Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

The Value Translation Gap: The FBS+M Model for Aligning Firm Intent and Consumer Meaning

Ian D Parkman

parkman@up.edu

University of Portland School of Business Portland

Research Article

Keywords: Design Theory, Design Evaluation, User Value, Design Cognition

Posted Date: May 25th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9589406/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

THE VALUE TRANSLATION GAP: THE FBS+M MODEL FOR ALIGNING FIRM INTENT AND CONSUMER MEANING

Ian D Parkman
University of Portland
School of Business
Portland, Oregon, USA
parkman@up.edu
https://orcid.org/0000-0002-3891-2035

ABSTRACT

This paper addresses a limitation in formal models of design evaluation: alignment between expected and derived behavior (Be ↔ Bs) does not reliably account for design success in use. While Gero's Function–Behavior–Structure (FBS) framework provides a robust account of design as a transformation process, it does not fully specify how artifact behavior is interpreted during evaluation. Building on prior critiques of FBS, particularly Dorst and Vermaas (2005), this paper introduces FBS+M, an extension that incorporates Meaning (M) as an explicit evaluative variable. Meaning is defined as the user-constructed interpretation of artifact significance arising from the interaction between perceived behavior (Bs) and socio-cultural context, and is operationalized through Boztepe's (2007) dimensions of user value. The inclusion of M extends evaluation from a single-loop comparison (Be ↔ Bs) to a dual structure comprising behavioral alignment (Be ↔ Bs) and interpretive alignment (Be ↔ M). This enables identification of two forms of misalignment: ΔBe–M (intended vs. perceived meaning) and ΔBs–M (realized performance vs. interpreted meaning). Drawing on an abductive qualitative study of designer encoding (F → Be → S → Bs) and consumer decoding (Bs → M) in athletic footwear, the paper shows that technical alignment may coexist with interpretive misalignment due to asymmetries in how value is encoded and evaluated. The paper contributes by extending FBS with an interpretive evaluation layer, distinguishing behavioral and interpretive misalignment, and demonstrating how meaning mediates design outcomes.

Keywords: Design Theory; Design Evaluation; User Value; Design Cognition

1.0 INTRODUCTION

Innovation in product development has traditionally been evaluated through a performance-centered lens, where competitive advantage is achieved through improvements in functional attributes such as efficiency, durability, and technical sophistication. This logic is embedded in both managerial practice and formal design models, including Gero's Function–Behavior–Structure (FBS) framework (Gero, 1990; Gero and Kannengiesser, 2004), which conceptualizes design as a process of transformation from intended function (F) to expected behavior (Be), realized through structure (S), and evaluated through alignment between expected and derived behavior (Be ↔ Bs). Within this paradigm, design success is often implicitly equated with behavioral success.

However, this assumption does not consistently hold in practice. Empirical studies of product perception and user response demonstrate that improvements in technical performance do not necessarily always translate into user preference, customer loyalty, or marketplace success (Crilly, Moultrie, and Clarkson, 2004; Norman, 2004). As the empirical evidence in this paper demonstrates, such failures often arise not from deficiencies in function or structure, but from how product behaviors are interpreted in use. Within FBS, evaluation is defined as a comparison between expected and derived behaviors (Be ↔ Bs), implicitly assuming that users largely assess artifacts through functional or performance-based reasoning. While this formulation provides a robust account of technical coherence, it potentially does not fully account for a central aspect of contemporary real-world evaluation: users do not evaluate artifacts based on behavior alone, but also on the meaning they attribute to those behaviors. Norman (1988) characterizes this gap as the *gulf of evaluation*, emphasizing the cognitive distance between system output and user interpretation. However, whereas Norman conceptualizes the gulf as a user-side cognitive challenge, FBS+M locates it within the structure of the design process itself, enabling more explicit model-based diagnosis rather than descriptive explanation.

Although a range of extensions and reframings of FBS have expanded its descriptive and cognitive scope—including situated cognition (Gero and Kannengiesser, 2004), process representation (Gero and Kannengiesser, 2007), formalization as a design ontology (Gero and Kannengiesser, 2014), and the inclusion of needs and requirements in early-stage reasoning

(Cascini, Rotini, and Russo., 2013)—these developments primarily elaborate how design operates as a transformation process rather than how it is evaluated. At the same time, critiques have highlighted limitations in how functions and outcomes are framed within the model (Dorst and Vermaas, 2005). More broadly, process-oriented accounts of design recognize that formal models provide only partial representations of evaluation, often omitting experiential and interpretive dimensions (Wynn and Clarkson, 2018). Taken together, these perspectives point to a persistent structural limitation in how evaluation is represented: while FBS has been extensively developed as a model of design reasoning, its evaluative logic remains under-specified with respect to interpretation. This paper identifies a largely unmodeled dimension in that evaluative logic and addresses it through a formal extension—FBS+M—which introduces Meaning (M) as an explicit evaluative variable defined as,

> *the interpreted significance of an artifact, constructed by users through the integration of perceived behaviors (Bs) with their goals, identities, and socio-cultural frames, resulting in structured value attributions that guide evaluation and use.*

In this formulation, meaning is not treated primarily as an external moderating construct, but as an observable evaluative outcome expressed through structured value dimensions (Boztepe, 2007). While much prior work has established that user meaning plays an important role in design and innovation (Krippendorff, 2006; Verganti, 2017), these contributions largely remain external to formal design process models. In contrast to prior work that treats meaning as external to design models, FBS+M specifies meaning as an internal evaluative variable within the formal structure of design reasoning. Accordingly, the objective of this paper is not to re-establish the importance of meaning, but to locate it within the evaluative structure of a design model and specify how misalignment occurs. Within FBS+M, the design process is extended as:

$$F \rightarrow Be \rightarrow S \rightarrow Bs \rightarrow M$$

This extension transforms evaluation from a single-loop comparison to a dual evaluative structure:

Technical evaluation: $Be \leftrightarrow Bs$

Interpretive evaluation: Be ↔ M

Accordingly, iteration operates across two pathways: (1) structural refinement (S → S′) to improve performance, and (2) interpretive refinement (Be ↔ M) to improve alignment between intended and perceived meaning. Evaluation in FBS+M is thus understood as a two-condition requirement: behavioral validity and interpretive validity**.**

The inclusion of Meaning (M) makes visible two distinct forms of misalignment:

ΔBe–M (Expectation–Meaning Misalignment): divergence between intended experience and perceived meaning

ΔBs–M (Performance–Meaning Misalignment): divergence between realized performance and interpreted meaning

These constructs extend the diagnostic capacity of FBS by more clearly distinguishing between failures of intent and failures of interpretation. As a result, what appears as alignment within the traditional FBS model (Be ≈ Bs) may still result in evaluative failure due to misalignment at the level of meaning. Empirically, this argument is developed through an abductive study of athletic footwear design and use. This context is analytically useful because it combines high engineering specification with high interpretive variability, making the separation between behavioral performance and interpretive evaluation particularly visible. Data were collected from both organizational designer-side encoding processes (F → Be → S → Bs) and consumer-side decoding processes (Bs → M), enabling direct observation of how intended behaviors are translated into meaning in use. The findings show that designers encode intent primarily through structure and behavior, while users evaluate products through interpretive frameworks grounded in identity, familiarity, and perceived authenticity. This asymmetry appears to produce a systematic divergence between intended and perceived meaning, even in the absence of technical failure. To capture this phenomenon, the paper introduces the *Value Translation Gap*, defined as the structured divergence between intended and interpreted outcomes within the design process. By embedding Meaning (M) within the evaluative logic of FBS, this paper provides a more explicit account of how and where evaluation breaks down. In doing so, it reframes design

success as dependent not only on how products perform, but on how those performances are made meaningful in use.

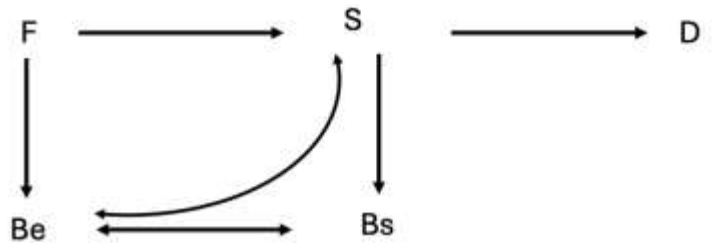
1.1 FBS as a Representative Design Logic

Design representation is the abstraction of design knowledge as objects, relationships, and structures and is a common and essential task in theorizing design processes (Shah and Wilson, 1989). Gero's (1990) FBS framework conceptualizes design as a structured transformation process:

F → Be (formulation)
Be → S (synthesis)
S → Bs (analysis)
Be ↔ Bs (evaluation)
S → D (documentation / external representation)

This formulation has proven influential across engineering design research (Galle, 2009; Singh, 2005; Gero and Kannengiesser, 2004; Gero and Kannengiesser, 2014), offering a structured account of how abstract intentions become materialized in artifacts and iteratively refined through behavioral alignment. Consider the design of an electric kettle. The intended function (F) is to boil water safely and efficiently, leading to expected behaviors (Be) such as rapid heating and automatic shutoff, realized through structure (S) and evaluated through alignment between expected and observed outcomes (Be ↔ Bs). However, behavioral alignment does not necessarily guarantee design success. A kettle may perform as intended yet be perceived as generic, low-quality, or uninspired, undermining Emotional or Significance value. Conversely, a visually distinctive kettle may resonate strongly despite offering no measurable performance advantage. In such cases, the breakdown is not behavioral (Be ≈ Bs), but interpretive: derived behaviors are translated into meanings (M) that do not align with user value.

Figure 1. The FBS framework (Gero, 1990)



The limitation here is not a flaw in the FBS framework itself, but a boundary condition of its evaluative logic. As Dorst and Vermaas (2005) note, design problems are often ill-defined and cannot be fully resolved through technical optimization alone. Similarly, research on design-driven innovation emphasizes that product success is not determined solely by improvements in performance, but by the meanings that users attribute to artifacts in use (Verganti, 2009, 2017). Taken together, these perspectives suggest that evaluation in design extends beyond behavioral alignment to include how outcomes are interpreted, a dimension that remains external to the formal evaluative structure of FBS. In parallel, Krippendorff (2006) argues that the meaning of artifacts only emerges through interpretation, rather than being determined solely by their functional properties.

While existing critiques of FBS, including Vermaas and Dorst (2007), identify important conceptual and ontological limitations, they primarily focus on refining the model's internal coherence. In doing so, they leave under-specified how artifacts are interpreted in use. This paper addresses that omission directly by extending FBS beyond technical transformation to include the interpretive alignment suggested by Dorst and Vermaas (2005) and Krippendorff (2006), among others. More broadly, prior critiques remain largely conceptual and descriptive in orientation, whereas this study advances the discussion empirically by showing how meaning is constructed, contested, and evaluated in practice. Taken together, these perspectives point to a missing layer within FBS—one that accounts for how users make sense of artifact behavior, not simply how they respond to it. The missing element, therefore, is not function or behavior alone, but interpretation.

1.2 Meaning as an Evaluative Layer in Design

Prior research demonstrates that product evaluation often extends beyond performance to include how artifacts are interpreted in use (Verganti, 2009, 2017; Desmet and Hassenzahl, 2012). However, while these perspectives establish that interpretation matters, they remain largely external to formal design models. To incorporate interpretation into the evaluation function, meaning must be specified in a more structured and observable form. Boztepe (2007) provides such an operationalization by articulating meaning as a set of user value dimensions that capture what, precisely, is being interpreted by consumers in use:

Utility Value: Perceived functional performance and effectiveness

Emotional Value: Affective responses such as enjoyment or excitement

Social Value: Perceived ability to signal belonging or social identity

Significance Value: Contribution to personal identity and self-expression

Spiritual Value: Alignment with personal beliefs, values of sufficiency, and sense of inner coherence

These dimensions provide a useful conceptual vocabulary for the evaluative content of meaning—what users respond to when judging a product—not only in terms of performance, but in terms of how it resonates across functional, emotional, social, and existential domains (Boztepe, 2007). Boztepe's framework is employed not as a normative model of value, but as a parsimonious and empirically observable structure for operationalizing meaning within evaluation. However, while Boztepe's (2007) framework clarifies what meaning consists of, it does not specify where or how these dimensions enter the design process itself. In other words, it describes the structure of user experience outcomes present (or absent) in an artifact, but not their relationship to the underlying logics of design. This omission becomes consequential when considered alongside descriptive models such as FBS. Within FBS, Utility Value maps relatively cleanly onto expected and derived behaviors (Be and Bs), as technical performance attributes that can be specified, measured, and optimized through structure. In contrast, Emotional, Social, Significance, and Spiritual values do not have a clearly specified position within the model. They have been effectively externalized and treated as subjective outcomes of behavioral use rather than as integral components of design evaluation. The result is a structural bifurcation between

how products are designed and how they are experienced. Designers tend to operate within a logic of functional alignment, while users often evaluate across all five dimensions simultaneously. This creates a systematic condition in which design decisions optimize for a subset of evaluative criteria, while users assess the product against a broader and differently structured set of values. From a strategic standpoint, this creates a blind spot: products may achieve high levels of behavioral alignment (Be ↔ Bs) while at the same time failing to deliver the "right" configuration of value across Emotional, Social, Significance, or Spiritual dimensions desired by consumers. While such misalignment may be intuitively recognized in practice, it remains largely invisible within traditional evaluation frameworks—resulting in a persistent *gulf of evaluation* (Norman, 1988).

Within the FBS+M framework, Boztepe's dimensions are explicitly included as evaluative variable M, specifying the structured content of *what* is being interpreted when users assess a design. In this sense, M makes explicit the dimensions along which interpretation occurs—what dimensions users are responding to when they judge a product in use and ascribe value. Importantly, these dimensions are not uniformly encoded within the design process. Utility may be directly specified and optimized through the transformation F → Be → S → Bs, where performance can be deliberately designed and evaluated. In contrast, Emotional, Social, Significance, and Spiritual values are not systematically encoded in the same way; they emerge primarily through interpretation in use. This asymmetry is structural: designers optimize Utility through F → Be → S → Bs, while other value dimensions emerge through interpretation in use.

Taken together, this results in a dual evaluative structure:

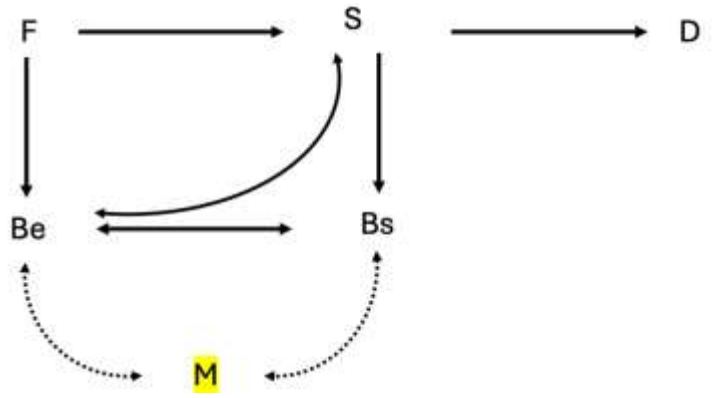
Technical evaluation: Be ↔ Bs

Interpretive evaluation: Be ↔ M

It is within the interaction of these two loops that the *Value Translation Gap* emerges. Designs may achieve high levels of behavioral alignment while remaining interpretively misaligned as multiple dimensions value, not due to failures in function or structure, but because different dimensions of value are governed by different logics. By making this dual structure explicit, FBS+M extends the explanatory scope of FBS by more explicitly accounting for how and where

evaluation breaks down. More precisely, this extension identifies a boundary condition in the evaluative logic of FBS—namely, the absence of an explicit mechanism for modeling interpretation—and addresses it through the introduction of Meaning (M) as an evaluative variable as expressed through Boztepe's (2007) dimensions.

Figure 2. The FBS+M framework (based on Gero, 1990)



In the FBS+M formulation, the design process is extended as:

$$F \rightarrow Be \rightarrow S \rightarrow Bs \rightarrow M$$

The inclusion of Meaning (M) transforms evaluation from a single-loop comparison (Be ↔ Bs) into a dual evaluative structure: behavioral alignment (Be ↔ Bs) and interpretive alignment (Be ↔ M). FBS+M retains the transformation logic of FBS while extending its evaluative scope. This dual structure enables the identification of two distinct forms of misalignment not captured in traditional FBS.

ΔBe–M (Expectation–Meaning Misalignment): divergence between intended behaviors (Be) and interpreted meaning (M), where intended experiences fail to translate into perceived value.

ΔBs–M (Performance–Meaning Misalignment): divergence between realized performance (Bs) and interpreted meaning (M), where technically successful behaviors are perceived as excessive, artificial, or otherwise misaligned with user expectations and context.

In this study, meaning is treated as observable through coded distributions across Boztepe's (2007) five dimensions. These two forms of misalignment are analytically distinct in that ΔBe–M originates in mis-specified intended experience, whereas ΔBs–M arises from reinterpretation of successfully achieved performance. For example, a kettle may satisfy Utility expectations yet be interpreted as "cheap" or "generic," reflecting low Emotional or Significance value and producing ΔBe–M. Alternatively, strong performance may be interpreted as "over-engineered" or inauthentic, producing ΔBs–M. In both cases, Be ≈ Bs, yet evaluative outcomes diverge because alignment in Utility does not ensure alignment across meaning (M).

2.0 EMPIRICAL CONTEXT AND ABDUCTIVE METHODOLOGY

2.1 Athletic Footwear as a Research Context

Athletic footwear provides a useful empirical context for examining evaluation within design processes due to its dual character as both a highly engineered product system and a site of symbolic and experiential interpretation. Prior research shows that evaluation in such categories extends beyond functional performance to include affective and symbolic dimensions (Crilly, Moultrie, and Clarkson, 2004; Desmet and Hekkert, 2007). While footwear provides a clear empirical setting, the mechanism is expected to generalize to any domain where performance is specified technically but evaluated interpretively (e.g., consumer electronics, medical devices, service systems). At the same time, footwear development remains closely aligned with the transformation logic of the Function–Behavior–Structure (FBS) framework (Gero, 1990), involving the specification and optimization of performance through materials, geometry, and construction. This combination—high technical specification alongside high interpretive variability—creates conditions in which alignment at the level of behavior (Be ↔ Bs) does not necessarily translate into alignment at the level of meaning (M). As such, the category provides an analytically useful setting for examining the Value Translation Gap as formalized in the FBS+M framework.

The research draws on semi-structured interviews with 12 firm-side designers and 36 experienced runners. This study adopts an abductive research design, iterating between empirical

observation and theoretical development to extend the evaluative logic of FBS. Abductive approaches are particularly appropriate where existing models provide partial explanatory power and where new constructs are required to account for observed discrepancies (Timmermans and Tavory, 2012; Dubois and Gadde, 2002; Alvesson and Kärreman, 2007). The analysis proceeded through iterative cycles in which qualitative data were compared against the evaluative assumptions embedded in FBS. Specifically, instances in which products satisfied behavioral expectations (Be ≈ Bs) but produced divergent user evaluations prompted closer examination. These cases were not fully explained within the Be ↔ Bs evaluative loop and instead indicated a missing interpretive layer. Through this process, Meaning (M) was introduced as a theoretically necessary construct, and two forms of misalignment—ΔBe–M and ΔBs–M—were formalized. Consistent with established qualitative theory-building approaches, analysis moved between first-order observations, second-order themes, and aggregate theoretical dimensions (Gioia, Corley, and Hamilton, 2013). The objective was not to catalog an exhaustive set of meanings per se, but to identify systematic divergences between behavioral performance and interpretive evaluation as expressed through the distribution of value across Boztepe's (2007) five dimensions and to locate those divergences within the structure of the design process. To examine the encoding side of the model, qualitative data were collected through semi-structured interviews with footwear designers, developers, and merchandisers at a large multinational footwear company in the U.S. Pacific Northwest. Participants were recruited using snowball sampling to access individuals with specialized domain expertise and direct involvement in product development (Churchill, 1995). The industry's triadic structure—product design, development (manufacturing and production), and merchandising (business operations)—provided holistic perspectives on how intended functions and behaviors are translated into structure and performance outcomes. On the consumer decoding side, qualitative data were collected from experienced runners following an analogous snowball process through organized running club communities[1]. Fifteen running clubs were contacted, with six participating, resulting in a final sample of N = 36 respondents with an average of 12.7 years of running experience. This level of experience enables observation of stable and internally consistent evaluative frameworks. Additionally, because participants were embedded in organized running

[1] Six clubs agreed to participate, including Oregon Road Runners Club, NoPo Running Club, Portland Stumprunners, Wy'East Wolfpack, Tacoma City Running Club, and West Seattle Running Club

communities, their evaluations reflect not only individual perceptions but also shared group norms around performance, authenticity, and identity. This enabled examination of how derived behaviors (Bs) are interpreted into meaning (M) across Utility, Emotional, Social, Significance, and Spiritual value. This dual-perspective design allows for direct comparison between encoded intent (F → Be → S → Bs) and decoded meaning (Bs → M), consistent with the structure of the FBS+M framework. Interview transcripts were analyzed using established qualitative coding procedures (TACT, 1997; NVivo, QSR International, 2002). Data analysis followed a structured abductive coding process. First-order coding captured how participants described product performance, experience, and evaluation. On the designer side, this included references to materials, geometry, biomechanics, and performance optimization—reflecting a logic grounded in structure and behavior. On the consumer side, coding captured references to identity, authenticity, effort, and affective judgment, reflecting interpretive evaluation in use. These first-order codes were then grouped into second-order themes aligned with encoding (F → Be → S → Bs) and decoding (Bs → M) processes. At the aggregate level, patterns of divergence between intended and perceived outcomes were mapped onto the constructs of the FBS+M framework, enabling identification of ΔBe–M and ΔBs–M as distinct forms of evaluative misalignment.

Coding results indicate a clear asymmetry: Utility-oriented codes dominate the encoding process (F → Be → S → Bs), while consumer-side evaluation distributes across Utility, Emotional, Social, Significance, and Spiritual dimensions. Table 1. illustrates this divergence, highlighting the concentration of Utility in design encoding and the broader distribution of meaning in consumer use. Representative quotes were selected based on their ability to illustrate theoretically relevant patterns rather than frequency alone, consistent with qualitative research practices that prioritize analytic generalizability over statistical representativeness (Gioia, Corley, and Hamilton, 2013). While Utility is explicitly encoded through structure and behavior, additional value dimensions emerge primarily through interpretation, contributing to divergence between Be, Bs, and M. This pattern supports the operationalization of meaning as a structured evaluative variable.

Table 1. Distribution of User Value Dimensions in Designer Encoding and Consumer Decoding

Value Dimension	Designer Encoding (F→Be→S→Bs)	Consumer Decoding (Bs→M)
Utility	*Dominant*	*Frequent*
Emotional	*Rare*	*Frequent*
Social	*Minimal*	*Moderate*
Significance	*Minimal*	*Frequent*
Spiritual	*Absent*	*Occasional*

The key analytical move in this process was not the identification of meaning as such, but the systematic observation that behavioral alignment did not reliably produce interpretive alignment. In multiple cases, products that met or exceeded expected behaviors were nonetheless evaluated negatively or ambivalently due to how those behaviors were interpreted within user contexts. Table 2. maps the FBS+M components across designer encoding and consumer decoding, illustrating how technically specified functions, behaviors, and structures are translated into user experience and interpreted meaning as expressed through the distribution of value across Boztepe's (2007) five dimensions, and where misalignments (ΔBe–M and ΔBs–M) emerge within the evaluation process.

Table 2. Empirical Mapping of FBS+M Components Across Designer Encoding and Consumer Decoding

FBS+M Component	Designer Encoding	Consumer Decoding	Analytical Role
F (Function)	*Performance goals (speed, efficiency, stability)*	*Often implicit or unarticulated*	*Intended purpose*
Be (Expected Behavior)	*"Improve ride," "increase energy return"*	*Expected experience (comfort, responsiveness)*	*Intended experience*
S (Structure)	*Materials, foam compounds, geometry, plate systems*	*Largely invisible to users*	*Design mechanism*
Bs (Derived Behavior)	*Measured performance (cushioning, propulsion, stiffness)*	*Felt experience (softness, responsiveness)*	*Realized performance*
M (Meaning)	*Assumed to follow from performance*	*Interpreted as "authentic," "artificial," "honest," etc.*	*Evaluative construct*
ΔBe–M	*Intended benefit ≠ perceived value*	*"Supposed to help, but feels wrong"*	*Expectation–meaning gap*
ΔBs–M	*Performance achieved ≠ meaning aligned*	*"Technically good, but feels artificial"*	*Performance–meaning gap*

These recurring discrepancies provided the empirical basis for formalizing Meaning (M) as a missing variable in the evaluation function. Within the FBS+M framework, these divergences are captured as:

ΔBe–M, where intended experiences do not translate into corresponding perceived value

ΔBs–M, where realized performance is interpreted in ways that undermine intended meaning.

Taken together, the results of Tables 1. and 2. make visible a systematic asymmetry between designer encoding and consumer decoding, showing how value is concentrated in Utility during the transformation F → Be → S → Bs, but distributed across multiple dimensions as behavior is interpreted (Bs → M). The following sections unpack this divergence in detail, first examining the structure-dominant logic of designer encoding and then the interpretive logic through which users construct meaning in use.

2.2. Designer Encoding: Structure-Dominant Logic in F → Be → S → Bs

Across roles, encoding is largely dominated by a structure-driven logic focused on optimizing performance (energy return, stability, efficiency). Meaning is not typically explicitly designed but assumed to follow from improved behavior. As one Footwear Designer explained, "*We're constantly trying to refine how the shoe behaves under load—energy return, stability, efficiency*," while another noted, "*If we can improve the mechanics, the experience should follow*." Developers similarly described the process as highly iterative and technically focused, often optimizing features that "*most people won't even consciously notice*." From a merchandising perspective, these technically encoded behaviors are subsequently translated into simplified marketing promotion narratives—typically framed around speed, comfort, or support—yet remain anchored in performance-based logic. As one merchandiser observed, "*Our job is to turn all that engineering into a story… because that's what consumers will understand*."

Additional selected quotations further reinforce the consistency of this encoding orientation:

> "*We're constantly chasing better foam compounds… the goal is always the same: improve the ride*" (Designer D)
>
> "*Fit is everything. If the geometry is right, people will trust the shoe*" (Designer F)
>
> "*We think in terms of systems… all working together to deliver a specific behavior*" (Developer C)
>
> "*You're solving for fit, performance, and biomechanics first. The rest tends to fall into place*" (Designer A)
>
> "*If we get the performance right, the product will speak for itself*" (Merchandiser G)

These qualitative accounts illustrate a structural asymmetry revealed by FBS+M: While designers explicitly specify functions (F), expected behaviors (Be), and structural mechanisms (S), and rigorously evaluate derived behaviors (Bs), Meaning (M) is not equivalently specified or or systematically evaluated during encoding. Instead, it is treated as an inferred outcome of performance. As a result, the relationship between intended experience (Be) and interpreted significance (M) is neither directly designed nor systematically assessed. This divergence helps create the conditions for both forms of misalignment identified in the FBS+M framework. When intended experiences do not translate into corresponding perceived value, ΔBe–M (Expectation–Meaning Misalignment) emerges. When successfully achieved behaviors are interpreted in unintended ways, ΔBs–M (Performance–Meaning Misalignment) occurs. In both cases, divergence arises not from failures in function or structure, but from the absence of meaning as an explicitly encoded and evaluated variable. Within the FBS+M framework, this can be understood as an origin point of the *Value Translation Gap*: designers encode intent through structure to produce behavior, but the transition from behavior (Bs) to meaning (M) is not formally integrated into the encoding process. Consequently, even highly refined technical solutions may produce unintended or misaligned meanings—not due to execution failure, but due to the absence of interpretive evaluation within encoding.

2.3 Consumer Decoding: Interpretive Logic in Bs → M

Among consumers a consistent pattern emerged across participants: derived behaviors (Bs) were not evaluated solely as performance but translated into structured value judgments (M) across Utility, Emotional, Social, Significance, and Spiritual dimensions, and thereby constructing meaning (M). Similar performance characteristics were variously interpreted as "*efficient*," "*over-engineered*," "*protective*," or "*artificial*," depending on user expectations and context. As one participant noted, "*I don't know what's inside it—I just know if I like it*," reflecting an evaluative orientation focused not on how a product works, but on what it means. This transformation (Bs → M) appears to be rapid and often non-deliberative, but observable through shifts in value attribution across dimensions.

Additional accounts further illustrate the consistency of this decoding logic:

> "*It's less about what it does and more about how it feels over time*" (Running Club Member IV)
> "*Some shoes just look fast, it isn't necessarily real, I just know it when I see it*" (Running Club Member VI)
> "*If it looks too aggressive or technical, I assume it's not really for me*" (Running Club Member VIII)
> "*I like shoes that don't look like they're trying too hard—it should just fit me*" (Running Club Member IX)
> "*You can just tell when a shoe is trying to be something it's not*" (Running Club Member X)
> "*There's a difference between a shoe that performs and one that feels right*" (Running Club Member XIV)

These accounts highlight the interpretive process that operates through alignment with identity, familiarity, and perceived authenticity, rather than through deliberate assessment of performance attributes. Technical characteristics such as cushioning, responsiveness, or fit are not evaluated in isolation, but filtered through expectations shaped by prior experience, brand associations, and community norms resulting in different configurations of Emotional, Social, and Significance value assigned to the same performance.

From the perspective of the FBS+M framework, this decoding process represents the transformation:

$$Bs \rightarrow M$$

Crucially, this transformation is neither linear nor deterministic. The same derived behavior was observed to produce different meanings across users, or within the same user across contexts. For example, highly cushioned shoes may be interpreted as "*protective*" and "*comfortable*" in one context, but as "*over-engineered*" or "*inauthentic*" in another. In such cases, behavioral performance remains constant while the distribution of value across M diverges. This variability has direct implications for evaluation. Consumers are not primarily assessing whether derived behaviors match expected behaviors (Be ↔ Bs), but whether the resulting meaning (M) aligns with their expectations and identity. As a result, evaluation is governed by the relationship between Be and M, rather than solely by Be ↔ Bs. This finding aligns with the two forms of misalignment captured by FBS+M: ΔBe–M (Expectation–Meaning Misalignment) occurs when intended experiences do not translate into corresponding perceived value. ΔBs–M (Performance–Meaning Misalignment) occurs when successfully achieved behaviors are interpreted in ways that undermine or invert intended value. In both cases, divergence arises not from failures in performance, but from how performance is interpreted.

Overall, the insights from the abductive process highlight that while designers encode intent through structure to produce rationalized behavior (F → Be → S → Bs), consumers decode products through meaning (Bs → M). The transition from behavior to meaning is therefore not determined by the design process but mediated through user interpretation as expressed through the distribution of value across Boztepe's (2007) five dimensions. Within the FBS+M framework, this is the point at which the *Value Translation Gap* becomes observable. Even when products perform as designers intended, evaluative outcomes necessarily depend on how those performances are interpreted by consumers in use. Technical success does not guarantee evaluative success; rather, outcomes are determined by the degree to which constructed meaning aligns with user expectations and interpretive frameworks.

2.4 The Value Translation Gap: Empirical Demonstration of FBS+M

The *Value Translation Gap* can be understood as the structured divergence between intended and interpreted outcomes within the design process. While the FBS framework models evaluation through alignment between expected and derived behaviors (Be ↔ Bs), the findings presented here show that this condition appears insufficient: products may perform as intended yet fail when those performances are interpreted in unintended ways. This gap can be understood as a formal extension of Norman's (1988) "gulf of evaluation". Whereas Norman describes this gulf in terms of the user's ability to interpret system state, the FBS+M framework locates it within the structure of the design process itself across two distinct logics: designers encode intent through behavior (F → Be → S → Bs), while users evaluate through meaning (Bs → M). This transition is not modeled within FBS, leaving interpretation under-specified.

Figure 3. visualizes the *Value Translation Gap* as the misalignment between designer-side encoding and consumer-side decoding. On the left, designers encode primarily for Utility through the transformation F → Be → S, while other value dimensions (Emotional, Social, Significance, Spiritual) remain implicit or assumed. On the right, consumers evaluate across all five dimensions through the interpretive transformation Bs → M, where performance is experienced and evaluated across multiple value dimensions (M), rather than solely in terms of Utility. The central "gulf of evaluation" (Norman, 1988) represents the transition between these two logics. The figure further distinguishes two points of divergence: ΔBe–M, where intended experiences fail to translate into perceived value, and ΔBs–M, where achieved performance is interpreted in ways that misalign with intended meaning.

Figure 3. The Value Translation Gap

Designers Encode (F → Be → S)		Consumers Decode (Bs → M)
• Utility (*explicit, optimized*) Emotional, Social, Significance, Spiritual (*implicit, assumed*)	The "*gulf of evaluation*" (Norman, 1988)	• Utility (*experienced, validated*) • Emotional (*felt, immediate*) • Social (*signaled, contextual*) • Significance (*personally integrated*)

	[redacted]	• Spiritual (*value-aligned, authentic*)
ΔBe–M: Divergence between intended experience (expected behaviors) and perceived meaning across value dimensions		ΔBs–M: Divergence between actual performance (derived behaviors) and interpreted meaning across value dimensions

Within FBS+M, the *Value Translation Gap* is conceptualized as a structural condition of design evaluation. It is not merely incidental or context-specific, but a predictable outcome of a process that specifies performance in detail while leaving meaning to emerge through interpretation. The critical transition is therefore not simply Be ↔ Bs, but Bs → M, where design intent is either realized or reinterpreted as expressed through the distribution of value across Boztepe's (2007) five dimensions. As a result, design success depends not only on how products perform, but on how those performances are rendered meaningful in use. By making interpretation explicit within the evaluation function, FBS+M and the Value Translation Gap extend Gero's framework from a model of behavioral coherence to one of interpretive alignment, providing a mechanism for reconciling the persistent gap between technically successful designs and their variable marketplace performance outcomes.

3.0 DISCUSSION AND CONCLUSION

This paper shows that while FBS is robust as a model of transformation, it remains incomplete as a model of evaluation. By introducing Meaning (M), FBS+M reframes evaluation as a dual process combining behavioral and interpretive alignment. The primary contribution is a formal extension of the evaluative logic of FBS. Prior work has strengthened FBS by incorporating context and situated cognition (Gero and Kannengiesser, 2004) and by questioning how functions are framed and outcomes assessed (Dorst and Vermaas, 2005). However, these strands stop short of specifying interpretation as a variable within the model. FBS+M addresses this by introducing Meaning (M) and by locating it precisely at the point where derived behavior is interpreted in use. FBS+M preserves the transformation logic of FBS while extending its evaluative structure. This shift reframes design success from a condition of behavioral coherence to one of interpretive alignment. In doing so, the model helps explain a class of outcomes that

traditional FBS cannot: why technically successful designs fail in practice, and why less optimized designs may succeed.

A second contribution is the integration of user value into the design process itself. Drawing on Boztepe (2007), the paper shows that value dimensions are unevenly encoded: Utility is directly specified and optimized through structure and behavior, while Emotional, Social, Significance, and Spiritual dimensions are largely deferred to user interpretation. This asymmetry provides a structural mechanism for divergence. Alignment at the level of Utility can coexist with misalignment across other dimensions of value, producing outcomes that appear contradictory under a performance-only lens. In FBS+M, iteration occurs not only through reformulation of structure ($S \rightarrow S'$), but through reframing of intended behavior (Be) and its communicative linkage to meaning (M). This perspective also reframes Norman's (1988) "gulf of evaluation." Rather than locating the gap solely in user cognition, FBS+M situates it within the structure of the design process itself—as a systematic divergence between behavioral specification and interpretive evaluation. In doing so, FBS+M relocates the "gulf" from a user-level cognitive problem to a model-level omission within design evaluation. Finally, the paper formalizes two distinct failure modes—ΔBe–M (Expectation–Meaning Misalignment) and ΔBs–M (Performance–Meaning Misalignment)—which extend the diagnostic capacity of FBS. These constructs specify not only that evaluation can fail, but where and how failure occurs within the design process.

The paper also contributes methodologically by demonstrating how interpretive gaps can be diagnosed empirically and mapped onto formal model components. Using an abductive research design (Timmermans and Tavory, 2012; Dubois and Gadde, 2002; Alvesson and Kärreman, 2007), the analysis iterated between observed discrepancies in user evaluation and the evaluative assumptions embedded in FBS. Cases in which $Be \approx Bs$ but evaluations diverged prompted the introduction of Meaning (M) and the specification of ΔBe–M and ΔBs–M. Crucially, this approach does not treat meaning as diffuse or purely subjective. Instead, it structures qualitative evidence around encoding ($F \rightarrow Be \rightarrow S \rightarrow Bs$) and decoding ($Bs \rightarrow M$), linking first-order user accounts to second-order model constructs (Gioia, Corley, and Hamilton, 2013). This makes interpretation observable, comparable, and diagnosable within the design process. The result is a replicable analytic approach for distinguishing whether failures stem from unclear intent (ΔBe–

M), misinterpreted performance (ΔBs–M), or both. In doing so, it moves beyond generalized notions of "product–market fit" toward a model-based diagnosis of evaluative breakdown.

For practice, the implications are direct. Contemporary development processes are highly effective at optimizing Be ↔ Bs through iterative refinement of structure. They are less equipped to evaluate Be ↔ M—that is, whether intended experiences are realized as meaning in use. FBS+M suggests three shifts. First, treat meaning as a design variable rather than an assumed outcome. This requires evaluating not only whether a product works, but how it is interpreted—early and iteratively—through mechanisms such as interpretive testing, narrative prototyping, and context-of-use validation. Second, use ΔBe–M and ΔBs–M as diagnostics. Distinguish whether underperformance reflects misaligned intent or misinterpreted performance, and intervene accordingly—through redesign, repositioning, or reframing. Third, recognize that in mature categories—such as athletic footwear—where performance gains are incremental and widely diffused, advantage increasingly lies in shaping interpretation. Under these conditions, differentiation depends less on what products do and more on what they come to mean.

The FBS+M framework incorporates performance and interpretation within a single evaluative model. By locating Meaning (M) within the evaluation cycle, it shows that behavioral alignment (Be ≈ Bs) is insufficient for design success. The contribution is twofold: specifying where meaning operates within a formal design model and explaining how misalignment emerges. Design success depends not only on what artifacts do, but on how those behaviors are made meaningful in use.

REFERENCES

Arnould EJ, Thompson CJ (2005) Consumer culture theory (CCT): Twenty years of research. *J Consum Res* 31(4):868–882. https://doi.org/10.1086/426626

Belk RW (1988) Possessions and the extended self in consumer behavior. *J Consum Res* 15(2):139–168. https://doi.org/10.1086/209154

Boztepe S (2007) User value: Competing theories and models. *Int J Des* 1(2):55–63.

Chapman J (2005) *Emotionally durable design: Objects, experiences and empathy*. Earthscan, London.

Churchill GA (1995) *Marketing research: Methodological foundations*, 6th edn. Dryden Press, Fort Worth, TX.

Cascini G, Rotini F, Russo D (2013) Towards the integration of TRIZ and FBS. *Procedia Eng* 131:760–769. https://doi.org/10.1016/j.proeng.2015.12.436

Dell'Era C, Verganti R (2010) Collaborative strategies in design-intensive industries: Knowledge diversity and innovation. *Long Range Plan* 43(1):123–141. https://doi.org/10.1016/j.lrp.2009.10.006

Desmet PMA, Hassenzahl M (2012) Towards happiness: Possibility-driven design. In: Zacarias M, de Oliveira JV (eds) *Human-computer interaction: The agency perspective*. Springer, Berlin, pp 3–27. https://doi.org/10.1007/978-3-642-25691-2_1

Desmet PMA, Hekkert P (2007) Framework of product experience. *Int J Des* 1(1):57–66.

Dorst K, Cross N (2001) Creativity in the design process: Co-evolution of problem–solution. *Des Stud* 22(5):425–437. https://doi.org/10.1016/S0142-694X(01)00009-6

Dorst K, Vermaas PE (2005) John Gero's function–behaviour–structure model of designing: A critical analysis. *Res Eng Des* 16(1–2):17–26. https://doi.org/10.1007/s00163-005-0004-7

Galle P (2009) The ontology of Gero's FBS model of designing. *Des Stud* 30(4):321–339. https://doi.org/10.1016/j.destud.2008.12.006

Gero JS (1990) Design prototypes: A knowledge representation schema for design. *AI Mag* 11(4):26–36. https://doi.org/10.1609/aimag.v11i4.854

Gero JS, Kannengiesser U (2004) The situated function–behaviour–structure framework. *Des Stud* 25(4):373–391. https://doi.org/10.1016/j.destud.2003.10.010

Gero JS, Kannengiesser U (2007) A function–behaviour–structure ontology of processes. *AI EDAM* 21(4):379–391. https://doi.org/10.1017/S0890060407000340

Gero JS, Kannengiesser U (2014) The function–behaviour–structure ontology of design. In: Chakrabarti A, Blessing LTM (eds) *An anthology of theories and models of design*. Springer, London, pp 263–283. https://doi.org/10.1007/978-1-4471-6338-1_13

Gioia DA, Corley KG, Hamilton AL (2013) Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organ Res Methods* 16(1):15–31. https://doi.org/10.1177/1094428112452151

Kannengiesser U, Gero JS (2012) Computational models of design processes. *AI EDAM* 26(2):117–129. https://doi.org/10.1017/S0890060412000044

Krippendorff K (2006) *The semantic turn: A new foundation for design*. CRC Press, Boca Raton. https://doi.org/10.1201/9780203299951

Lichtenstein DR, Bloch PH, Black WC (1988) Correlates of price acceptability. *J Consum Res* 15(2):243–252. https://doi.org/10.1086/209161

Lower-Hoppe LM, Aicher TJ, Baker BJ (2022) Running clubs as communities of consumption: An exploratory study. *Sport Manag Rev* 25(3):567–580. https://doi.org/10.1016/j.smr.2021.09.002

Norman DA (1988) *The design of everyday things*. Basic Books, New York. (No DOI available)

Norman DA (2004) *Emotional design: Why we love (or hate) everyday things*. Basic Books, New York. (No DOI available)

Schmitt B (1999) Experiential marketing. *J Mark Manag* 15(1–3):53–67. https://doi.org/10.1362/026725799784870496

Singh V (2005) The function–behaviour–structure framework and its extensions: A review. *AI EDAM* 19(2):123–135. https://doi.org/10.1017/S0890060405050126

Timmermans S, Tavory I (2012) Theory construction in qualitative research: From grounded theory to abductive analysis. *Sociol Theory* 30(3):167–186. https://doi.org/10.1177/0735275112457914

Verganti R (2009) *Design-driven innovation: Changing the rules of competition by radically innovating what things mean*. Harvard Business Press, Boston.

Verganti R (2017) *Overcrowded: Designing meaningful products in a world awash with ideas*. MIT Press, Cambridge, MA. https://doi.org/10.7551/mitpress/10756.001.0001

Wynn DC, Clarkson PJ (2018) Process models in design and development. *Res Eng Des* 29(2):161–202. https://doi.org/10.1007/s00163-017-0262-7