DESIGN DRIVEN PORTFOLIO MANAGEMENT

Søren Ingomar Petersen[1], Martin Steinert[1] and Sara Beckman[2],
(1) Stanford University, (2) UC Berkeley

ABSTRACT
Design practice and anecdotal evidence point to the existence of a chasm between business plan generation and the execution of new product development. The failure to including vital industrial design criteria in business plans prevents portfolio managers from managing execution risk effectively. At the same time, the gap between design team and portfolio manager hinders the communication of theses criteria to the design team. Especially in terms of concept synthesis, this omission may jeopardize the project execution and ultimately its success.
Competitive design concepts, concepts that cross that chasm, are well informed by business plans and consist of a comprehensive industrial design philosophy and results in a well balanced design discourse. Based on literature review and interviews with leading firms, we have established a best practice for design briefing and formulated the Design Driven Portfolio Management method. This method comprehensively evaluates, maps and communicates business and industrial design opportunities throughout the organization. The validity of the approach is established by applying the method to leading firms' innovations. We chose polar opposite innovation types: The design of products based on sustainable and disruptive technologies as test cases. Based on our observations, we can conclude that design brief content and concept performance correlate with innovation types and can be mapped and managed using the Design Driven Portfolio Management method.

Keywords: design, portfolio, management, quantification, briefing

1 INTRODUCTION
Management shows tendencies to pay little attention to established success criteria related to the execution of new product development. Instead management limits their focus to the customers, core competencies, competitive advantage, technical feasibility, profitability and impact as well as business plan strength [1]. Business literature contains few references to the execution of business plans product development part, reflecting a certain disconnect between the management and the design team [2]. This affects risk-assessment and effective portfolio management as well as hampers the briefing of the development team.

Critical Design Quality Criteria (DQC): Philosophy, Structure, Innovation, Social/Human, Environmental, Viability, Process, Function and Expression, are poorly relayed to the design team. These DQC, are derived from design awards world wide and correlate with user's awareness of products and their financial performance [3], See Figure 1. The content of these criteria affects the risk of budget overrun [4] and are influencing concept quality. Furthermore, management is unaware of the importance of balancing design briefing content to complement the characteristics of the proposed innovation type and team experience level. Such as products that are produced based on sustainable and disruptive technologies [5], which consequently limit team performance. Sustainable technologies are characterized by extending the performance of an existing technology in an existing market, while disruptive is introduction of a new technology into a new market.

Successful application of industrial design in new products development has been shown to positively correlate with increased revenue and investors' expectations [3] & [6]. Furthermore, hierarchical models explain how early and controlled integration of industrial design leads to increased value creation [3] & [7]. However, there is only a one percent difference in revenue generation between corporations including industrial design at a process level with that of corporations including industrial design at an innovation and business level [7]. This suggests that there are sizable financial opportunities in improving integration of design execution and business plan formulation.

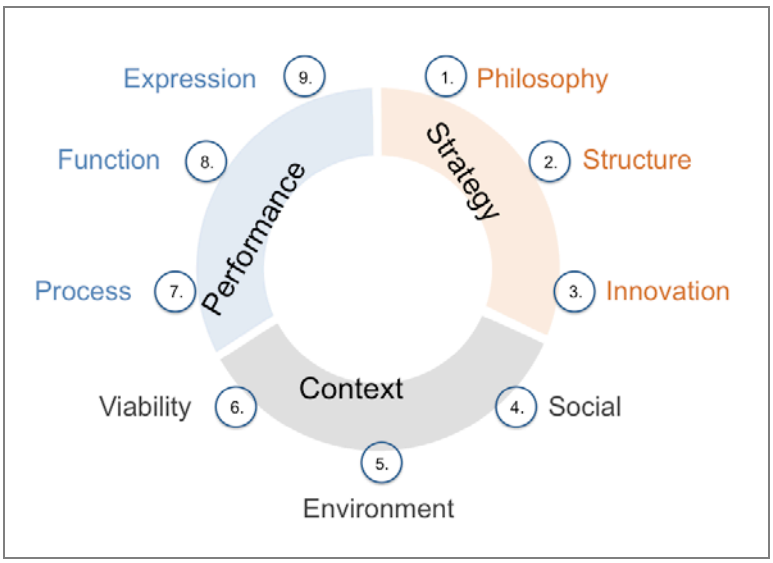

Figure 1. Design Quality Criteria framework; comprehensively covering worldwide design award selection criteria.

Limited attention has been given to quantitative studies on how design creates value in the individual process phases. Leading marketing and branding studies describe product differentiation, positioning and brand valuation; however do not relate these studies to specific design actions, aspects or features. A design research study of designers' concept discourses connects the aspects: Design philosophy, development planning, the products function and the user's activity in his/hers social context, to external performance metrics, in the form of trend setting ability and investors expectation [8] & [9].

If design is to be used as a competitive advantage, where does it reside in the design process and how is it best leveraged? A business literature review informs us that design resides in the organizations architecture, routines and culture. Proper integration provides a competitive design driven advantage though coordination, positioning and building of capabilities [10].

Execution is more important for success than strategizing and only ten percent of strategies' content is actually communicated to the executing teams [11]. Consequently, this research addresses coordination, bridging strategy and execution as its starting point. The core of design's value creation is the synthesis of the initial concept and therefore, we raise the question, - what is the essential information required by designers to synthesize initial design concepts? Our hypothesis is, that balancing the nine Design Quality Criteria in portfolio management and design briefing will improve design concept generation performance.

Upfront design coordination can align and maximize the organization's resources by aligning Design Quality Criteria with business plans. We establish a new portfolio management framing of opportunities, by merging two established models: The Market-Technology-Revenue Bubble Diagram [2] and the Aggregated Project Plan [12]. We then augment this model with Design Quality Criteria content distribution. The proposed Design Driven Portfolio Management Model enhances portfolio overview, decision-making and design team communication. In conclusion, we show how effective communication of design criteria, though the portfolio driven briefing process, offers significant performance improvements.

2. BUSINESS PLAN AND CONCEPT CREATION REVIEW

Grounding our methodology in best practice, we analyze the coordination opportunity by observing the crucial initial specification handover from business to the product development team.

2.1 Concept synthesis as the core strength of winning design discourses

What makes a successful design discourse? When designers create and communicate their designs, the overwhelming emphasis is on the supporting philosophy. This philosophy is the essential idea of the concept, communicated though storytelling / design discourse, that makes it stand out from other

concepts. The design philosophy is not limited to aesthetic however is often inspired by ideas from architecture, fashion, automotive and aeronautic design as well as significant events such as space exploration or wars. Analyzing the rational behind a hundred world-renowned industrial designers' products [13], eighty of them mentioned the supporting philosophy. Thirty designers included social criteria and design process criteria. Expression-criteria, which are also called styling or aesthetic criteria, were only mentioned by fifteen of the designers.

Comparing the attention to philosophy between experienced designers and design students, revealed a significant difference in their weighting of design philosophy. Applying the Concept Attention Profile segmentation to analysis of designers' concept discourse showed that professionals pay twice the amount of attention to philosophy, as do students. In fact, philosophy represented eight percent of the content as compared to four percent [3]. The Design Concept Attention maps the relationship between the user and the provider, describing their physical and cultural connection. The Concept Attention Profile consists of thirteen aspects, collected from user, product and provider characteristics, established in the product development literature. This framework describes the progression of key aspects in the provider development on one side and the user experience of a concept and the context in which the user exists on the other side.

Comparing design award winners' and non-qualifiers' supporting design discourse, using the Concept Attention Profile segmentation, showed that the winners uniquely balanced the philosophy content [14]. This strongly suggests that the development of a supporting philosophy for a design is key to industrial design success. The philosophy is relayed though effective verbal and visual storytelling, enhancing the corporations philosophy and its right to existence, in the minds of the multiple stakeholders.

Other aspects, which acted as early predictors of a concepts ability to provide trendsetting and investors expectations when correctly balanced, were: Planning of development, function description, activity analysis and understanding of the individual user in his/her social context [14]. Therefore, design briefs, which support synthesis of concept with discourse, which contain a balanced mix of these five aspects, are expected to outperform typical briefs.

2.2 How do designers arrive at a supporting philosophy?

Designers arrive at a supporting design philosophy, when they synthesize the information in the brief with their previous experiences. Contemporary super-star designers have been shown to draw inspiration from the same artifacts and events [15]. Examples of inspiration were found to be the Guggenheim in Bilbao, La Chapelle de Notre Dame du Haut Ronchamp, the Citroen DS and the Apollo mission. See Figure 2.

Figure 2. Inspirational objects for super-star designers in the late 1900. Guggenheim in Bilbao (1997), La Chapelle de Notre Dame du Haut Ronchamp (1954), the Citroen DS (1955-75) and the Apollo mission (1969).

In a world where all reference material is digitally available to anyone, you see a streamlining of design expression. It comes therefore not as a surprise, that leading design school student projects show strong similarities. This contradicts the historical unprecedented proliferations of art, fashion and architecture produced today. Designers also show no discernable ability to detect early trends [3] and will therefore rely on trends being communicated to them in the design brief. This suggests, that if concept synthesis is relying on the designers' intuition alone, concepts will converge. The competitive advantage therefore lies in effectively aligning concept inspiration with the brief's content.

What differentiates excellent design briefs from the mediocre is their inclusion of strategic and expression criteria [16]. Strategic criteria relates to the perceived performance of users and investors, while inclusion of expression criteria relates to project performance, measured as the likelihood of staying within budget!

2.3 Key information embedded in business plans that need to be transferred to designers through design briefs

From the above observations, we conclude that in order for a business plan to be useful, individually and as an aggregated portfolio, they will have to include criteria related to corporate philosophy, planning, function, users identity and activities. The formulation will then have to be effectively translated into a design brief supporting design concepts creation.

The research question is consequently, how do you integrate design execution considerations with business plans and portfolio management to effectively inform design team concept synthesis. Our hypothesis is that (A) design execution knowledge can be mapped onto existing portfolio management tools to facilitate understanding by management and enable them to adjust the portfolio for the execution risk of individual business plans, and (B) that business plans need to address a project specifics. Here, innovation type, though balancing of the nine Design Quality Criteria, do effectively brief designers and reduce execution risk.

3. RESEARCH PROCEDURE

To improve upon portfolio management, by inclusion of critical design execution criteria, we focused on how the business formulation process affects design teams' performance though the design brief.

3.1 Development of Design Driven Portfolio Management model

Based on insights from design consulting experience we conducted a literature study of over 300 books and articles on portfolio management, business strategy, models, plan, design strategy, management, branding and marketing. Concurrently we conducted open-ended unstructured interviews with eight experts in design research, product development and business management. Concurrently we analyzed fifty-one design proposals, using Design Quality Criteria segmentation for performance related content. We then consolidated the best practices in integrating business with design, structuring these according to the Design Quality Criteria [14], See Figure 3. The findings were presented visually in a booklet [17] and PowerPoint form. See Figure 4.

In subsequent workshops, the previously interviewed experts reviewed the findings and through four unstructured brainstorming sessions, the model was further developed and refined into the Design Driven Portfolio Management. See Figure 5. We then justified the tool by applying it to design proposals addressing sustainable and disruptive technologies, representing to polar development situations.

Strategy	1. Philosophy What gives this organizations the right to existe? Identify competitive advantage and roadmap these advanrages! Design contributes with ideation and visualization of philosophy and visual communication of design trend knowledge. 2. Structure How the organization's "Porters Five Forces" play out? Apply SWOT analysis to determine stakeholders and their influence! Design contributes with knowledge on design related aspects of the Five Forces and performs a visual audit of current product portfolio on all SWOT issues. 3. Innovation What does the organization's innovation map look like? Apply a "User -Technology Innovation Map! Design contributes with ideation, visualization and visual communication of innovation opportunities.
Context	4. Social Who are your customers and what design strategy works best with them? Apply user behavior segmentation combined with an Adoption Curve and effective Design approach! Design assist with user studies, communication of findings and testing of corporate design philosophy. 5. Environmental What is the organization's environmental strategy? Identify the level of ambition, resources needed and time horizon! Design aid in exploring opportunities for eco-opportunities and visually communicating these opportunities as related to trends. 6. Viability How does the organization sustain viability? Develop business model in alignment with competitive advantage, optimizing capabilities, activities, position and cost! Design explores opportunities for positioning, creating value and eliminating costs.
Performance	7. Process How does the organization's development process work? Apply a Stage - Gate procedure involving all parties from the business to concept development! Design synthesizes concepts and communicates these to the decision-makers. Highlights tradeoffs and makes design recommendations. 8. Function What user-needs are being addressed by the organization addressing and how does it provide and capture value? Indentify opportunities and enablers by performing activity analysis and constructing functional diagrams. Designers assist in uncovering the users need and how to translate these into product attributes and features. 9. Expression What is the organization's design statement/brand? Identify the MAYA (Most Advanced Yet Acceptable) niche and related risk tolerance. Designers illustrate the design solution space, the hierarchal structure of aspects and explore opportunities of design, product and user insights. They translate Design Pyramid and Design Language into final expressions.

Figure 3. Best design briefing content in practice, structured according to the Design Quality Criteria.

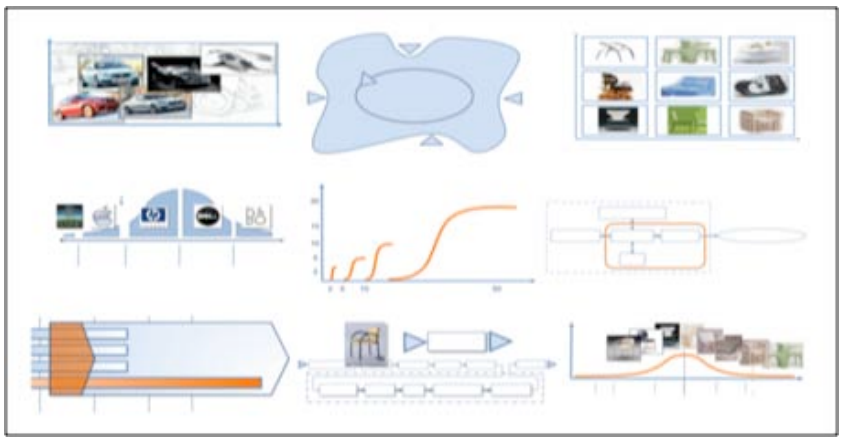

Figure 4. Sample illustrations of visual material presented to the workshop participants during brainstorming on a new Design Driven Portfolio Management model.

3.2 Proposed Design Driven Portfolio Management method

To facilitate adoption, the proposed Design Driven Portfolio Management method is inspired by contemporary knowledge and practice in product development. It is a design-augmented combination of the standard Aggregated Project Plan and the Bubble diagram. The Aggregated Project Plan component locates projects in a business plan - R&D - Platform - Derivative diagram. The Bubble diagram contributes with financial assessments, relaying a projects position regarding estimate execution and market risks along a coordinate system's axis. The size of the outside bubble represents the projected revenues.

The design augmentation to the model consists of an added inner Design Quality Criteria color-coded pie chart, depicting the established Design Quality Criteria content. The size of this pie chart depicts the expected required investment. Projected project path, over time, is conveyed using light gray arrows. While project interactions, significance, direction and content are communicated using color-coded arrows and their thickness. The arrows colors coding correspond to the Design Quality Criteria. Three levels of color saturation illustrate project progress. Vivid colors signifying project completion and washed out colors, showing that the project is in the initial phase. See Figure 5.

The advantage of the new portfolio management model is that it visually displays quantitative project-execution criteria and their inter-dependencies as projects develop, along with traditional performance metrics.

Balancing the product portfolio commence by following the existing procedure, assessing market and technical risk, followed by projecting revenues and estimating required investment. The additional steps are then conducted before aligning the portfolio with strategic goals. Design Quality Criteria coding is performed on each project's briefing in the four stages: Business plan, R&D, platform and derivatives. Based on the Design Quality Criteria distribution, design briefing effectiveness is assessed and the corresponding execution risk established. Finally, technology risk is swapped with execution risk. Opportunities for leveraging information between projects are then mapped before evaluating and deciding on which projects to eliminate in the strategy alignment discussion.

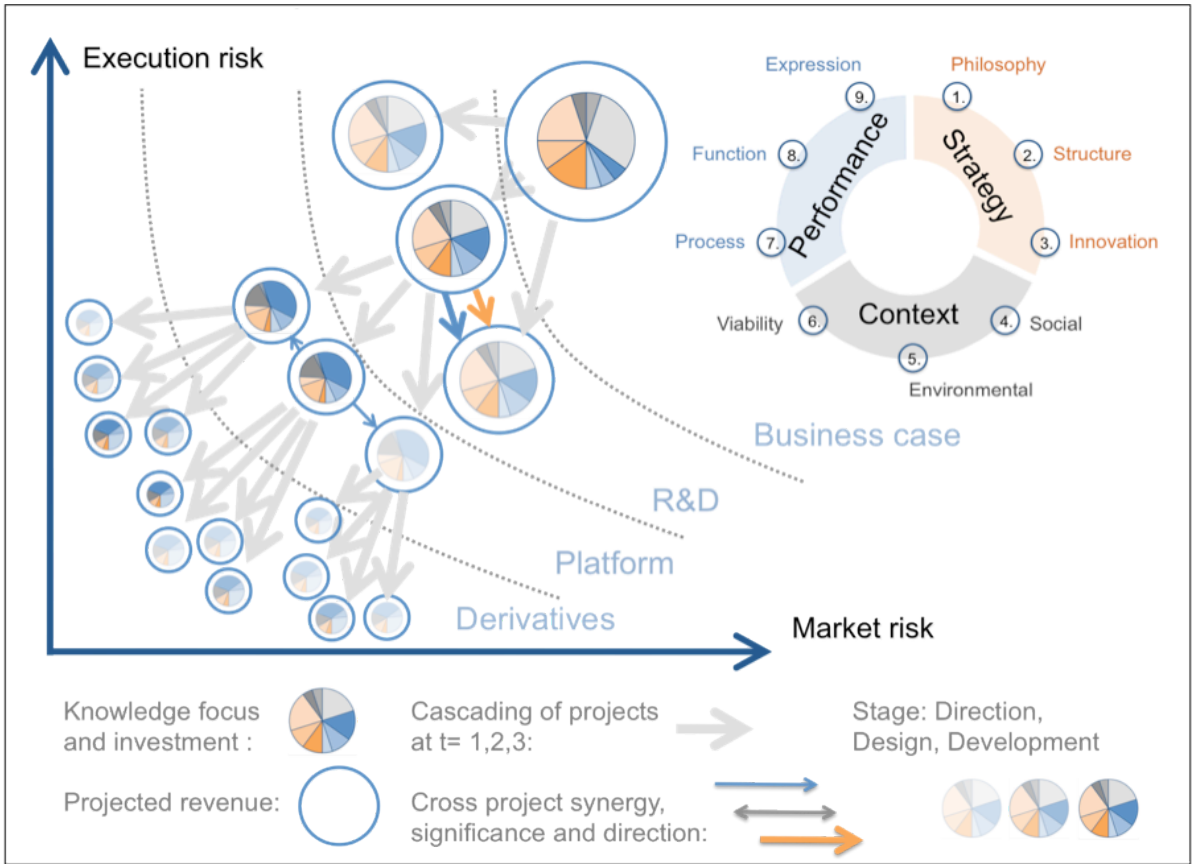

Figure 5. Design Driven Portfolio Management. At the outset, the map provides an overview of market and technical execution risk, projected revenue and expected investments. Also, knowledge relayed from business plan to briefing for R&D, platform and derivative development. The flow of projects over time and information flow between projects are displayed together with project completion level and the projected course of the projection.

4. JUSTIFICATION OF MODEL

4.1. Innovation type and design brief's content focus

Evaluating the applicability of the Design Driven Portfolio Management Model, we examined two polar opposite businesses in portfolios, exemplified by briefing for implementation of sustainable and disruptive technologies [5].

We would expect that these two innovation types would provide the biggest differences in business plan emphasis formulation and subsequent design briefing content distribution. Together, these types span the 2 x 2 innovation space of market and technology risk.

Determining the Design Quality Criteria content characteristics for the four combinations of market and execution risk we examined fifty-one (n=51) design proposals, covering the phases from need finding to prototype, from Stanford Mechanical Engineering's ME310 projects. Analyzing these proposals showed clear differences between the four combinations at a 95% confidence interval, $p<0.05$ significance level, using SPSS One WAY-ANOVA F-test for comparison of means and Pearson Correlation Coefficient for determining significant relationships, See Figure 6.

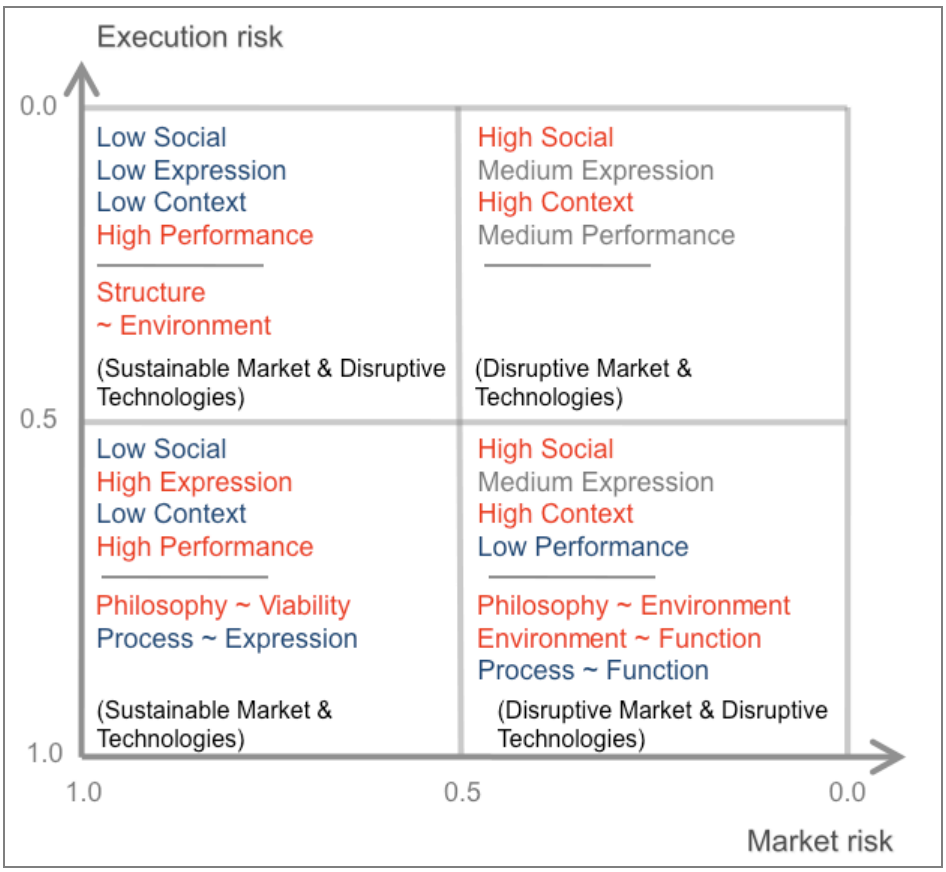

Figure 6. Design Driven Portfolio Management model applied to projects focusing on both sustainable and disruptive markets and technologies. Correlations are symbolized by "~" where text in red refer to positive correlation and text in blue to negative correlation. For high values of Design Quality Criteria text is in red, for medium value text is in gray and for low values text is in blue. The difference in the design briefs content of Design Quality Criteria is shown for significances at a p<0.05 level

The study shows the following characteristics for the four combinations of market and technology development:

Sustainable market - Sustainable technology

Project briefs for projects based on a known market and known technology contain a comparatively large focus on Expression and Performance criteria. Briefs also exhibited a linear positive correlation between Philosophy and Viability, at a significance $p<0.05$ level.

This corresponds well with an effort to optimizing existing performance and updating the products expression/styling.

Sustainable market - Disruptive technology

Project briefs for projects based on a known market and unknown technology contain a comparatively large focus on Performance criteria. Briefs also exhibited a linear positive correlation between Structure and Environment, at a significance $p<0.05$ level.

This corresponds well with an effort to enabling the execution.

Disruptive market - Sustainable technology

Project briefs for projects based on an unknown market and known technology contain a comparatively large focus on Social and Contextual criteria. Briefs also exhibited a linear positive correlation between Philosophy and Environment and Environment and Function, at a significance $p<0.05$ level.

This corresponds well with the effort on understanding new needs in a new context.

Disruptive market - Disruptive technology

Project briefs for projects based on an unknown market and unknown technology is similar to disruptive market - disruptive technology, except that it contain a somewhat comparatively large focus on Performance. Briefs did however not exhibit any scientific significant correlation between any of the Design Quality Criteria.

This corresponds well with a somewhat increased effort to enabling the execution.

For all four innovation-types, Process correlated strongly negatively with Function and Expression. However, only for low technology risk combined with low and high market risk were these findings significant at a $p<0.05$ level. This corresponds well with previous studies of design proposals [4].

The analysis shows that design briefs addressing the four combinations of market and technology development, require significantly different content and that these differences correspond to expectations, justifying the method and supporting that the "Design Driven Portfolio Management" framework has practical applications.

4.2. Appraisal by expert panel

Evaluating the novelty and usefulness of the "Design Driven Portfolio Management" method, the method was presented to twelve senior managers, with knowledge of product portfolio management. Using an unstructured open-ended interview protocol, the method appeared useful, an improvement to any previous method they had used. There was a consensus that the methodology contained sufficient elements, without overpowering or confusing the user of the method.

5. SUMMARY AND CONCLUSION

This paper has described the transmission and transformation of information in the product development process, from business plan to concept generation. We gave special attention to often neglected but crucial interface between designers and company program managers. The design brief was identified as key bridging tool.

Based on a thorough literature review, the analysis of actual design briefs, as well as sequential workshops, we were able to distillate nine key design criteria that, when adequately balanced, determine the value of a such design brief and its concept synthesis power.

Going a step further, we have leveraged existing portfolio management models and product development execution models. We propose a new comprehensive and visually forceful Design Driven Portfolio Management method that relies on framing the relevant information in terms of execution vs. market risk. This method enables us to capture, relate and transmit the key information for a design brief. In fact it allows us to test for the possibility to optimize design briefs based on the portfolio evaluation.

Using real design proposals from industry, we were able to identify four generic technologies - market combinations that are each associated with a specific design brief formulation. Future research should allow us to test and improve the deducted generic strategies and blueprint advice in the support of the designer-management interface. An expert panel has reviewed the model and judged it to be an improvement over existing models, novel and useful.

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Contact: Søren Ingomar Petersen
ingomar & ingomar - consulting
511 Prospect Avenue
South Pasadena, CA 91030
USA
Tel: Int +1 626 441 4862
Email: soren.petersen@ingomar.net
URL: www.ingomar.net

Søren Petersen advises organizations on design research, strategy, and decision support. He holds a PhD in ME Design Research from Stanford, a MS in ME from the Technical University of Denmark and a BS in Transportation Design from Art Center College of Design. His research focuses on Design Quantification.