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Loudspeaker Industrial Design—A Quest For Market Share

By Steve Mowry

In looking at the state-of-the-art for the loudspeaker industry relative to the history of loudspeaker technology development, I use the term "mature" to describe the status. Most advances seem to be in materials, manufacturing process, design methodology, and test systems. Permanent magnet-moving coil interaction is still the dominant approach to electrodynamic transduction. Loudspeaker technical advances are typically incremental and many times are a recycling and/or recombination of old ideas, sometimes with new materials including composites.

QUESTION

Companies such as JBL, BOSE, Infinity, Polk, B&W, Nearfield Acoustics, B&O, Genelec, Genesis Technologies, Wilson, and Thiel Audio have a broad "array" (pun intended) of products with regard to their sonic characteristics, size, and appearance, although the basic transduction technologies and topologies are quite similar. What then, is the elusive common element of the loudspeakers and systems from the most successful audio companies?

Until now, I have always attempted to focus on the engineering and technical aspects of new product development, including R&D, manufacturing, and project management, but even this is not the whole answer. The larger companies invest in R&D and have highly skilled technical staffs; however, the companies listed are vastly different in size and structure. Some of these companies are large with the respective resources to conduct serious R&D, while others are small and must rely on consultants or a handful of key people and/or partners to remain competitive.

The answer is actually a design process that determines the form of a product, shaping it to fit the people who use it and the industrial processes that produce it. It is "Industrial Design," which works to make lives more comfortable, pleasurable, and efficient by studying people at work, at home, and in motion. In particular, industrial design philosophy deals with the parts of a product that people interact with. It also gives products that distinctive elegance that produces a want.

In the case of loudspeakers, this takes on the addition of sound and sound perception, acoustics, and psychoacoustics. The chase is on for consumer dollars and Euros, but great sound in a box alone is just not enough for the consumer anymore. The loudspeaker must also look good and fit into the user's décor. It must sound, look, and feel good.

Industrial designs contain innovative features and better ways to do things. The methodology is based on creative problem solving, asking "How do people want to listen?" rather than "Let's build another loudspeaker." To answer such a question, design and development teams must explore a broad range of alternatives through drawings and models, with the designer steadily refining the designs as they implement the new technology, while the team evaluates the design within the context of the user's wants and needs, the suppliers' constraints, and the manufacturer's capabilities.

The term "Industrial Design" was coined early in the 20th century to describe the creative role previously performed by an individual artisan for mass-produced goods. In keeping with the complexity of mass production, designers must work with other functions involved in new product development. The design and development team must conduct usability testing to ensure that a product meets user needs, wants, and expectations, and they often rearrange internal components to make products easier to manufacture, assemble, service, and recycle.

Industrial design links knowledge about technology and the visual arts with knowledge about people. In addition to a thorough understanding of the physical sciences, engineering principles, ergonomics, aesthetics, and industrial materials and processes, designers should have a good understanding of the social sciences, such as psychology, sociology, and anthropology, and the communication arts, such as photography, video, print, and electronic media.

INTELLECTUAL PROPERTY

An industrial design contains ornamental or aesthetic

aspects of an article. The design may consist of three-dimensional (3D) features, such as the shape or surface patina of an article, or of two-dimensional features, such as patterns, lines, or color. To be protected under most national laws, an industrial design must appeal to the eye. This means that an industrial design is of an aesthetic nature, and does not protect any technical features of the article to which it is applied. Filing patent applications can protect technical features and inventions.

Industrial design methodology makes an article more attractive and appealing; hence, value is added to a product and its marketability is increased. When an industrial design is protected, the owner—the person or entity that has registered the design—is assured an exclusive right against unauthorized copying or imitation of the design by third parties. This helps to ensure a fair return on investment. An effective system of protection also benefits consumers and the public at large, by promoting fair competition and honest trade practices, and promoting more aesthetically attractive products.

Protecting industrial designs helps economic development by encouraging creativity in the industrial and manufacturing sectors. When healthy, these sectors of the respective economies contribute to the expansion of commercial activities and the export of products. Industrial designs can be relatively simple and inexpensive to develop and protect. This provides reasonable market accessibility and stability to small- and medium-size enterprises in both industrialized and developing countries.

In most countries, under industrial design law, an industrial design must be registered in order to be protected. As a general rule, to be eligible for registration, the design must be *"new"* or *"original."* Different countries have varying definitions of such terms, as well as variations in the registration process itself. Generally, "new" means that no identical or very similar design is known to have existed before.

Once a design is registered, a registration certificate is issued. Following that, the term of protection is generally five years, with the possibility of further periods of renewal up to, in most cases, 15 years. In some countries, industrial design and copyright protection can exist concurrently. In other countries, they are mutually exclusive: once the owner chooses one kind of protection, he can no longer invoke the other. Under certain circumstances an industrial design may also be protected under unfair competition law, although the conditions of protection and the rights and remedies ensured can be significantly different.

Generally, industrial design protection is limited to the country in which protection is granted. Under The Hague Agreement Concerning the International Deposit of Industrial Designs, a WIPO-administered treaty, a procedure for an international registration is offered. An applicant can file a single international deposit either with the World Intellectual Property Organization (WIPO, www.wipo.int/portal/index.html.en), or the national office of a country that is party to the treaty. The design will then be protected in as many member countries of the treaty as the applicant wishes. The United States Agreement can be found at www.uspto.gov/web/offices/com/doc/uruguay/finalact.html.

In the US Patent and Trademark (USPTO) database, registered designs use the preface "D" in the unique identifying number and are contained in the same database. For example, US D521,494 is Genelec's Enclosure Design Patent, www.freepatentsonline.com/D521494.pdf, while US 7,051,835 is Genelec's Bass-Reflex Loudspeaker System (Invention) Patent, www.freepatentsonline.com/7051835.pdf. The design patent is granted with regard to appearance, and the patent is granted for claims of an invention(s). US designs and US patents can be conveniently searched and printed to public domain files (PDF) from www.s-m-audio.com/resources.php (scroll down to the bottom of the page).

CONCURRENT DESIGN & DEVELOPMENT

It follows that the industrial design functions and resources within the new product design and development process need to be applied and utilized concurrently and preferably from the onset of the project. ***Figure 1*** illustrates a simple eight-function concurrent design and development cross-functional diagram. Inherently, industrial design is an integrated process that ideally contains the input and/or efforts from all functions.

It seems unlikely that one individual could possess the complete skill set required to implement world-class industrial designs. The objective is to cooperate and share information, although competition is typically a healthy endeavor.

Industrial design methods can be categorized as

A. Exploring design possibilities and constraints by focusing critical thinking skills to research and define problem spaces for existing products.

B. Redefining the specifications of design solutions which can lead to better guidelines for traditional design procedures and activities.

C. Managing the process of exploring, defining, and producing artifacts continually over time.

D. Prototyping possible scenarios or solutions that incrementally improve the inherited situation by either physical samples or virtual prototypes.

Industrial design is a way of thinking, a holistic approach to problem solving that encompasses the subjective as well as the objective. It is more than a trade or profession; it's an evolving mindset. In the limit, the engineer needs to think like a designer at times and the designer needs to think like an engineer at times.

Industrial design is the next generation of concurrent product development and is a natural transition and/or

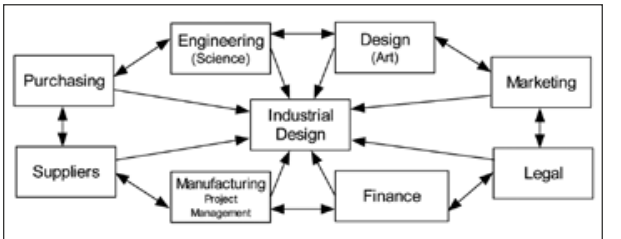

FIGURE 1: Diagram of an integrated industrial design process.

expansion of that methodology. Under no circumstance should the foundation of a concurrent approach to new product development be abandoned. There is no room for functional silos in the concurrent industrial design process. This topic was discussed in the July/August 2004 issue of *Multi Media Manufacturer*, "Concurrent Product Development," and presented at the American Loudspeaker Manufacturers and Acoustics International (ALMA) Symposium in January 2004, www.s-m-audio.com/cpd.pdf.

The cross-functional new product design and development team is chosen with regard to the functions illustrated in ***Fig. 1***. The project manager is preferably selected from the manufacturing function. The reasoning for this was presented in a discussion that appeared in the Jan/Feb 2007 issue of *Multi Media Manufacturer*, www.multimediamanufacturer.com/articles/Mowry-Project-107.pdf. The resultant industrial design output is represented as the "core" of integrated functional process, the industrial design.

ART & SCIENCE

According to the ICSID (International Council of Societies of Industrial Design, www.icsid.org), "Design is a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole product life-cycles. Therefore, industrial design is the central factor of innovative humanization of technologies and the crucial factor of cultural and economic exchange."

Engineering is often viewed as a more rigorous form of design. Contrary views suggest that design is a component of engineering aside from production and other operations that utilize engineering. A neutral view may suggest that both design and engineering simply overlap, depending on the discipline of design.

The American Heritage Dictionary defines design as: "To conceive or fashion in the mind; invent," and "To formulate a plan," and defines engineering as: "The application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical structures, machines, processes, and systems." Both are forms of problem solving with a defined distinction being the application of "scientific and mathematical principles." How much science versus art is applied in a design is a question of what is considered "*science*" and what is considered "art."

Loudspeaker design and development has its own set of challenges and constraints. The design must also be with regard to the physics of mechanics and acoustics. The ears along with eyes provide important inputs to the user.

The designer needs the following skills and characteristics as a minimum requirement:

1. Creative problem-solving skills.
2. Ability to convey concepts with sketches and drawings.
3. Good verbal and written communication skills.
4. Computer proficiency in vector-based 3D programs.
5. Mechanical aptitude with basic understanding of how things work.
6. Visualization of concepts early on in the process.

This list represents broad-based skills; however, no broader than what the loudspeaker engineer needs. Frankly, it's a shorter path for a loudspeaker engineer to acquire these skills than for the designer to acquire the skills required to become a loudspeaker engineer, if and only if one has the creative and artistic capability. I discussed the topic of loudspeaker engineering qualifications in the July 2006 issue of *Voice Coil*, "So You Want to Be a Loudspeaker Engineer?" www.audioxpress.com/magsdirx/voxcoil/addenda/media/mowry706.pdf. My point here is that sometimes the functions of engineering and design will be provided by an individual, a design engineer who can work in both the objective and subjective domains.

VALUE ADDED

A manufacturer's profitability depends on the price a product can command in a marketplace versus the cost to produce it. Because virtually all manufacturing for consumer products has been outsourced to Asia, there has been significant cost savings for manufacturers in the last decade. However, because these manufacturing services have become commoditized, cost savings are approaching their limit. Good industrial design allows a new product to command a premium price on a crowded shelf of other commodity items. This is what manufacturers and corporations call "top line growth."

Consumers have become wary of slick ads, color supplements, promotions, and so on in the marketeers' efforts to build strong brands. Good industrial design allows products to communicate brand attributes directly through the product. Thus the general consumer population as a whole is gaining an appreciation and under-

PHOTO 1: The Genelec 8050A two-way active loudspeaker with industrial design, $3,798/pair, www.dealtime.com/xPO-Genelec-8050A.

PHOTO 2: Commercial two-way active loudspeakers with no apparent industrial design, commodity price $268/pair, www.amazon.com/M-Audio-BiAmplified-Studio-Monitor-Speakers/dp/B0009VT9PC.

standing of design, and the result has been a market boom for well-designed products. ***Photos 1*** and ***2*** illustrate examples with and without industrial design, respectively. The value added for industrial design is significant.

3D DESIGN SOFTWARE

Industrial design software enables you to capture the design of creative and innovative product concepts through the use of complex geometry creation and freeform NURBS (non-uniform rational b-spline) and push-pull surfacing tools. There is no shortage of industrial design tools available to facilitate the documentation and illustration of the industrial design.

1. Design Expert, www.deskartes.com.
2. Autodesk AliasStudio, www.autodesk.com
3. SolidWorks, www.solidworks.com
4. SHAPEWORKS, www.baren-boym.com
5. SurfaceWorks, www.aerohydro.com
6. GeometryWorks3D, www.cadcamcomponents.com
7. SolidThinking, www.solidthinking.com
8. Rhino 3d, www.rhino3d.com
9. Think3 DesignXpressions, www.think3.com
10. FreeForm System and PHANTOM Desktop, www.sensable.com
11. Pro/ENGINEER, www.ptc.com
12. CATIA, www.3ds.com
13. UGS, www.ugs.com

COMMENTS

Because the transduction and propagation of sound is a mechanical process, acoustic performance and physical structure are interdependent factors. This introduces an element of expectation to the industrial design that goes beyond pleasing looks—the user makes strongly held assumptions about the acoustic performance of a loudspeaker based on its physical structure. To put it another way, every visual and tactile cue that communicates intentional, careful engineering and utter commitment to quality of build and optimization of performance will contribute to the customer's sense that they are looking at, feeling, or listening to a high-performance loudspeaker, a psychoacoustic phenomenon.

Because real objective improvements in acoustical performance are usually incremental, subjective visual perception of engineering care and functional quality becomes a dominant value factor. For this reason, I believe it is useful to think of high-end loudspeaker design as a type functional sculpture where every form must loudly proclaim function, not as an exercise in which the functional interior is hidden beneath a pleasing, camouflaging exterior.

The addition of the design function along with engineering function in a product development process will lead to added value by improved product usability, lowered production costs, and more appealing loudspeakers. Industrial design focuses on concepts, products, and processes in a global product lifecycle context. Questions such as "How will the product age?" and "How will the product be recycled?" should also be discussed.

In addition to considering aesthetics, usability, and ergonomics, the industrial design methodology also encompasses the usefulness as well as usability, market placement, and other global concerns. The complete product life cycle is considered. This takes vision, imagination, creativity, and courage! A good industrial design is an "intelligent" team-oriented design and development process. ***VC***

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