

# DESIGN CRITERIA AND THEIR COUPLING IN CONCEPT SYNTHESIS

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## ABSTRACT:

Effective and efficient concept development requires methodical management of the dynamic and detailed complexity of tightly and loosely coupled criteria. In this paper, we examine the coupling of key design drivers, according to nine design quality criteria and the input informing these criteria. We identify a new approach to prioritizing design synthesis, as well as, identify opportunities for improving understanding and evaluation of business strategies as communicated through product concept.

## 1. INTRODUCTION

The most noteworthy change in design over the last decade is that business has seen the added value of design to their bottom line and that it is now an important requirement to compete in the marketplace. Design is now being taught in several business schools and leaders are increasingly getting involved in design management and execution (Petersen and Siegel, 2013). In addition, designers are learning how to manage and participate in the early business phases and to contribute to business model experimentation (Petersen and Ryu, 2013).

Now that management is embracing design, they want design to be responsible, as well as accountable, like all other departmental functions. Management, therefore, continues to seek mechanisms for controlling investments and risk in design through metrics for design performance. At a firm level, 'Design Maturity' models have been established to assess firms' design capabilities (National Agency for Enterprise and Housing, 2003) and 'Design Balanced Scorecard' methods can capture individual design projects' value to the firm (Borja de Mozota, 2006). At a project planning level, recent design quantification methods have become available for assessing the integration of Design in Business Plans (Petersen and Heebøll, 2011), Driven Portfolio Management (Petersen, Steinert and Beckman, 2011) and translating business objective and goals into Inspirational Design Briefs (a. Petersen, 2010 and b. Petersen 2010). On the product level, methods now exist for evaluating concept and final product designs (Petersen, 2011). This pallet of new methods is now assisting management and designers in collaboratively bridging business and design through improved framing of business and design opportunities.

In particular, when a business opportunity has been defined, the design brief is the critical instrument in transferring business objectives and goals to the design teams. To a large extent, the quality of the design process and resulting design concepts depend on the quality of the brief. Design briefs can be evaluated using the 'Design Quality Criteria' (DQC) (a. Petersen, 2009). The DQC consists of nine criteria derived from auditing design awards worldwide. These criteria comprehensively describe how the design community evaluates design, as well as how they form the content of design briefs. In addition, they serve as lead indicators of investors' evaluation as well as trendsetting. Studies show that projects informed by design briefs with a high content of strategic criteria, outperform mediocre briefs by up to thirty percent, along investors' evaluation of novelty, usefulness, value of a business opportunity (Petersen, 2011).

Upon utilizing the briefing, designers tend to combine the information given in the brief with their own experiences and conduct informal, ad hoc design research. Through gaining understanding of the project, they then begin synthesizing the information through several iterations, into multiple offerings in the form of concepts. These concepts are supported by a design argument, in story-form, and the offering can include artifacts, services, experiences and hedonistic symbols. At this point, the design concept can be quantified and commercial success assessed using the Concept Attention Profile (CAP) analysis of the design story (a

Petersen 2009, b Petersen 2009). CAP consists of thirteen aspects, derived from literature, describing the connections between the user and the provider as a physical and cultural connection, each divided into a series of steps. Designers' relative attention to these steps captures their thinking and is a lead indicator for performance of the design concept.

With established metrics for design briefing and concept evaluation, what remains is a metric driven guideline for how to approach the design concept synthesis. A model, that provides insights into how to arrange and prioritize the array of elements to be synthesized in the conceptual phase. It is in this arena, that this empirical study makes its contribution.

## 2. FRAMEWORK

This study evaluates the design performance of students systematically developing business opportunities for either a consumer product or an automotive company. Over the course of a semester, the students were guided through the various concept development phases. These ranged from need finding and technology search, to business definition and design briefing, concluding with the concept design and business opportunity presentation. The process applied Design & Business Model Experimentation (Petersen, 2013) followed by an established three-phase Direction-Design-Development design process (Petersen, 2011). At the end, the concepts and business opportunities were evaluated using the Design Quantification Criteria (a. Petersen 2009). The following is a short description of the methods applied in our empirical study.

### 2.1 DESIGN & BUSINESS MODEL EXPERIMENTATION

An iterative method for integration of industrial design upfront in the preliminary business phases: It offers directions for how designers can add value to the business strategy, business modeling, business planning and creation of design briefs. The Design & Business Model Experimentation method has four steps: (I) Creation of a Business Strategy, (II) Business Model Experimentation, (III) Formulation of Business Plan and an Inspirational Design Brief and (IV) Conceptualization. The step-by-step execution is described and visualized in the following: The first iteration supports generation of concepts, the second, design, the third, engineering, the fourth, simulation of use and the fifth, the complete user experience. Each iterative step re-examines the assumptions and instructions in all previous steps, while evolving from abstract to concrete. See Figure 1.

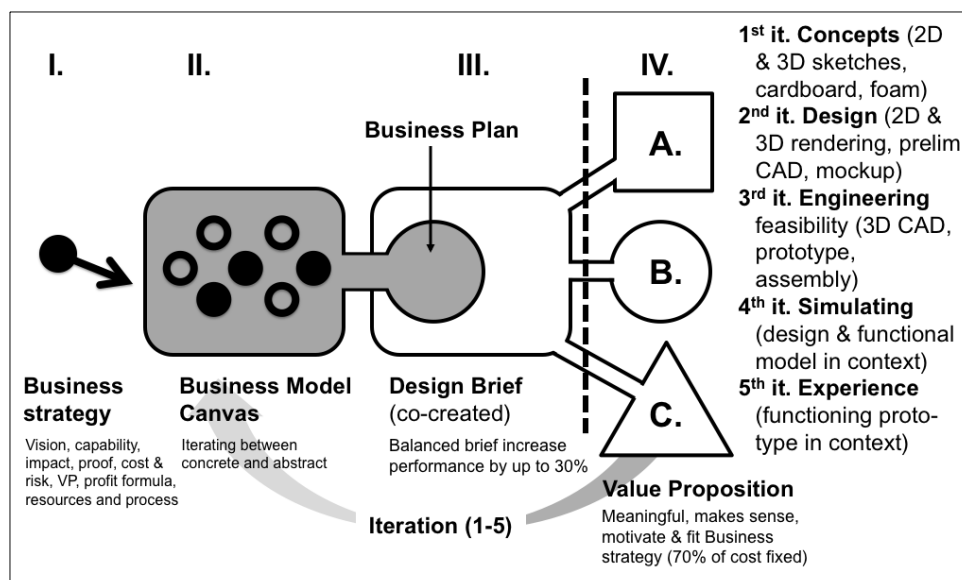


Figure 1. Design & Business Model Experimentation method, with four phases and five iterations

### 2.2 DIRECTION-DESIGN-DEVELOPMENT

The design process, from design consulting (Petersen, 2011), applies a three-phase approach. The first phase is dealing with an understanding of the opportunities (Direction),

the second, synthesizing and refining concepts (Design) and the third, supporting implementation of the design, (Development). The design process has tremendous opportunities to create value since major decisions are made here. It normally occupies five percent of the time and allocates eighty percent of the resources resulting in a knowledge gap (Andreasen and Hein, 2000). For the student project, phases one and two were executed. See Figure 2.

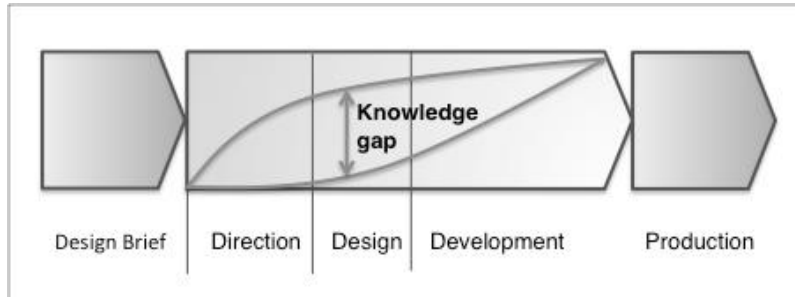


Figure 2. The Three Step Design process: First five percent of the design phase allocates eighty percent of the resources

### 2.3. DESIGN QUALITY CRITERIA (DQC)

A set of nine quality criteria derived from auditing design awards and design briefs from across the globe. These criteria comprehensively describe how the industrial design profession evaluates design, as well as how they inform the content of design briefs. Additionally, they act as the lead indicators of investors' evaluation and the products ability to create trends (a. Petersen 2007 and b. Petersen 2007). See Figure 3.

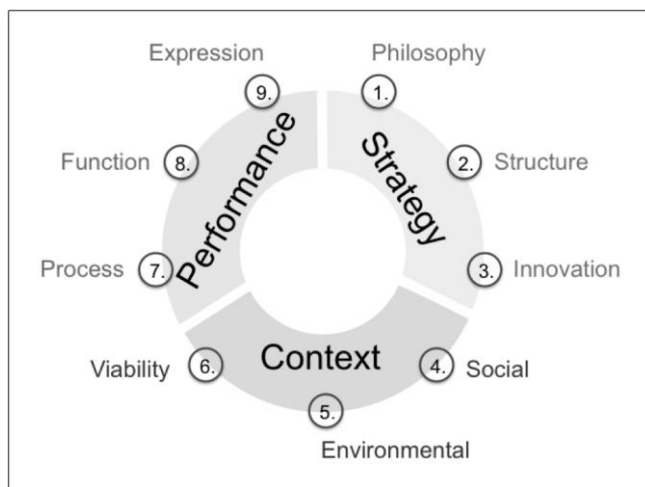


Figure 3. Design Quality Criteria

The Design Quality Criteria align with the earlier established design maturity model the "Design Ladder" (National Agency for Enterprise and Housing, 2003), where the Process Criteria correspond to level 2 (integration with process), and the Strategic Criteria correspond to level 3 (integration with business).

The nine quality criteria are:

#### Strategic Criteria

Corporate philosophy: What are the company's values, history, belief, vision, mission, and strategic intent? How is the brand communicated?

Structural Position: In which business and category does the firm operate? What is its business model? How is it vertically and horizontally integrated, and what are its competitive advantages?

**Innovation:** What is the business' innovation area (that is, technical, financial, process, offering, or delivery)? Is the innovation type sustainable or disruptive? What is the organization's level of ambition?

#### Contextual Criteria

**Social/human:** What are the users' and other stakeholders' cultural connection, identity, needs, behavior, and activities?

**Environmental:** What are the environmental requirements and expectations?

**Viability:** What are the expectations regarding market share, ROI, and so forth, as related to the time horizons?

#### Execution/Performance Criteria

**Process:** What are the project's budget, schedule, and deliverables? How are these aligned and coordinated with other projects?

**Function:** What is the nature of the deliverables: platform, modular, or custom product? What are the unique selling points and required number of SKUs? What are their technical requirements?

**Expression:** What are the brand's attributes, design language, and design principles (proportion, surface, details)?

### 3. EMPIRICAL STUDY

The main objective of the empirical study was to show the benefits of coupling (or decoupling) key design drivers, i.e., nine design quality criteria, and how this can be effectively performed for concept generation and for the discovering of new business opportunities.

#### 3.1. RESEARCH BACKGROUND

The exploratory study applied quantitative methods on the performance of eight design teams. It combined self-assessment of risk perception with, grading of four strategic assignments by the first author and a Design Quality Criteria evaluation, performed by four external experts. The first two parts are treated separately in a paper submitted to the ACM Computer-Human Interaction Conference 2014, in Toronto, and the third part is described here. The study was conducted at Hanyang University, The Graduate School of Technology and Innovation Management, in the spring of 2013. The students were from either the design or engineering discipline, sixteen male and four female, between the ages of 26 and 40, enrolled in the graduate program. The following is a description of the evaluation of the design outcome.

#### 3.2. OPPORTUNITY PERFORMANCE AND DESIGN PERFORMANCE (DQC)

An expert panel consisting of four judges, two internal representing academia together with two external technology experts, representing industry, judged how well the team's design outcome (business description and proposed artifact) would serve new business opportunities. The objective was to I) assess the investment attractiveness of the business opportunity, and II) judge the team's design outcome along the nine design quality criteria, to uncover relationship between performance and design criteria coupling.

A survey package for each team project was handed out to the judges at the outset of the presentations and they were asked to complete the relevant survey for each presentation after its completion, including Q&A session.

#### 3.3. DATA ANALYSIS

The 32 surveys (4 judges x 8 teams) on the ten ratings (one investment + 9 DQCs) were coded into Excel and the correlations between the team's design outcome and the nine DQC were examined using SPSS. Also, correlations between the individual DQCs were identified to examine the interconnectivity of the DQCs.

The analysis revealed that the DQC criteria Structure and Process co-varied with Strategic Comprehension and expert panel's valuation of the value of the business opportunity co-varied with their average DQC score. This finding may seem mundane, however it submits an effective design guideline showing that a successful design outcome would arise from the understanding of strategic comprehension throughout the whole design process and that observing DQC performance can act as a predictor of the resulting business performance. See Figure 4.

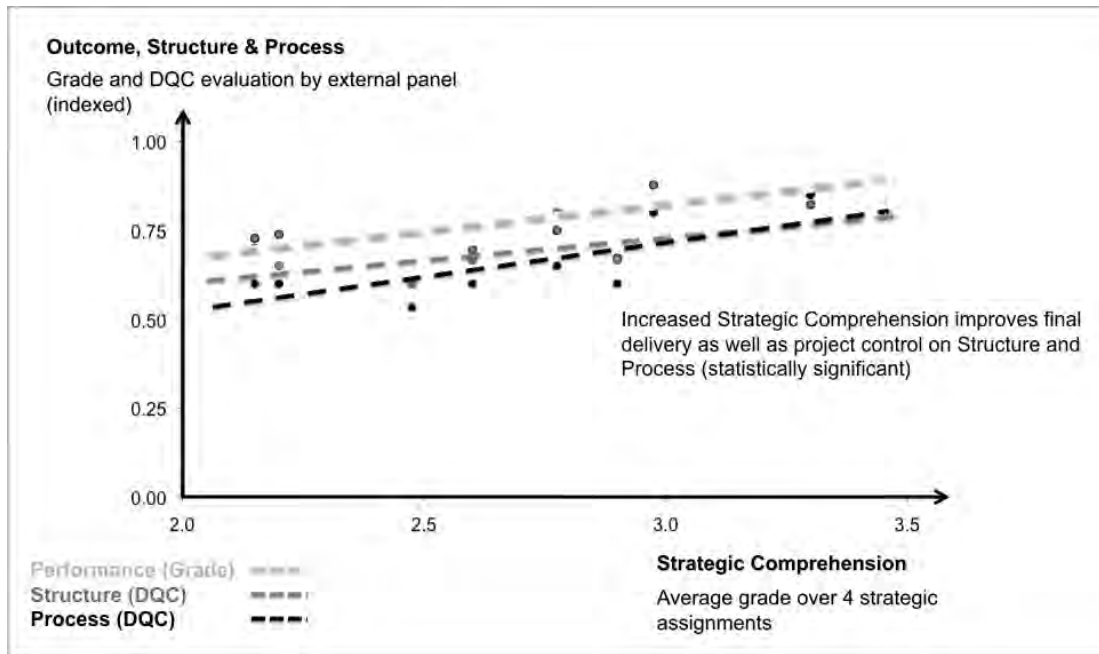


Figure 4. Performance of outcome, Structure and Process as a function of Strategic Comprehension

Strategic Criteria are loosely coupled (one to two connections each) with the Context (Social/human, Environmental and Viability) and Expression Criteria. Philosophy is connected with Social/human and Viability, Structure is connected with Environment and Expression and Innovation is connected with Social/human. Process and Function are only indirectly influenced by Strategy. This suggests that although Strategic Comprehension has a significant influence on the quality of the final outcome, the other six criteria can relatively easily be connected into cohesive solutions without Strategy. This may explain why cohesive designs can exist and fit various strategies, with Execution and Functionality being more or less independent of Strategy.

Social/human, Environmental and Expression are the tightest coupled (six to seven connections each) both to each other as well as to the remaining criteria. This suggests that it may be advantageous to begin the synthesis process by focusing on these tightly coupled criteria. Then move on to include medium coupled criteria, such as Process, Function and Viability, followed by lesser-coupled criteria under Strategy.

This further suggests that a business opportunity is more likely to be executed successfully, if it carefully considers the Strategy - Context coupling. Please see Figure 5.

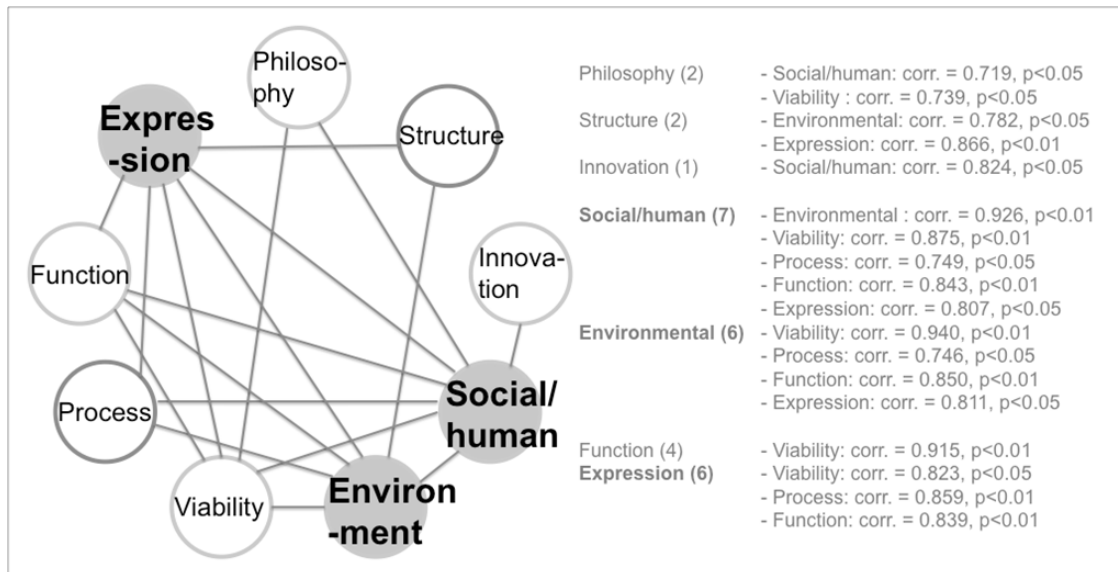


Figure 5. Coupling of the Design Quality Criteria. The number next to the nine DQC indicates the number of connection between the criteria.

#### 4. KEY FINDINGS, DISCUSSION & CONCLUSION

Analysis of the relationship between the nine Design Quality Criteria provided the following three insights, mapped in Figure 5.

- Strategic criteria: Philosophy and Structure and Innovation are design criteria, which are independent of each other and only loosely coupled to Context.
- Social/human, Environmental and Expression are the tightest coupled design criteria
- Performance of business opportunities are strongly coupled to the design teams' Strategic Comprehension, Structure and Process.

From a strategic perspective, this suggests that although Strategic Comprehension has a significant influence on the quality of the final outcome, external evaluators tend to overlook the importance of the Strategy component, supporting a proposed concept. A range of decision-biases may be at play, such as the Pro-innovation bias, the Availability heuristic and Illusion of validity. This may explain why cohesive designs can exist, be persuasive and end up being selected, more or less independent of Strategy. This suggests that a business opportunity is more likely to be executed successfully if it carefully considers the Strategy - Context coupling. Future studies could be done examining the advantage of the stronger coupling of Strategy and Context.

From a design perspective, this suggests that it may be advantageous to begin the synthesis process by focusing on tightly coupled Context criteria. Then, moving on to include medium coupled criteria, such as Process, Function and Viability and finally checking the currently lesser-coupled criteria under Strategy.

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