors within this digging machine.

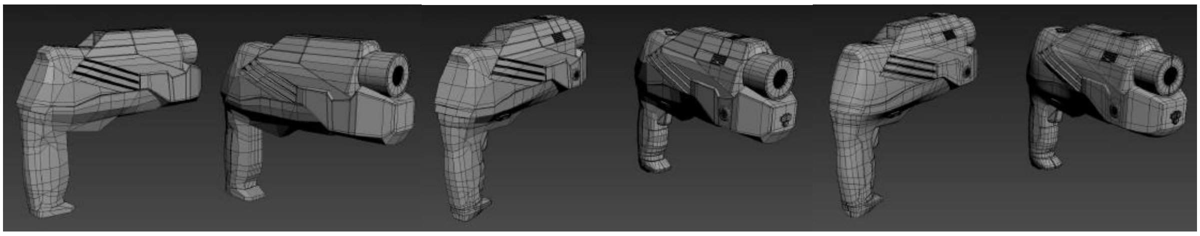

Fig. 4. Blades engine air protection / Power drill assembly – unsubdivided / TurboSmooth

To close the sizable empty space and protect the exposed engine, three strips were positioned parallel to the lower portion of the viewfinder. These strips filled the space left vacant after removing some planes from the central body to enhance engine ventilation. This composition results in an aesthetically pleasing appearance that seamlessly integrates every component [12 - 14]. Additionally, several polygons were extruded from the central body on the side of the handle. Some of these polygons formed the adherent segment of the handle, while others were solely for appearance and integrated different material inserts. Two ventilation slots were added to the upper front, one on each side of the model. Every element, including the trigger, front sensors, viewfinder switch, thread for mounting the side handle, display, and attached buttons, was meticulously analyzed and modeled, paying close attention to small details.

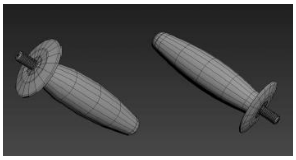

Fig. 5. Side handle

As a final step to achieve smoother results, the TurboSmooth modifier was applied to refine the geometry. This modifier splits each plane into four equal segments, increasing polygon density and enhancing model resolution. The side handle was crafted by extruding the ends of a cylinder into the desired shape and then sculpted accordingly, figure 5. A screw is used to attach it to the specially designed slot on the front of the model. The transport box was created from a primitive, initially a rectangular parallelepiped.

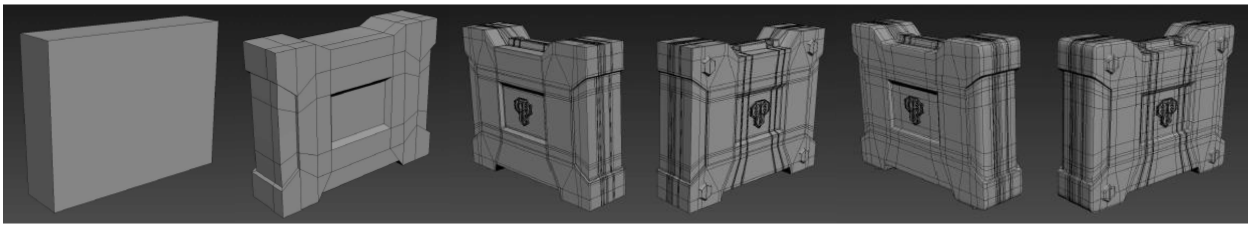

Fig. 6. Transport box – process modeling – TurboSmooth

With great care, the rectangular parallelepiped was meticulously divided to create the necessary lines for the extrusion process, figure 6. The 'connect edge' instruction was used on a line ring to facilitate the subdivision procedure. After duplicating the lines and chamfering the edges, the desired shapes were achieved upon activating the subdivision modifier.

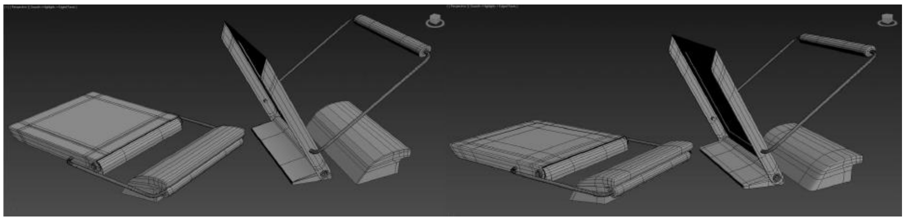

Fig. 7. Clamps – TurboSmooth

In addition to finalizing the area for the handle placement, several minor details were addressed. The TurboSmooth modifier was applied to assess if the desired recoil effect was achieved, Figure 7. The clamping clamps, located above and on each side of the handle, received meticulous attention to detail. The selection of this closure mechanism prioritized enhanced safety and quick accessibility.

The subdivision modifier is added to enhance realism, similar to the other components. Subsequently, parts that interact with the ground, such as the transfer handle and small hexagon-shaped elevators, were modeled, Figure 8.

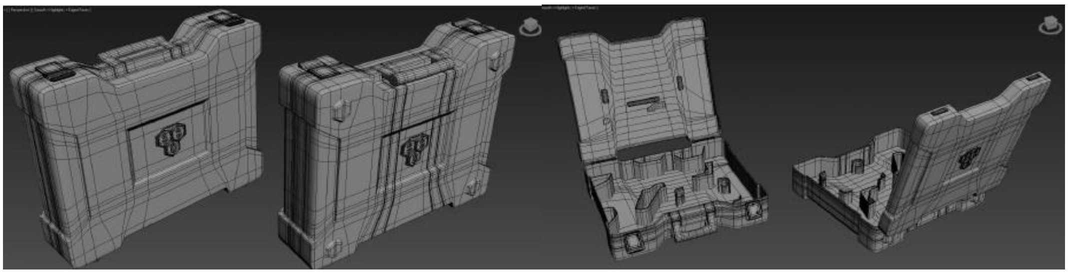

Fig. 8. Transport box – process modeling

3. RESULTS AND DISCUSSIONS

To begin, the focus shifted from industrial design to sensory design, emphasizing the product's sensory aspects, figure 9. One of the initial objectives was to craft an ergonomic product, adapted to human needs, with a compact and maneuverable design, prioritizing the positioning of elements.

Fig. 10. Integrated screen detail / Exterior sensor detail

One of the central components that drove the entire design was a 2-inch LCD screen, which would showcase the data collected from the attached sensors. The intention was to position it in the upper section, facing the rear of the machine, ensuring clear visibility during the digging process. Several function control buttons were situated in front of the screen. Additionally, buttons were strategically placed to provide easy access for checking sensor data, ensuring convenient consultation whenever required. The placement of external sensors was a crucial component of this design. A dedicated cassette was manufactured to house these sensors, positioned below the chuck level at the front of the drill. This module includes a video camera aimed at the drill tip, enhancing precision during the initial positioning of the drill for drilling operations. Moreover, since this camera faces the chuck, it also records the forward speed at which the power drill operates.

Another crucial aspect of this design was the placement of external sensors. These sensors were housed in a cassette located at the front of the drill, below the chuck level. This module includes a video camera aimed at the tip of the drill, enhancing precision when positioning the drill for the drilling process, figure 10. Additionally, since this camera is directed towards the chuck, it also records the speed of the drill's operation.

The module also incorporates a laser sensor capable of real-time depth detection and measuring the distance to the drilling surface. This sensor operates on the telemeter principle, commonly known as a laser rangefinder, which accurately measures distances using laser beams. It's particularly useful for precise measurements over long distances. Additionally, the module includes a small-range metal detection sensor directed toward the drilling location, aiding in the prevention of damage to iron fixtures or wiring within walls [7, 9]. Furthermore, the drilling machine features an additional 7-inch LCD screen designed to function as a tablet, albeit without touch screen capabilities. This separate device allows users to view data transmitted by the sensors via Bluetooth. Its design prioritizes safety in hazardous environments, such as those prone to collisions, to minimize the risk of injury.


Fig. 10. 7-inch LCD touch screen


Fig. 11. Material details

The program displayed on this screen includes several indicators: the temperature indicator within the drill; the SSD logo (Smart System Drill); the temperature at the drill level; positioning guides; the distance between the drill tip and the surface in front of it; the engine temperature (the machine will stop operating until the temperature returns to normal values once this temperature reaches a critical value); the depth graph of the last ten holes; and the graph of the last ten uses (which shows the working time on the left column and the average temperature during that duration on the right); the real-time hole depth, which is measured as soon as the drilling process starts and can be programmed to a desired value; the car will automatically stop when the given value is reached; tilt indication; metal detector display; portable screen battery indicator; depth graphical indicator (it becomes functional when the hole depth is scheduled); rotation speed indicator (this is displayed in rotations per minute), Figure 11.


Fig. 12. Presentation of proposed product design – 1

The final step in designing the box involved completing the inner partitioning to facilitate the separation and secure clamping of the drill's accessories, figure 12. The materials used are sourced from the latest generation of vehicles and airplanes, selected for their combination of robustness, light weight, and elegant appearance. A number of pictures featuring the 3D model were created for the product's presentation, figure 13. The KeyShot software, a powerful rendering engine utilizing ray tracing technology and harnessing both the CPU (central processing unit) and the GPU (graphics processing unit), was utilized to create these images.


Fig. 13. Presentation of proposed product design – 2

Images were captured from various perspectives: the drilling machine and its accessories were positioned with the transport box open; the drilling machine was depicted alongside a portable screen; the machine was set up to begin drilling into a wooden block, with the camera's image displayed on its screen; and a few close-ups shots were taken to highlight the specific locations of individual components, figure 14.

Fig. 14. Presentation of proposed product design – 3

To achieve highly realistic images, the model was textured with materials that mimic those found in reality, using a chromatic palette consistent with real-world objects, figure 15. Lighting was achieved using HDRI (high dynamic range image) images, which are spherical panoramas that simulate real-world environments.

Fig. 16. Presentation of proposed product design – 4

4. CONCLUSIONS

The designed product falls into the category of durable goods, which are purchased less frequently and where factors such as price, quality, and brand significantly influence purchasing decisions. The goal of this project was to create a modern drill product design that fulfills the purpose of the design activity. Various drills with different capacities, aesthetics, and functions are already available on the market, ranging from conventional to unique designs, offering state-of-the-art features to meet diverse consumer needs. Adding a camera to a drill can offer a number of advantages, enhancing the accuracy, safety and documentability of the drilling process. This can be an innovative solution for those who want to improve their performance and make drilling more efficient and safe.

Manufacturing costs for a drill can vary widely depending on several factors, including the complexity of the design, the materials used, the scale of production, the level of automation, and additional features. To understand the key cost drivers, it is important to break down the primary components of drill manufacturing costs: materials, labor, design and development, electronics and components, overhead, marketing and distribution, quality assurance and compliance.

The showcased product is a groundbreaking innovation in the industry, offering modern technology tailored to meet various user needs, ensuring safety and optimal performance in any condition or environment. It embodies the qualities of a high-quality product, including practicality, ergonomic design, uniqueness, and relevance.

The entire design process, from market research to product decommissioning, has been encompassed in the product design. The technical solutions employed represent fresh approaches within a creative concept, building upon previous solutions while introducing innovative elements. This product falls within the category of durable goods, where brand, quality, and price are key factors influencing consumer purchasing decisions. By continually improving products and bringing new and creative solutions to existing problems, companies can strengthen their market position and help improve the quality of life for consumers and society as a whole.

Funding: This work was supported by a grant from the National Program for Research of the National Association of Technical Universities – GNAC ARUT 2023.

Conflicts of Interest: There is no conflict of interest.

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Received: August 21, 2024 / Received in the revised form: October 21, 2024 / Accepted: December 15, 2024 / Paper available online: December 20, 2024