PRODUCT PORTFOLIO STRATEGIES IN PRODUCT DESIGN EDUCATION
THE INTEGRATION OF PRODUCT PORTFOLIO FRAMEWORK TO INDUSTRIAL DESIGN STUDIO CURRICULUM

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Introduction: This paper presents a study that proposes the integration of a product portfolio framework, a common marketing and business planning tool, with a product design curriculum. Design educators often plan studio teaching and projects focused on a single product. Business, however, tends to build upon product portfolios and market all of them strategically. It will be beneficial for students to learn to design with an awareness of business strategies and thus be better prepared for their professional careers. In this study, a list of design courses are recommended to incorporate both the macro (product portfolio strategies) and micro (single product) aspects, enabling students' zooming-in and zooming-out of scope during the design process.

1. WHAT NEEDS TO BE CALIBRATED IN THE CURRICULUM?

Launching a new product is like going to war. In most cases, products were assigned to work together strategically in the market and shield a company against marketplace changes. Products of a brand coordinate and support one another to fight like a military unit, hence the design priority of each product is slightly different. If a designer simply zooms in on a single product's development without considering the other role players in this struggle, it's likely this design effort might be in vain due to fierce market competition.

In addressing current design education, the typical curriculum is designed to address society's needs, including the needs of industry. A good designer is expected to look at an entire ecosystem rather than at isolated problems. Insight development about customers, business, and technology happen in parallel in this system. By understanding the strategic role of a product, designers can make more informed design choices in the design development phase.

Taking current studio planning as an example, it is usually a process involved with defining a user's pain point and a solution delivery. Students may be asked to meet manufacturing feasibility, but rarely take any strategic marketing roles into consideration. However, an understanding of different toolboxes and vocabularies help designers to think from different perspectives. Accordingly, a proper calibration of curriculum would make design students maintain their focus on user needs, as well as zoom in and out constantly to make sure design details are strategically connected.

The research method of this article is to retrace product portfolio management in business so that expectations for education can be reevaluated. Both literature research and a design case study were conducted. By understanding the cognitive theory of education and principles behind the cumulative acquisition of design expertise, curriculum calibration is designed to gradually increase in complexity under the given context while a student moves through the program.
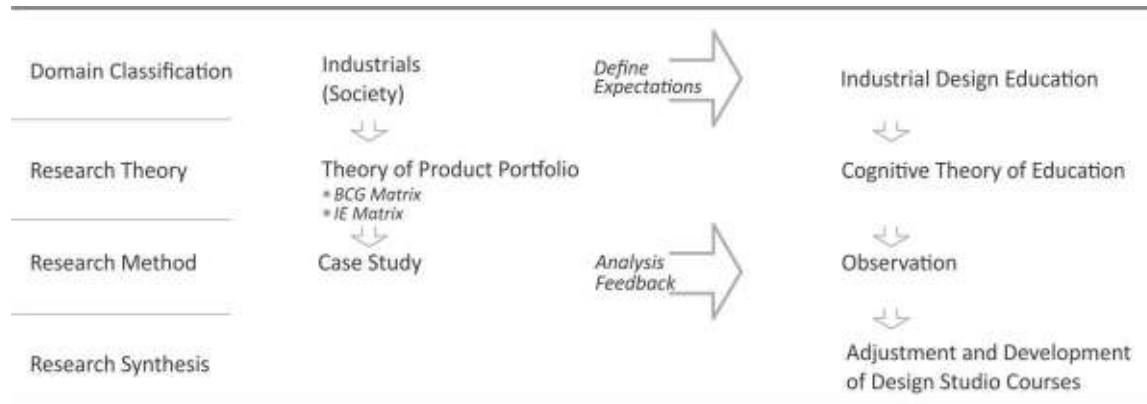
Figure 1. Illustration of the research method

2. PRODUCT PORTFOLIOS

Due to the many varieties of business models, discussion is limited here to a business with a range of products that make up a portfolio. Disruptive design is not part of this discussion, as it flips over the market and often includes breakthroughs in technology or service models. Only product teamwork in a saturated market will be discussed in this paper. In a mature stage, the technology will asymptotically approach a natural or physical limit so that more design efforts would be expected to make products strategically work together. This will bring more interactive interfaces to synthesize information in course planning, which would help to reduce information overload during students' design studies.

A product portfolio is a collection of different products marketed from a company. Within the product portfolio, each item typically makes a different contribution to the company's bottom line. Some products cost more to produce, some are increasing their market share, some bring in more revenue and some have greater marketing expenses. Low-risk products help offset the riskier ones. The combination of each role makes up a competitive landscape.

Named for its creator, the Boston Consulting Group, the BCG matrix is the most renowned corporate portfolio analysis tool, which aims to identify high-growth prospects by categorizing the company's products according to growth rate and market share. This growth-share matrix was divided into four sections: Stars, Cash cows, Dogs and Question marks. In each Strategic Business Unit (SBU) in a company, four alternative objectives could be pursued: Build, Hold, Harvest and Divest. Nearly 50 years after its inception, the BCG matrix remains a valuable tool for product portfolio management. Harvard Business Review named BCG's matrix one of five frameworks that changed the world. The main idea of these business concepts is summarized below.

A Star's role is to build a brand's image. It is easily identified and represents the future of the brand or the capability of the brand. A star is a visionary approach, and is expansive and inspirational. A star helps to push growth instead of generating a large cash flow at the given moment. The hope is that the star becomes the next cash generator of this brand.

A Harvester is the high growth unit typically generating cash needed to maintain the business. In a "mature" market, usually this cash-generating ability was protected by some patented features or its service system. A Harvester could be a former star or fade when competition gets fierce.

A Holder is the unit holding their position on the shelf with an affordable price. From an accounting point of

view such a unit is worthless. However, owning a break-even unit increases the exposure rate on the shelf or to the customer. It maintains a certain amount of market coverage and possible synergies of assisting other business units.

A Niche Tester plays a role of testing a market reaction and searching for growth, which is a starting point for most businesses. This role is a good position for market testing by offering more products through customization. The Niche tester must be analyzed carefully in a pilot launching stage, and use the time spent on the pilot phase to invest in the infrastructure required to roll out the production on a larger scale. There's always some dynamic interplay between different roles. Each role in this portfolio switches around. The natural cycle for most business units is that they start as a Niche Tester, and then turn into a Harvester, or a Holder when eventually the business is drowning in red ink.

3. CALIBRATED PERSPECTIVES ON SELECTED COURSES

Given the above brief overview of business product portfolios, design courses could be calibrated to use both macro and telephoto views. The macro views enhancing user desirability should still be covered in all design courses. Telephoto views will be merged into selected courses to explore how the design of a single product supports a competitive landscape in business.

The following curriculum calibration (Figure 2) is designed to encourage future designers to think broadly from telephoto views, to actively bridge the gap between design and business and balance manufacturing costs through a portfolio via synthetic thinking.

Business Infusion Product portfolio		Curriculum Calibration Calibrated Perspectives on selected courses
Competitive Landscape		**Foundation Courses**
Star	-->	**History of Industrial Design**
Brand Flag/Award Winner/Limited Edition High Visual Impact High Media Exposure Push Growth	Introduction	①Product portfolios analysis of renowned brands. ②Analysis on innovation's dilemma or design management via historical telescope.
	-->	**Material & Processes**
Harvester	Design	①To deliberately find 2% improvement based on
Patented Features or Materials Basic & Functional Needs High Media Exposure High Growth	Practice of Holder	limited budget of the manufacturing cost. ②To avoid the drawback of manufacturing limits through design ③Integrated with supplier chains from design standpoint
	-->	**Design Practice**
Holder	Design	**Studio A**
Affordable High Volume Maintain	Practice of Star or Niche	①To understand the strategic role of a product ②To seek an extreme way to express brand value

On Site Exposure		③To seek a niche market under a given business context
Niche Tester		
Versatile	=>	**Studio B**
Specialization	Design	①To Deliver a portfolio which is easy for distributors to market strategically
Pilot Launch Testing	Synthetic	②To deliberately design a difficult-to-imitate manufacturing process combination
Search Growth		③A synthetic outcome with an innovative combination of processes and resources through deliberate design
	=>	**Exhibit Design**
	Extend	①To deliver its brand value with its product
	Calibration	portfolio in a defined space as if it's a giant product.

Figure 2. business infusion on design curriculum

Observing how the renowned brands manage their portfolios is a good way to illustrate how a product portfolio approach works in a design history class context. Managing product portfolios is like playing chess, in which one plays both defensive and offensive roles. The role of each product was carefully considered and renowned brands are usually good at managing this dynamically. Only one common business scenario about product portfolio management was introduced in this article. If a different business interactive interface was chosen then related perspective calibration should be adjusted accordingly in design education.

Once students understand how a product portfolio approach works, a 3-stage studio plan summary was chosen specifically as an example, which was presented as a cumulative developmental framework. Stages 1-2 are designed under limited relevant variables for development. Stage 3 is designed to facilitate systematic thinking.

A design case study of a furniture brand would be introduced as an example. This brand was founded in 2002 and has survived in the high-end global market since. Due to space constraints, this article only summarizes and focuses on strategic thinking in organizational interactions.

3.1 STAGE #1—PRODUCT AUTOPSY

Recommended Grade Level: Sophomore year
Emphasis: Design innovation in material and manufacturing processes, consideration of cost constraints.
Preferred industrials: Products in a price sensitive segment.

Product Autopsy is an assignment in the Materials and Processes class in the Industrial Design program in the College of Design at North Carolina State University. This approach could be a suitable starting point and require minimal skill to complete. Students were asked to use forensic analysis and knowledge of materials, and manufacturing processes to tear down an existing manufactured product, analyze its

components, materials and construction and apply those findings in the development of a new product. Two new perspectives are suggested for integration into traditional materials-based courses. It could be seen as a exercise to design a defensive role, such as a Holder, in a product portfolio setting.

Calibrated Point A: To Achieve A 2% Improvement

In this stage, students are asked to seek any 2% improvement from a design point of view during the product autopsy based on limiting manufacturing costs. This could be a very small adjustment such as reducing the usage of screws or adjusting a parting line to create a better grip. To deliberately avoid the drawback of manufacturing limits is also part of a designer's job. It could also be a good starting point in building a trustworthy relationship between a company and a freshly-hired designer as those changes could be made in company's current system with minimum cost.

Calibrated Point B: To Explore Material Development From A Design Perspective

The second perspective is to explore a guideline for material development from a design point of view. "Vertical integration with supplier chains" is a phrase often heard from industrial concerns, which was conducted from a manufacturing standpoint. Integration with supplier chains from a design standpoint will bring about a unique experience. The differentiation of material and manufacturing processes would build higher competitive barriers.

Case Study: In Figure 3 #1, the material of these designs used a noodle-like pattern that enhances the stylish appearance of acrylic. This material was specifically used to create a unique look by adding texture inside. Much effort was made by the design team working with engineers by adjusting the formula to make two materials mix well aesthetically. In Figure 3 #2, the component on each corner of the table was the most distinctive feature of this design and this part was patented. This unique transitional component also makes the table more stylish. To directly patent the part as well as the whole design of this table will add competitive strengths. Both designs aimed to build a difficult-to-imitate barrier through design and succeeded.

Figure 3.   Case study 1

3.2 STAGE #2—STAR & NICHE TESTER

Recommended Grade Level: Sophomore year
Emphasis: To seek a extreme way to express brand value, high visual Impact, minimal concern for cost
Preferred industrials: Projects involving emerging technologies or new lifestyle explorations

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Star and Niche Tester play important roles in pushing or seeking growth in a company's product portfolio. It is also part of the point of the practice at this stage. Both Star products and Niche tester products were picked and both could be seen as a practice of designing an offensive role in the product portfolio exercise.

Calibrated Point A: To Raise the Quality Bar and Seek Growth

Star products set up the brand's highest standard of design and manufacturing, which could be seen as a prediction or an announcement of a future lifestyle made by the brand. Different from seeking 2% improvement in the first stage, students are now expected to explore an extreme manner to express brand value and benefit the target user's lifestyle. It conveys a brand value with a combination of aesthetic impact and sophisticated manufacturing skills. Also emerging technology is usually first introduced in its Star or Niche Tester role. The Niche testing project is an alternative project choice in this stage. It is a role of testing a market reaction and searching for growth in a given business scenario. Limited editions or award winners of a brand are usually in this segment. Very few budgetary constraints are set in this stage.

Case Study: The bar stool, DYLAN in Figure 3 #3, was created at an earlier stage of the brand development process and won an international design award. It was intentionally designed to set a high bar for the brand. It used a simple circle and its transition along the form as its main visual language. A major manufacturing endeavor was also undertaken to achieve the simple yet distinctive form. Leather and steel are seamlessly joined together through circles. Because of deliberate forethought, no signs of assembly can be seen in the finished product.

The lounge chair SPIDER (Figure 3 #4) has an aluminum adjustable leg inside and provides a relaxed posture while working at home. It was strategically planned as a star product and staged to draw attention. So the design language chosen here is more dramatic. Unsurprisingly, Spider performed its role admirably in all trade shows and retail stores. It drew the crowd's attention and people enjoyed interacting with this alien and wanted to know more about this brand.

3.3 STAGE #3—PRODUCT PORTFOLIO PRACTICE

Recommended Grade Level: Junior year

Emphasis: Creating portfolio with selected roles, conveying brand values systematically

Preferred industrials: Projects with matured technology and product roles shifting quickly in the markets. *e.g.,* eyeglasses, suitcases, lighting, etc.

In this stage, students are expected to deliver a portfolio proposal with selected roles. These three or four designs should support one another strategically and convey a brand value that addresses customers' concerns.

Calibrated Point A: To Create a difficult-to-imitate system

A creative combination of processes and resources is essential to build a difficult-to-imitate design barrier and block copycats. Here it is suggested to use the practice in Stage 1 as a backbone, deliberately increasing the manufacturing barrier while developing the product portfolio. The unique combination of process is an effective way to create product differentiation from competitors. Accordingly, it would also increase the manufacturing cost while increasing the complexity of manufacturing. So as a designer, it is also important to balance the cost with variety of products through systematic design thinking. Both the business partner and the design team might find it easier to reach common ground if designers could step

up and think broadly by balancing the related cost throughout the portfolio. Therefore, organizing a supplier chain and integrating manufacturing resources are not just business concerns, and should begin at this stage with design education.

Calibrated Point B: Building Distributor Confidence

Design concerns about other stakeholders were rarely addressed in design studios. However, it would be better if students were able to calibrate their outcomes from a different perspective. A strategic portfolio could illustrate a promising outcome to a distributor. Gaining a distributor's confidence is a good way to check the consistency of the design language and to keep the whole design plan viable. Maintaining this perspective will benefit students' professional practice in the future in many ways. Gradually improving design language in the current sales system or matching developmental pace with the timing of seasonal retail commodity transitions in stores are all reliable ways to build confidence with one another and help both to achieve a goal together.

Figure 4. Case Study: Competitive Landscape

Case Study: this case study will become much more clear once the whole competitive landscape has been laid down. The two inner circles are the domains of Stars and Harvesters, both of which are memorable and have high media exposure. Compared to the second from center, the design language of the Star section is more adventurous. The second and third sections generate the majority of sales. Patented structure design and material designs protect its competitive advantages. The outer rim is the Niche Tester, where design languages are more diverse. Each detail involved significant effort in manufacturing innovation. Intentionally integrating the manufacturing process from different industries increased manufacturing complexity. The cost was eventually balanced out through the portfolio. As stipulated earlier, this article focused only on bridging the gap, reinforcing a strategic role and experiential equities through every exposure. Being able to predict the future lifestyle in a targeted market segment is always a major priority in each design.

4. SYNTHESIS

Welcome to Chess Club.

It's like playing chess. Different pieces can only make certain moves; however acting as a team these pieces can execute almost any move. Surviving in the market as a unified team first will make all design efforts more likely to succeed. It is important to carefully differentiate the products in a portfolio.

Even in most large corporations the strategy department and the design department are worlds apart. As Harmut Esslinger, the founder of frog design, noted, "businesses are from Mars, and designers are from Venus." This remains true today. Designers should step up and think actively during design development, which could help the two groups who are currently speaking different languages to develop a common ground in a desire to accomplish business objectives and make positive social contributions. Always putting business viability in mind will eventually pay back the efforts designers made in each design.

Taking this story as analogy, it is necessary for design education to deliberately conduct progressive stages of design courses incorporating the complex and interdisciplinary scope of the business context. It is time to bring these two worlds, Mars and Venus, into alignment.

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