The **CMF Design** approach engaging the Contemporary **Interior Design** practice

The interdisciplinary perspective of
branding strategy, marketing and sensorial user experience.

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ABSTRACT

CMF design is the acronym of Colors, Materials and Finishes adopted in the meta-design methodology for strategic projects of given brands to support both functional and emotional attributes of the identity of entire ranges of products. Since the 1980s, application fields and design approaches of this emerging discipline evolves as the marketing and user experience change in recent years.

The break out of consumer-products in recent years has changed people's behavior and ways of thinking space, strengthening the relationship between the way to look at products and space. Interior design needs to take these factors into account, thus CMF, as the color and material solution widely approved in consumer-product design, may provide new ideas and approaches for interior design and vice versa / conversely.

This thesis briefly introduces the early development and current situation of CMF, by representing a framework of the general CMF creation process in stages. Projects analysis are engaged under this framework from three perspectives in terms of brand strategy, marketing and user experience, which mainly focuses on CMF approaches in products and relevant application in interiors.

The research is built on primary and secondary data sources, deductive conclusions stem by representing the discourse of literature into the visual charts, and inducting information of existed projects in a form of case studies. Reports of interviews with senior practitioners are also involved as important supplements.

Therefore, this study is a tentative proposal of how to properly introduce CMF approaches in interior design with corresponding adaptive discussion to form a closer relationship with products and interior space.

CMF design / Interior Design / Brand / Market / User Experience

ABSTRACT

CMF Design è l’acronimo di Colore, Materiali e Finitura, adottato nell’ambito dell’approccio di meta-design in progetti strategici di determinati brands per supportare la definizione degli attributi funzionali ed emotivi nell'identità di intere gamme di prodotti. Dagli anni '80 ad oggi, gli ambiti di applicazione e gli approcci progettuali di questa disciplina emergente si sono evoluti insieme al marketing e all'importanza acquisita dallo studio della user-experience.

La vasta diffusione dei prodotti di consumo degli anni recenti ha cambiato il comportamento delle persone e i modi di pensare allo spazio, rafforzando la relazione tra il modo di studiare prodotti e spazio. L'interior design deve tenere conto di questi fattori poiché il CMF, e le soluzioni cromatiche e materiche ampiamente utilizzate nella progettazione di prodotti di consumo, possono fornire nuove idee e approcci per l'interior design e viceversa.

Questa tesi introduce brevemente lo sviluppo iniziale e l'attuale significato del CMF design, rappresentando un quadro del processo generale di creazione della CMF in più fasi, L'analisi dei progetti è presentata in questo framework secondo tre prospettive: in termini di strategia del marchio, nel marketing e nella user experience, concentrandosi principalmente su approcci CMF nella progettazione di prodotti e applicazioni rilevanti negli interni. La ricerca si basa su fonti di dati primarie e secondarie, conclusioni deduttive derivate dalla rappresentazione del dibattito letterario attraverso diagrammi, e integrando informazioni sui progetti esistenti in forma di casi di studio. Infine le restituzioni delle interviste effettuate a professionisti senior del settore costituiscono fattori integrativi importanti nell’ambito di questo studio.

Pertanto, la tesi costituisce una proposta su come introdurre correttamente gli approcci della CMF nell’ambito dell’interior design generando un conseguente dibattito per formare una relazione più stretta tra approccio progettuale per il prodotto e lo spazio interno.

CMF design / L'interior design / Marchio / Marketing / User Experience

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INTRODUCTION

1.0 Introduction

This study aims at analyzing the relatively new concept of CMF – Colors, Materials and Finishes – with its practice/application in the product design field and engaging/ending with a discussion about its possible use in the interior design practice.

CMF is gradually recognized as an **emerging concept**. It is a **methodology based on meta-design**, which concentrates color, material and finish in the design process by involving related factors such as brand, market and user experience. This concept is incline to introduce different disciplines, think about the role of **colors and materials in functional attributes and emotional attributes**, to form a more comprehensive design strategy. At present, CMF is commonly applied to the design of consumer-products and automotive interiors, etc.

The inspiration of discussing CMF and interior design stems from a closer relationship between interior design and products than before. For example, the concept of space intelligence and the proposal of a lifestyle based on consumer products. Of course, the rapid innovation of new technologies in products has also largely changed the way that people may behave in interior spaces. In the chapter of CMF Identification, a brief introduction of its vicissitude to depict the origin and current industry states, interviews with practitioners are involved as supplements. Since CMF has not been widely standardized in the current application, there are few systematic materials about it, so the research is mainly based on the current relatively authoritative or most cited materials. By understanding its general design approaches, a map of framework would be represented to depict the design process in the chapter of CMF Context/Creation, also as the premise for further case studies.

The Chapter Fifth introduces case studies to recognize the CMF design approaches in such contexts from the perspective of brand factors, market relevance and user experience. For example, the first perspective discusses how a **brand** introduced the color and material preference in products and corresponding spaces to build consumer awareness of the brand or cultural identity. The second perspective is to review how a visual effect has become a **trend** and its popularity in different fields, including quotes in interior space. The third perspective is aim to analysis how colors and materials enhance the **user experience**, as well as the interior consideration related to the experience.

To sum up, it dose not to challenge existing principles in interior design. Like the definition of CMF in meta-design, the conclusion would be a proposal to incorporate some approaches into interior design considerations.

1.1 Research subjects

Initially, the CMF design operates according to the logic of the meta-design[1], which is in planning simultaneously the identity of entire product ranges of a given brand. As a representative example, the application of CMF concept was adapted in the 1980s by the Italian designer Clino T. Castelli on the occasion of the project to renew the color ranges, materials and finishes of the furniture systems by Herman Miller[2]. The contribution to this design approach was the impetus provided by the proliferation of the emerging new systemic products, however, from the beginning, CMF design has established itself on the previous design models of the color ranges, generally defined as Color design, Material design, etc.

This has led to differences in the understanding and operations of CMF design in different industries over a long period of time. For example, in the automotive industry, Color & Trim department[3] undertakes the relevant progress, which provides creative solutions in order to achieve clients objectives, style and vision. In the era of Nokia[4] dominating the consumer electronic goods, the CMD (Color and material design) was considered as the excellence in its rich product family. This explains to some extent, why there are few written materials and even on the Internet about CMF design.

And the book "***The fundamental principles of CMF Design***" was published in 2016 by Liliana Becerra, which plays an important role in the research of this knowledge filed. The CMF design was defined as an emerging professional discipline in this book, which consists of the research of **color, material and finishes in consumer-products and industrially manufactured consumer goods**.

Actually, the discussion and research on colors and materials in contemporary interior design have never stopped, on the one hand, some classical theories and design approaches are still adopted, either presented by new technologies or applied in different fields, on the other hand, new relevant design approaches are proposed to adapt to the changing needs. Studying the application of colors and materials in CMF design may provide any inspiration for interior design, as an **inter-disciplinary study of branding strategy, marketing and sensorial user experience**.

1. Meta-design is a conceptual framework aimed at defining and creating social, economic and technical infrastructures in which new forms of collaborative design can take place. It consists of a series of practical design-related tools for achieving this.
2. Herman Miller, Inc. is an American company that produces office furniture, equipment and home furnishings.
3. Color & Trim department is a consultancy which provides creative solutions in order to achieve clients objectives, style and vision. / Technicon Design
4. Nokia Corporation is a Finnish multinational telecommunications, information technology, and consumer electronics company, founded in 1865.

1.2 Representation and Methodologies

The research started with a **visual representation of the CMF design process**, dividing the important "**key nodes**" from branding, marketing and users, which according to the degree of participation of the CMF design, and the distribution of developing stages. This provides a framework with easy-access to have a general understanding of CMF design creation.

Under this framework, the research intends to analyze the correlation or discrepancy between the CMF in product design and the color, material in interior space through case studies, which involve the discussion of functional and emotional attributes of colors and materials in branding strategy, market relevance and user experience. The "key nodes" plays as important indicators in analysis, which makes a clear perspective in a certain scope. Some key factors or valuable approaches in CMF design could be considered as the counterpoint to form a closer relationship among interior space, products and users.

This research not only combines literature research with field studies but also introduced the methodologies of induction.

Literature research: By collecting the existed literature materials, it could provide the much easier and more effective accessibility for domestic and overseas information and achievements on relevant subjects, which could be direct quotations or to instruct analysis of this thesis.

Field Studies: The field research has been partially involved in case studies, with images taking and video shooting, etc. Moreover, Interviews with practitioners provided an industry perspective of the theoretical framework, through which the first-hand materials and perceptions could be acquired to further deepen the understanding of the related topics, as well as compare the similarities or differences between the practical case and relevant discussion.

Methodology: After finishing the above two studies, it is necessary to induce materials, both deductive and inductive methods would be involved. For example, by inducting the design approach of CMF on literature research, the discussion of colors and materials in actual application may introduce deductions or hypothesis, in order to intend to table proposals for respective categories.

1.3 Limitations and Framework

The main limitation of the research is the lack of systematic research of CMF design, especially **without materials from different sources to support the relevant design approaches**. The CMF design as an emerging topic has been developed for nearly four decades, however as a "professional discipline", which has not a certain scope of research on the relative standard. Also, it is difficult to acquire the accurate design interpretation of CMF design strategy of certain products in the brand-based analysis. Actually, through interviews with practitioners, strategies of CMF development as important confidential, rarely systematically formed as reports for study. Brands are more inclined to achieve the market appealing by explaining the CMF nature of specific products. Even commercial institutions engaged in CMF design also rarely disclose information besides marketing.

Another limitation could be attributed to the limited field survey, mainly the timeliness. Due to the rapid market strategies and temporary application, for some case studies, only images materials and field experiences could be preserved to further facilitate the understandings, which is not systemic, specialized and comprehensive. Hence, this research is more inclined to analyze and to represent the existing materials in detailed description with case studies which combine with the field research and the desk research. Relevant discussions would be introduced to enrich the sources of materials, which especially with theoretical support, and the research scope would be defined as the premises. The induction would point out the uncertainties and deviations.

The general framework consists of four main stages. **The first stage** would firstly identify the definition of CMF, including its induction context and early development also its current application in the industry. **The second stage** represents CMF approaches in consumer-products design into visualized flow chart. **The third stage** would recognize CMF approaches in application by conducting case studies of existing projects from the perspective of brand, market/trend, and user experience. Case studies including product design and interior design. **The fourth stage** introduces deductive result of the inspiration, limitation and adaptive discussion of CMF approach in interior design. **The interviews** could be considered as supplementary material to discuss the practical application of CMF approaches in the automotive interior / aviation interior design.

1. Meta-design is a conceptual framework aimed at defining and creating social, economic and technical infrastructures in which new forms of collaborative design can take place. It consists of a series of practical design-related tools for achieving this.
2. Herman Miller, Inc. is an American company that produces office furniture, equipment and home furnishings.
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4. Nokia Corporation is a Finnish multinational telecommunications, information technology, and consumer electronics company, founded in 1865.

Background of Research
The identification of CMF design development.

CMF and Meta-design
A brief of Meta-design methodology.

CMF in Early Development
CMF practice and relevant theories from 1960s, the context of CMF induction.

CMF and Industry States
Design content of current practitioners.

Framework of Research
The representation of CMF creation process and design approaches in application.

CMF Creation Process and Design Approach
The functional and emotional attributes of colors, materials and finishes in CMF.

CMF Design Process
The visualization of CMF design process with structural description.

CMF Design Approach
Illustrations of each approach in CMF design process with corresponding description.

Interviews of CMF Practitioners
The feedback of CMF design process and the application in working practice.

CMF approach in projects.
Research form three perspectives.

Brand Perspective
CMF analysis in Products / Interior.

Market/Trend Perspective
CMF analysis in Products / Interior.

User Experience Perspective
CMF analysis in Products / Interior.

Deduction / Conclusion
Recognizing CMF approach in Interior design with adaptive discussions.

Contribution of Research
The proposal of CMF approaches in Interior design.

CMF approach in projects.
Landing to Interior

CMF approach in Interior Design
CMF analysis in Interior with color, material and finish discussing in actual interior application.

Fig.1.3.01 The framework of research.

CMF IDENTIFICATION

2.0 Identification of CMF Design

There are different opinions towards the emergence of “CMF” concept, some figures out the early application by Harley Earl from General Motors was the first one in the automotive industry who convinced that CMF, at the time called Art & Color section[2]. Another common view indicates the design concept was proposed with the exact appellation of “CMF” by Clino T. Castelli as early as the 1980s, which was adopted in the project known as the “Action Office 2” in Herman Miller’s office furniture system.

Afterwards, the CMF design now is considered in the meta-design methodology, which is in planning simultaneously the identity of entire product ranges of a given brand, and the adoption of "soft" product re-design techniques, based on the periodic renewal of the identity without directly touching the existed shape of products.

This approach inclines to consider and to optimize the identity of products in dynamic context rather than changing the specific design process. However, different appeals in industries were diversifying design approaches of color and material, rather than forming a consensus with general design approaches. Other features of current CMF practice is the intention to establish the Brand-based visual identity and trendy tracking. (Becerra, 2016.)

This working process is advantageous in terms of the choice of color base for systemic products, even if characterized by different forms, can be connoted with the base colors or materials that are representative of the brand due to CMF design. Since CMF design manuals and the color matrix[3] have a prescriptive role, the designers who create them are rarely involved in the applicative distribution either of colors, materials or finishes of individual products. (Becerra, 2016.)

Industries and brands have different strategies of specifications and standards for the application of their colors and materials in products, to a certain extent, this explains why there are few clear development research as the keyword of CMF design on the Internet or published reports. Before discussing this new discipline and design approaches in the current application, a brief of the context in which this concept was first proposed could be helpful for a better understanding of the theoretical basis in contemporary design.

2.1 CMF in Meta-design Methodology

A meta-design methodology is built by gathering and organizing information with a clear and understandable attitude. This systematization brings a set of requirements capable of generating a multitude of different but homogeneous and coherent design solutions[4]. It consists of a series of practical design-related tools for achieving this. As a methodology, its aim is to nurture the emergence of the previously unthinkable as possibilities or prospects through the collaboration of designers within interdisciplinary ‘meta-design' teams[5].

Van Onck (1965), as pioneer in the proposal of meta-design, who underlines the work of a number of Italian and Brazilian researchers. At the beginning of his career he went to Italy to work with Ettore Sottsass at Olivetti[6]. His vision was developed in the historic peak of pragmatism, marked by a great confidence in technology of computing, and a success by the new rationality[6]. The meta-design tool has the abstract nature of types, schemes, structures, principles, guidelines, reference rules; it is a generative-matrix that can give rise, through application processes, contextualization, adaptation, hybridization, to a multitude of specific projects.

The nature of meta-design allows for the management and control of the complexity emerging from the multi-scalar and multidisciplinary dimension of the Campus for Citizens project and from its systemic nature consisting in diverse elements linked by multifaceted relationships. The interdisciplinary character of the meta-design tool captures knowledge and brings it to abstraction introducing a strategic and extensive dimension that can support design innovation[7].

The notion of meta-design has been applied in many fields, including graphic design, industrial design, information architecture and system design. These applications, ranging from processes of high-order design to participation and co-evolution. However, these concepts are often tied together. The idea of reflexive thinking about design has been commonly translated in the application field as the “design of a design process[5].” From this point of view, the meta-design works on the design process itself, rather than to change the design nature, the matter design would recognized as the concept to transcend design.

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[2]. Omuus.com. (2018) , *From the beginning to unknown*. https://omuus.com/from-the-beginning-to-unknown.

[3]. Sarah O. Marberry. (1985), *Compendium helps designers coordinate color program, Contract*.

[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.

[4]. A. Mendini. (1969), *Metaprogetto sì e no*, in *Casabella*, n.333.

[5]. Elisa Giaccardi. (2017), *Meta-design as an Emergent Design Culture*.

[6]. Ione Maria Ghislene Bentz, Carlo Franzato. (2017), *The relationship between Strategic Design and Metadesign as defined by the levels of knowledge of design, Strategic Design Research Journal.*

[7]. L. Collina (2005), *Design e metaprogetto: teorie, strumenti, pratiche*. Milan/Italy: POLI Design.

2.2 The Early Practice of CMF

In 1964 the American Herman Miller presented the Action Office office furniture system. The project was designed by George Nelson, who was responsible for shaping the detailed functional program defined by Robert L. Propst, head of the Herman Miller Research Department. The change in work takes the office away from its traditional archetypes far more than the introduction of the typewriter had done. Although the inadequacy of normal office furniture (desk, filing cabinet, chair and table for the typewriter) already emerged in the late 1950s in the face of new ways of working, the response from the furniture manufacturers was not prompt and quick [8].

The Action Office was the first system that attempted a new response, replacing the traditional furniture catalog with a wide and articulated offer of coordinated components, easily assembled and modular in order to cut out in the indefinite space of the Open Office or Office Landscape individual, protected and equipped workstations [8].

Changes in Italian market and particular for Olivetti, the only company to offer the integrated offer of machines and office furniture at that time. Olivetti "produced the “Serie Spazio dei BBPR” which was not designed as a system: it was conceived as a set of tables, desks and containers and was intended to furnish small rooms or at most areas for no more than five or six people [8].

Serie Spazio, was a system of furniture designed by BBPR, it was a group of Italian architects composed by 1932 Gian Luigi Banfi (1910 - 1945), Lodovico Barbiano di Belgiojoso (1909 - 2004), Enrico Peressutti (1908 - 1976), Ernesto Nathan Rogers (1909 - 1969). Fully in step with the European avant-gardes, they become members of International Congresses of Modern Architecture (CIAM). They worked in the thirties when the rationalism movement started to spread in Italy. In 1938, racial laws force Rogers to emigrate to Switzerland. Due to their antifascist commitment, Banfi and Belgiojoso are sent to the Mauthausen concentration camp in 1944 where Banfi dies[9][10].

BBPR innovates the panorama of office furnishings with the Spazio series for Olivetti Synthesis, winning the 1962 Golden Compass Award. (Fig.2.2.01)

It was Roberto Olivetti who commissioned Ettore Sottsass in 1968 to design a new and complete system of furnishings, thinking that the head of design of the company's Electronic Department was

Fig.2.2.01 The series of metal office furniture produced by Olivetti, BBPR, 1960.

the most suitable person to define the furniture that had to live with those machines. A dimensional standard that Sottsass summarizes in a rigid spatial grid with a base of 45 centimeters, with relative multiples and submultiples, within which the technical volumes of the electronic equipment are joined together with relative supports and auxiliary shelves [8].

Fig.2.2.02 "The art of coloring the office: Olivetti Synthesis combinations", serigraphy Bernardi Milano, 1971

Fig.2.2.02 "The art of coloring the office: Olivetti Synthesis combinations", serigraphy Bernardi Milano, 1971

[8]. Enrico Morteo. (2016), *Sottsass: Olivetti Synthesis,* https://www.doppiozero.com/materiali/sottsassolivettisynthesis.

[9]. Maria Gabriella Errico. (2012), *Tra Razionalismo e Continuità: Ernesto Nathan Rogers e i BBPR.*

[10]. Ezio Bonfanti, Marco Porta. (2009), *Città, Museo e Architettura: Il Gruppo BBPR nella cultura architettonica italiana 1932-1970.*

Within these strict parameters, and with unwavering respect for the rigid dimensional grid with its 45cm base, Sottsass and his group proceeded through successive levels, with gradual changes to the complexity of the system. The premise was to reduce visual impact and eschew luxury in what would be a deliberately democratic and modular system. Maximum neutrality – both formal and symbolic – was reserved for the work surfaces (all made from very light grey laminate) and for the desk surfaces[11].

Starting from a premise that imposes a reduced visual impact and the absence of luxury versions within a deliberately democratic and unitary system, maximum neutrality - both formal and symbolic - is reserved for the worktops (all in very light gray laminate) and to the supports of the desks, which Sottsass derives directly from the uprights already used as supports for the machine systems[11].

No less simple were the modular walls, screens and large cabinets, which had fabric coverings and an initial palette of colors that was relatively neutral and understated – integrated and co-ordinated with the dark colors of a limited selection of carpets. A second palette of colors, this time more vibrant and contrasting, characterized the smaller containers – the drawer units, vertical filing cabinets, sideboards and suspended shelves [11].(Fig.2.2.02 / Fig.2.2.03)

Fig.2.2.04 "The art of coloring the office: Olivetti Synthesis combinations", serigraphy Bernardi Milano, 1971

Although some years later Sottsass stated that the use of color had been timid and overly limited in the 45 series design, in reality the project's well-structured color code was one of its strongest and most innovative features; so much so, in fact, that Sottsass and Olivetti based the entire marketing campaign on color, using the color schemes to introduce the system's numerous innovations [11].

When, however, the design moved away from components that were strictly related to work-based tasks (writing, filing) and into the orbit of actions such as hanging up a garment, discarding waste paper, grasping a handle or putting out a cigarette, Sottsass abandoned the rigor of sheet steel, the puritanism of flat surfaces and calm neutral backgrounds, and allowed himself an enormous amount of freedom (Fig.2.2.04). Working with melamine and ABS, he designed pieces that were playfully ironic and joyously colored [11].

In this way, the application of color and material innovations at that time greatly improved the relationship between users and the interior working space, especially with the emergence of electronic technology. According to some accounts, the concept of CMF appeared in the automobile industry earl as the 1920s[2], through applying colors and materials to strengthen the consumer's awareness of the product. And this expression is a very experimental exploration of how colors and materials contribute the relationship between products, interior space and users. Even today, such forms and settings are widely proceed in working space.

In designing "Sistema 45", Sottsass was moving through what was mostly unknown territory, as he later explained: "When we designed the 45 series… there was only Propst's project, the Action Office for Herman Miller [8].

The first version of the Action Office was however short-lived and was replaced by a first update in 1968, Herman Miller launched "Action Office 2", a pioneering system of office furniture that laid the blueprint for the modern cubicle. Its designer, Robert Propst and the industrial designer Leon Ransmeier mainly process this work with less aesthetically cared for, but extremely effective and convincing[12].

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[8]. Enrico Morteo. (2016), *Sottsass: Olivetti Synthesis,* https://www.doppiozero.com/materiali/sottsassolivettisynthesis.

[11]. Enrico Morteo. (2016), *System 45 From the conceptual work to the concept of work,* http://kvadratinterwoven.com/sistema-45.

[12]. Leon Ransmeier. *Live action: Inventor robert propst and the history of the modern cubicle,* https://pinupmagazine.org.

[2]. Omuus.com. (2018) , *From the beginning to unknown*. https://omuus.com/from-the-beginning-to-unknown.

Fig.2.2.05 Action Office 2 “Altar”, one of ten, demonstrating Clino Castelli’s CMF program, 1983

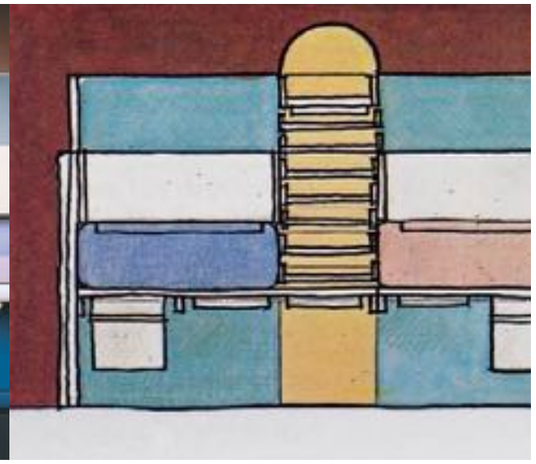

Fig.2.2.06 Action Office 2 “Altar”, one of ten, demonstrating Clino Castelli’s CMF program, 1983

“After Propst left Herman Miller in 1980, Jack Kelley[1] who was still working there collaborated with Italian designer Clino Castelli to overhaul Action Office 2 and make it more contemporary, updating the materials and colors. For an installation at NeoCon in 1983, they created a series of alters out of Action Office 2 components and they ended up winning best showroom of the year. To put it in context, Memphis[2] was launched in 1979.” Leon Ransmeier Said. [12]

The influence of Ettore Sottsass, with whom Castelli worked in the mid-1960s, for Olivetti, helped to form his approach to design[10]. In 1978 Castelli established Colorterminal IVI, the first European workshop for research in color design, and in 1984 he received an IBD Gold Award for his work on color, material and finishes for furniture company Herman Miller [12]. (Fig.2.2.06 / Fig.2.2.07)

There was a conversation held in 1996 when Castelli talked about the “High-Touch” office for Herman Miller:

When initially I was asked to work for Herman Miller, I saw what the situation was very clear. If you remember 1981 and 1982, the American office with systems furniture followed a military kind of organization. We transformed this through the Herman Miller project and with the showroom at the Chicago Merchandise Mart for Neocon in 1983. We made it a very “High Touch” kind of environment – introducing a multiplicity of color complexity, as well as other aspects that made the environment very rich, more similar to the domestic environment. Or, if you prefer, we transformed the office from a factory environment to a hotel environment, because it is more connected with the public domesticity of the hotel than with the private domesticity of the home[13].

The aim was to change dramatically the perception of the work or office environment in the world. Today it is to easy to understand that our work for Neocon in 1983 was absolutely revolutionary Before that time everybody was thinking of the office of the future as an environment that would be very cool, very dry, very futuristic, and very technological. We said, “No, our office in ten years will be like this – a high-touch office with a polychromatic color scheme, very rich fabrics, materials, environmental wallpapers, and wood – lots of rich wood.” The feeling of this kind of environment was absolutely different from the others at that time. In fact, offices are still high touch today. I think it’s time to change, right now, but the short-term reality of the office was that one[13]. (Fig.2.2.07)

As is evident, one of Castelli’s primary impetuses in much of his consulting work has been to help “humanize” the impact of technology[14].

Fig.2.2.07 The chromatic redesign of the Herman Miller was actualized according to a global approach to sensorial space.

Fig.2.2.08 A page of *No-Form*.

1. Jack Kelly, headed at that time by Robert Propst, inventor of another world's first: the Action Office system. Kelley worked side-by-side with Propst throughout the 60s and early 70s and played a pivotal role in the design of many Action Office components.

2. The Memphis Group was an Italian design and architecture group (active 1980-1987) founded by Ettore Sottsass in 1980 that designed Postmodern furniture, fabrics, ceramics, glass, and metal objects.

[12]. Leon Ransmeier. *Live action: Inventor robert propst and the history of the modern cubicle,* https://pinupmagazine.org.

[13]. Matteo Vercelloni. (2008), *Interni: Clino Trini Castelli, meta-design*, p. 61.

[14]. Mitchell, C. T. *New Thinking in Design: Conversations on Theory and Practice*, Wiley Publisher, p. 62-71.

The enhancement of technology in an environment, as in an office where you have more and more machines, is based on a sort of reduction of the sensory stimulation, a limitation of subtle and profound experience. The strategy for Herman Miller in the 1980s was to make the environment more complicated through use of multiple colors, such as the polychromatic schemes, different surface materials used simultaneously, different tactility. All of this was done in order to enrich the environment with light and shadow-to put in more complexity [14].

In Castelli's Verbal description, he pointed out the importance of sensory perception and the design value of polychromatic color and tactile material. Another design exploration by Castelli, which were known as " Design Primario", "Qualistica", for some years has been summarized in the expression "No-Form"[15]. (Fig.2.2.09)

As a conjecture, the thinking of CMF design originated from the general concept that focuses on material as the founding element of an icon, beyond its sculptural-compositional aspects[13] .

At that moment, the CMF concept intends to be combined with other design thinking of color, material, and surface effect by light, which Castelli originally sought to develop the "soft" qualities of design to the exclusion of form.

About the attitude towards the "hard" qualities, Castelli later explained:

Fig.2.2.09 ŠKODA Color & Trim exterior color palette, 2017.

Fig.2.2.10 Herman Miller Sync Series Textiles, 2020.

I know that form was impossible to eliminate, even if the dematerialization of the contemporary technological object is a reality. But now with my clients, such as one that is developing a computer in Japan, I have for the past three or four years, for the nineties, said that the technological object must be rematerialized. I feel that it now reaches maturity in terms of evanescence. In my poetics at the moment, for example in my furniture designs, the quantity of objects is my last concern. But if an object exists we have to abandon the strategy of the seventies and eighties, which tended to dematerialize the object by making it appear very light through color and shape [14].

I think now we have to design objects that are very heavy, very present, very strong in their physicality because we want fewer objects around us, but those that exist should be very strong. We should avoid producing a lot of very light and very camouflaged ones. This is a very important statement today, I think, and this guided me when I was working on what we have to do in certain fields, like the computer industry in the nineties. Every period is a statement, we must be ready to change strategy continuously in the last Milan Triennale most people were working on the design as concept. I said no, I want to do design again as object, and I want to clarify through form what kind of object it is[14].

With the change of Castelli's design thinking, the "CMF" concept was not widely recognized in other industries. In the early 1990s, CMF design was still an unknown industry both in consumer products and in fashion. Understanding the deeper influence and importance of colors and materials was often left aside and was not considered an entity of its own [16].

On the hand, this field of design has existed in the automotive industry, where color, material and finishing design had been a curtail part of the design process for decades. CMF design in the automotive industry is known as Color and Trim design (Fig.2.2.10), which includes in-depth trend and consumer research and their application to the vehicles[16].

Back to the Herman Miller, Nowadays, the design quality of color and material are still emphasized as the proud trait their branding strategy, and the relevant research and practice are encouraged with designers from various fields. In their WHY magazine, numerous reports and conversations are portrayed with a narrative about colors and textiles in their products, however rarely contains the keyword of "CMF" design. (Fig.2.2.11)

[14]. Mitchell, C. T. *New Thinking in Design: Conversations on Theory and Practice*, Wiley Publisher, p. 62-71.

[15]. Giampiero Bosoni. (2016), *Un maestro di lungimiranza*, http://www.abitare.it/it/design/prodotti/2016/09/13/clino-trini-castelli-cmf-design/.

[13]. Matteo Vercelloni. (2008), *Interni: Clino Trini Castelli, meta-design*, p. 61.

[16]. Heini Isoaho . (2016), *Color, material and finish design*, p. 9-10.

2.3 Practitioner of CMF in Industry States

The demand for CMF design covers many industries, although with different depicts of title and job requirements, which is largely due to differences in strategies of colors and materials in application and manufacturing.

In the automotive industry, the specialists of Color and Materials was defined as the Color & Trim department before, and recently, international brands have gradually reached consensus and established their own CMF design team to respond to more refined market positioning and user experience based on brands and products.

In a report of automotive design in 2019, "*A Look at Six Car Design Specialties"*, the interview with CMF designers in Acura design studio (Fig.2.3.01), which provides some information of CMF in the current design process from a certain perspective. In the conversation of working content and in CMF department, the interviewee Gypsy, the Color & Materials Principal Designer said:

We incorporate the brand and product identity through the use of color, material and finish. People's relationship with that makes a really strong connection emotionally. The second thing that we do is help performance by material choices. We refine that aesthetic of interior and exterior design, bringing up the level. We also delve into material innovation and cutting edge technology[17].

And some discussions about the inspiration of CMF creation, the Gypsy indicates that the inspiration of design approaches from the cross-pollinating ideas, such as fashion, and international design fairs and auto show for color group. For visitors about the nebulous definition of CMF design, Gypsy responded with examples[17].

With all of our products we're trying to create an extraordinary experience, so we have to think outside the box a lot. You can't just get inspiration from sitting at your desk and looking at Pinterest or Instagram [17].

Some other inspiration has been created in to specific effects through natural trips, such as the clouds, she took a sample panel (Fig.2.3.02) to describe.

Fig.2.3.01 Acura design studio California, US, 2019

You can see here the color's quite dynamic. Even though it's a sophisticated shade, there's other things going on. It's like a fresh new growth contrasting with these smoky elements. So that's what we want to bring to the table. We developed a lot of colors and materials based on that trip, and at least three colors specifically from that moment, that experience of encountering that cloud[17].

Then they go into proposals.The other facet of Acura that we convey in the color development is that we use advanced, cutting-edge technology. A lot of this pigmentation didn't exist before. And one principle that we work towards, is a Japanese word called "Omotenashi (おもてなし)[1]". One possible translation of this word is, it means to have your back scratched before you knew it was itching[17].

She explained the Omotenashi working process with a detailed description of the optimization for each material. When asked about the participation of CMF in the entire design process, she said:

A CMF job is really varied. While the actual thing we're working on daily can change day-to-day, with a project we're right there in the beginning, conceptualizing the product and [determining the needs of] our next buyer. All the way through to the end, when we're right there at the plant, planning out parts. It's a really, really a broad span of work that we cover [17]. (Fig.2.3.03)

[17]. Rain Noe. (2019), *How Acura orchestrated a massive turnaround with a renewed focus on design.* https://www.core77.com/posts/87484/A-Look-at-Six-Car-Design-Specialties-Part-6-The-CMF-Color-Material-Finish-Designers.

1. Omotenashi (おもてなし) is a Japanese word which represents the act of providing detailed service in a variety of ways to allow guests to spend a relaxing and memorable time by putting customers first.

Fig.2.3.02 The sample panel of RDX.

Fig.2.3.03 The CMF application on sample seats of RDX.

At the same time, she pointed out the content of “lab-based material research” with technologies.

We do a ton of research--we have an advanced products group here in the building that we can't talk about too much. But I can tell you that we experiment with 3D printing, bio-plastics and aspects of color and material development that aren't just for decoration, but have some additional functional facets. That's addressing the future and [what will exist in the] next wave of automotive production: Sustainability, electrification, connectivity, automation. We think about "What experience is the customer going to have in [a vehicle with those things?]". And we develop proposals for materials that will support those different modes that we don't currently have now[17].

At last, she described challenges in CMF concept.

Our challenge is that a lot of people are familiar with it and know what's good, but can't really articulate it. They have a really close connection with the CMF and it has to be perfect for them--if one thing is off, "I like the color but I don't like the material," they won't buy it. But if they see something they like they'll say "Yeah, that's my character" and demand will be high. So we really need to be on point with that. And I think we accomplished that with the RDX[1]*, which is the beginning of this generation of our CMF*[17].

As the primary data, another interview with Zhang GuoJun, the Principal Designer of Geely[2] CMF department, he provides more perspective about CMF design in the independent automotive brand. (see 2.3 Practitioner interviews)

The CMF concept was recently mentioned in the aircraft interior design, a relevant report[18] on the website Airline Passenger Experience Association (APEX) in 2019. The exhibition in Salone del Mobile 2019, entitled *Softwear*, was by Google and curated by Dutch trend forecaster Lidewij Edelkoort. A cooperation with the design consultancy Tangerine[3] (Fig.2.3.04), which known for its work on British Airways’ iconic yin-yang business-class cabin (Fig.2.3.05) and, more recently, interior designs for Virgin Australia, Cathay Pacific and Gulf Air [18].

We are noticing that the pull of technology no longer means things have to be hard or less sumptuous [18]*. — Emma Partridge, tangerine*

We attend these types of shows not to identify trends – these are of no use in the aircraft world where designs have a longer shelf life – but to be aware of how tastes and expectations beyond the cabin are evolving,” says Emma Partridge, head of Color, Material and Finish (CMF) at tangerine. “What we are noticing is that the pull of technology no longer means things have to be hard or less sumptuous,” Partridge says [18]*.*

Fig.2.2.04 The sample selecting of Tangerine, 2019.

Fig.2.2.05 The Yin-yang seating system in British Airways, 2019.

[17]. Rain Noe. (2019), *How Acura orchestrated a massive turnaround with a renewed focus on design.* https://www.core77.com/posts/87484/A-Look-at-Six-Car-Design-Specialties-Part-6-The-CMF-Color-Material-Finish-Designers.

1. The Acura RDX is Acura’s first compact luxury crossover SUV, taking over from the MDX as Acura's entry-level crossover SUV.

2. Geely Auto Group is a leading automobile manufacturer based in Hangzhou, China and was founded in 1997 as a subsidiary of Zhejiang Geely Holding Group.

[18]. Valerie Silva. (2019), Touching, Feeling: Aircraft Interior Design Gets a Softer Edge, https://apex.aero/2019/03/14/touching-feeling-aircraft-interior-design.

3. https://tangerine.net/en/about-us/.

As the author of an important reference in this thesis, Liliana Becerra said for this,

If the very companies responsible for replacing the tangible with the digital and thrusting sleek, shiny screens into our hands are now rethinking the visual and tactile characteristics of their technologies, so, too, should airlines, the current approach to CMF in commercial aviation is still very traditional and needs to be pushed forward in general, according to emerging consumer and technological trends[18].

Becerra points to self-driving cars, which transform the ride into an opportunity to perform activities other than driving, as a site for innovative CMF design. These still-nascent environments, what she calls "in-between spaces" or "mobile living rooms," use calmer, more muted colors, textures and materials, as well as smarter surfaces. "Here, the approach to interior design is very different than the one traditionally used for commercial aviation interiors," she says. "We can expect a similarly subtle approach to commercial aviation interiors moving forward[18].

As supplementary materials, a direct interview with Wang YuanHao, the Senior Designer of COMAC[1] interior design team, she shares the actual working experience of CMF application in domestic commercial aircrafts interiors. (see 2.3 Practitioner interviews)

In the consumer-products industry, especially in consumer electronics, Nokia was recognized as a successful case, which brought CMF concept in the design process in the early 1990s. Prior to CMF design at Nokia, the color, material and finishing decisions were normally made by marketing executives based on their own perceptions of what the consumers might find appealing. (Fig.2.2.05)

The new approach to design was established by Nokia's Chief of Design Frank Nuovo, who saw the deficiencies in the existing design methods. Nuovo introduced CMF design to Nokia by applying his previous working experience from the automotive industry to the mobile phone design process. While previously working for Design works in BMW[2], which made him realized the importance of CMF design in automotive design and saw the transforming possibilities to the consumer electronics industry. Nuovo led a team that was specialized in trend forecasting, colors and materials rather than the executives' personal opinions[16].

In this innovative design process, colors and materials were seriously considered in an earlier stage before mass production, which colors and materials were designed to meet the expected market segments and tested to be technically available in prototypes. Even in recent years, due to various factors, Nokia's experienced a huge decline in the personal smart device market, the design approach of CMF has the impressive influence on other competitors of the same generation, and even today is still considered to have the epoch-making significance.

On Plantronics[3] official channel, they released a series documentaries[19] of their design teams (Fig.2.2.06), which involves the introduction of CMF design in products. Gregor Magnusson, Director of CMF Design at Plantronics briefly described the functional and emotional attributes of color and material application in their products family, and those were happed in 2012.

On the one hand, the large company prefer to form its own CMF design team to develop strategies according to existing work process. On the other hand, more emerging professional institutions or consultancies, which consist of professionals from multiple fields to process cooperation with brands or based on commissioned projects. Regarding the application of CMF design in Fast-moving consumer goods (FMCG) and consumer electronic products, follow-up case studies will explain in detail.

Fig.2.2.06 Nokia CMD design achieved the IF Awards in 2014.

Fig.2.2.07 The design team of Plantronics.

1. The Commercial Aircraft Corporation of China, Ltd. (COMAC) is a Chinese state-owned aerospace manufacturer established on 11 May 2008 in Shanghai.

2. Bayerische Motoren Werke AG, translated in English as Bavarian Motor Works, commonly referred to as BMW, is a German multinational company which produces luxury vehicles and motorcycles.

3. Plantronics, Inc. is an American electronics company producing audio communications equipment for business and consumers.

[18]. Valerie Silva. (2019), Touching, Feeling: Aircraft Interior Design Gets a Softer Edge, https://apex.aero/2019/03/14/touching-feeling-aircraft-interior-design.

[16]. Heini Isoao . (2016), *Color, material and finish design*, p. 9-10.

[19]. Poly, Behind the Scenes with Industrial Design -- Episode 1: CMF, https://www.youtube.com/watch?v=rk1SPDLnA7A.

2.3 Practitioner Interviews

1. How did you get in touch with CMF?

Zhang GuoJun (Principal Designer of Geely[1] CMF Department):

At first, I worked for Geely Auto as an interior designer. My major in college was industrial design, and my graduation design was also related to car styling. In my work, I was engaged with the car interior design according to my preferences rather than the exterior styling. Of course, because of the "Styling Center" of Geely Automobile, the professional requirements for designers would be higher.

At that time, the entire interior department had few acknowledge of CMF. The job title at the time was called COLOR & TRIM designer. Compared with the CMF design platform we are currently building, COLOR & TRIM's work content is more focused on particular design approach in car interiors. The selection and development of the relatedly "Soft materials", such as defining specific leathers and textiles, and the color matching of the center console, etc. Actually, it is not difficult to imagine, because in 2013, Geely Automobile as a local brand in China, its market positioning is on the entry-level, so there is little demand for a systematic CMF strategy in the market environment. At that time, the overall shape design of the car was more able to attract the attention of the target customers than the detailed interior design.

Therefore, at the time, the general customer's evaluation of domestic brands of cars was: "there is certain configuration but with poor quality", which is difficult to deny. After all, international brands like Mercedes-Benz, BMW, and Audi have very mature design and development experience, which our brand couldn't do at the time. Therefore, COLOR & TRIM design is considered to meet the basic needs of automotive interior and exterior color matching. Designers consider more about the processing cost of materials in mass-production. Our strategy at the time with more cost-effective in design. Benchmarking competitive models, which also draw on the existing design experience of many international brands.

Wang YuanHao (Senior Designer of COMAC[2] interior design team):

My major at the post-graduate is also industrial design. The school I attended is Shanghai Jiao Tong University, the college introduces very professional courses in the field of transportation, which directly lead my choice of industry in the future. I joined the Commercial Aircraft Corporation of China in 2015 and have been working as an aircraft cabin interior designer until now. The concept of CMF is something I only came into contact after working for a while. It can be said that this is a very new concept. Sometimes it is even difficult to explain the specific work of CMF for people outside the industry. Since interior design is not the main business in the entire company's business model, we have fewer design experience for various models, and CMF design plays a certain role as conceptual design in our work.

2. How do you define CMF's job content in your industry?

Zhang GuoJun (Principal Designer of Geely CMF Department):

Because I am the earliest group of designers who participated in the interiors design of whole range of products categories in Geely, so after the company started to establish a CMF design platform, I was also one of the main designers of the department, currently leading 40 to 50 people. The team is responsible for the CMF development of some models in the company. In fact, CMF is a relatively mature concept in the design of international automobile brands. It ws at least five years earlier than the establishment of the corresponding work process by our team.

Of course, the previous experience accumulated by these brands in COLOR & TRIM helps to quickly establish an effective CMF design process. In my opinion, CMF's work includes the previous COLOR & TRIM part, and incorporates more professional fields of thinking into the interior design workflow, such as our closer cooperation with the marketing department and branding professionals. An obvious example is that the company has been rapidly updating its brand image in recent years while continuously deepening its research on consumers. In addition, after Geely Automobile acquired Volvo Cars, we communicated with Volvo designers very frequently. They also participate evaluation in the review of new car development and put forward valuable opinions.

1. Geely Auto Group is a leading automobile manufacturer based in Hangzhou, China and was founded in 1997 as a subsidiary of Zhejiang Geely Holding Group.

2. The Commercial Aircraft Corporation of China, Ltd. (COMAC) is a Chinese state-owned aerospace manufacturer established on 11 May 2008 in Shanghai.

In general, CMF design belongs to the optimization of the appearance and interior in terms of color and materials in the automotive industry, thereby helping users to establish brand recognition and favorability. From the working level, the CMF workflow needs to coordinate more departments.

Wang YuanHao (Senior Designer of COMAC interior design team):

In the interior design of commercial aircraft, CMF enriches the sensory experience of the relatively enclosed cabin space in terms of color and materials. For small commercial aircraft or low-cost airlines, CMF design considers how to help Airlines form a unified brand identity. For example, we will consider the choice of textiles for internal seats to maximize wear resistance and stain resistance, and choose a color that is consistent with the brand, because at this situation. CMF designers consider the functional factors to the greatest extent and to take into account the visual aesthetics, and low-cost airlines will also be very concerned about costs. In some luxury commercial aircraft, the CMF design needs to communicate directly with the appearance design department of the seats inside the airport, because usually in the aircraft cabin, the structure of the seat needs a very sophisticated design, which hides many electronic devices and functional structure. CMF design is intent to improve the sensory and quality perception of these structures.

After all, for high-level positions, the luxury of the seat directly determines the customer's impression of the airline brand. According to my current understanding, CMF plays an important role in enhancing the added value of aircraft interior design.

3. What do you think of the relationship between CMF and Meta-design?

Zhang GuoJun (Principal Designer of Geely CMF Department):

If only discussing the concept of Meta-design, I am not very clear. However since you explained the definition for me. I think it it is closely related to the CMF design process. Indeed, in such process of establishing this CMF design platform, the most important thing we need to consider is how to coordinate the work between different departments, including the horizontal and vertical dimensions. The horizontal dimension means how many departments would be organized together to coordinate the work in one stage , and the vertical dimension indicates how the work at different stages should be delivered and confirmed. This way of working allows us to gradually improve the development process and evaluation system, which makes the design more convincible and could particularly meet market expectations.

Wang YuanHao (Senior Designer of COMAC interior design team):

I don’t know this concept very well. Based on your description, I think at least in my current work we would like to focus more on specific design approach and relevant researches. Of course, there are some very professional institutions in our industry that specialize engaged in cabin interior design of high-end commercial aircrafts. But one thing could be concluded, since the interior space of the cabin is limited and full of electrified equipment, our design relies heavily on the advice provided by engineers.

In their feedback, both of them indicated the CMF could be considered as a new concept in their industry, truly there have been already existing design approaches in their work flow, the CMF concept introduces a more comprehensive perspective from different industries and professional fields. Moreover, this concept has been gradually recognized by more practitioners, to manage the project with this “design language”. And they emphasized the importance of CMF in their future works. There would be also additional discussions from these two practitioners, which concentrate on the CMF design process. (see 4.8 CMF Process Mapping (Interview Feedback)

CMF CONTEXT

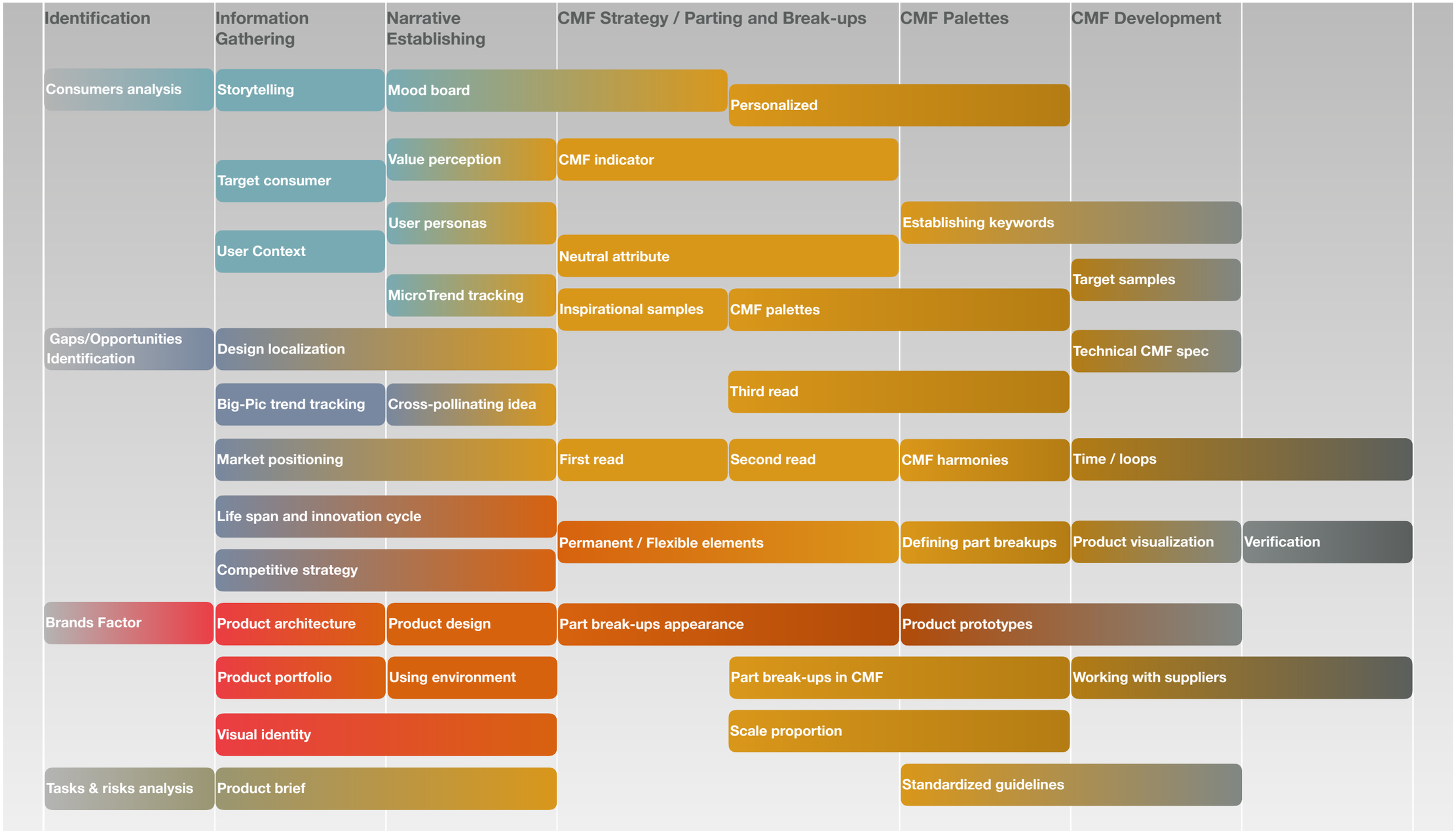

Fig.3.0.01 The map of CMF creation process.

3.0 Functional and Emotional Context

At present, the publications on sale as the main topic of CMF design with systematic introduction are very rare on the market. Thus, a very important bibliography, *The Fundamental Principles of CMF Design: Colour Material Finish* (Fig.3.0.02), has a certain value in the research of CMF design with summative and constructive opinions from a very practical perspective, especially for beginners, this helps readers to establish a general understanding of the current CMF design in the consumer-products. Before the discussion of CMF creation process, the author emphasizes the importance of the context in the application of CMF design on products, which as the priority or prerequisite involves the relevant aspects of consumers, brands and marketing.

In the practice of color material and finish design, context is everything. Understanding and leveraging the right context the where products will live can make the difference between a successful or failed product. (Becerra 2016.)

Moreover, since an important research in this thesis would be a representation of the general CMF design process, which consists of the colored "key nodes" to represent approaches in the design process, to the relevant characteristics, thereby establishing a more intuitive read. (Fig.3.0.01)

Fig.3.0.02 Lilliana Becerra, *The Fundamental Principles of CMF Design: Colour Material Finish*, 2016.

The whole creation process are distributed into several stages, from left to right, the direction indicates the design project from the initial stage to the completion. The staged classification in the actual project process will be more complicated because of changing external factors. Here, it is mainly organized according to the prompts in the literature.

The “key nodes” cover two main lengths, which respectively indicate the stage to which a particular approach belongs, and some will span multiple stages. Each “key node” indicates its attribute through various colors with single or gradient color. For example, the cyan is assigned with mainly “User/consumer attribute”, the red red is assigned as “Brand attributes”. The brights yellow is assigned with “Design relevant works” in CMF, such as creating color and material strategy that designers provide greater engagement. The gradient color is aim to depict the workflow that requires the collaboration. For example, some ideas need to start from “User/consumer attribute” consideration to specify the design strategy, the gradient appears from gray-blue to bright yellow.

In addition, in the design process, the appearance design is highly related to the color and material, so as a counterpoint, vermilion is assigned to indicate “appearance design attributes”, the lightness and saturation of colors decrease as the design works are confirmed to the next stage.

[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.

3.1 Functional Context in CMF Design

There are different functional needs and expectations when it comes to interacting with product. Defining and identifying the consumer group can help to portrait the consumer in order to create a more accurate product strategy. Consumer segmentation is a common way to describe the result of user classification according to a set of similar characteristics and consumption behaviors. Based on the different business models, companies would target one or several consumer groups. (Becerra 2016.)

To create well targeted CMF design, it is very important to work closely with the people who create consumer segmentation within large organizations or companies. They can be part of internal division or department which is usually called “Consumer Insight”, is an interpretation of trends in human behaviors which aims to increase the effectiveness of a product or service for the consumer, as well as increase sales for the financial benefit of those provisioning the product or service[20] . They could also be external agency or institution fully dedicated to consumer understanding. Actually in some professional institutions which involve the design solution by applying CMF, they usually have the experts in this field to prove the design strategy.

Once the consumer segment have been clearly defined, by materializing their aspirations into tangible design elements, the people who have certain interdisciplinary background would help designers to bridge the gap between the world of consumer insights and the world of design. This process ensures the concept would also received by the right group of consumers. They could also be external agency or institution fully dedicated to consumer understanding. Actually in some professional institutions which involve the design solution by applying CMF, they usually have the experts in this field to prove the design strategy. (Becerra 2016.)

Based on the different industries, there are different families objects of sharing similar functionality or brand strategy. Even in the same category, targeting a specific group of user by presenting a particular visual aesthetic of specific family. The design of CMF for protect families are usually determined by the brand strategy and marketing positioning. In parallel, the context in which products will be utilized contributes a great number of decisions regarding its color material and finish specifications. One of them is the space where products would be fully functional and operational. The product can not be absent from the using scenario, and it is also directly related to the user operation, and usually coexist in the same place with other products. (Becerra, 2016.)

Because of the technical constraints, external regulations or restrictions and the certain required performance. Products have their lifecycles / lifespans in every industry. Making products with higher quality to produce the longer lasting than others. CMF design must carefully considered useful life-cycle / lifespan of products in order to guarantee its accurate performance and endurable aesthetic appeal. (Becerra, 2016.)

CMF design approaches are versatile for various industries, certain colors and materials or finishes they look good on a range of products but may not transfer well on other applications. The main purpose of the product is important when translating a similar CMF design approach from one industry to another. A good example to describe this principle is the difference in time-to-market cycles. Consumers have certain expectations on products in terms of functionality and aesthetics according to the categories they belong to, fashion wear, consumer electronics, automotive ,etc.

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[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.

[20]. Jure Klepic. (2014), *What Are Consumer Insights and How Do They Impact Marketing Effectiveness*?,The Huffington Post.

Life span and innovation cycle

Brands Factor

Product architecture

Generally products are designed for a longer period in the market, however, some industries encourage a shorter lifespan with innovation of products, such as the seasonal refreshments in fashion industry. The fast-pace industry prefers to apply border aesthetic experimentation in CMF design, in contrast, the slow-pace mainly relies on more traditional and a long-lasting aesthetic appealing. The lifespan of specific products are design with various strategies even within the same product category. Different products are given different meanings in the product architecture, which also directly determines the life cycle of these products. This is a market-driven result and part of the brand strategy.

The CMF design strongly contribute to the “quick update” in products, the ideal CMF design offering the longevity and timelessness of athletic and functional elements for products with a longer life-cycle in mind, and a quick personalization opportunities for what is considered a fast “product update” supported by changing or tweaking small portions within the small line of products. (Becerra, 2016.)

Based on the professional institution Baolab[1], which concentrate colors and materials solution in design, they introduce the CMF experts:

Baolab work at enhancing the sensorial qualities of a product, in consideration that consumers are most likely to link to it their personal use experiences. A competent re-design of the object’s “light” characteristics – color, materials and surfaces – can very often set new sensorial and functional values, without having to turn its production process upside down. A well-defined CMF project does help the end user perceive the product the best; this can highly influence its repositioning on the market.

In this description, they indicates the “flexibility” in CMF approach of product design and in production process, and highlight the CMF design in consumer’s using experience and the value in market positioning. In many cases the marketplace dictates the product innovation cycle. Market retailers drive an important aspect of the creation of CMF design variants as they directly request exclusive colors materials and finishes from product manufacturers. A sense of exclusivity in color and material would help the product differentiate from the competition, such as the American brands get used to chose an exclusive color to represent their identity against other competitors. (Becerra, 2016.)

Market positioning

Competitive strategy

Through this approach the products offered by different retailers could be exactly the same in terms of form and functionality that is where apply unique and exclusive colors, the best example may be Coca-Cola and Pepsi.

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[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.
1. https://baolab.net/

3.2 Emotional Context in CMF Design

Almost consumer-products design in the market are trying to evoke positive emotions through sensorial experience, which could elevate the value of the products. Emotional attributes are considered together with functional factors in the product design process, compared with the importance of functional attributes in product architectural and market aspects, emotional attributes are more emphasized, through the use of colors and materials to establish the goodness of the product and the user's experience and the identity of the product's brand.

At least 80% of CMF design is about the perceived value it creates for consumers. Consumers with different backgrounds such as various ethnicities, social status or education or gender factors, is looking for aspirational objects to fulfill the emotional needs and intangible benefits such as the status, beauty and belonging. (Becerra, 2016.)

This strategy in CMF design to acquire such value is not only through the knowledge of actual high-end manufacturing processes, which are easier considered as the direct way by CMF design to improve the performance and expressiveness of products, such of the application of precious materials or astonishing finish effect by cutting edge technology.

The cultural connection that is purely based on emotional perceptions transforming ordinary objects into status symbols. Besides those products are design for serving purely functional purposes, the objects surrounding are the reflection of us involve the self-awareness and value identification. When objects are defined as products, especially in consumption, that people consume in ways that are consistent with their sense of self, and consumers use possessions and brands to create their self-identities and communicate these selves to others and to themselves[21]. (Becerra, 2016.)

User Context

Value perception

In this case, giving the product the value, which beyonds simple functionality and then turns into the reflection of the physical experience and emotional connections. Added value can be real or it can be just a perception. (Becerra 2016.)

Real value are most likely be tangible and measurable through the use of higher materials, intricate surface finishes or complex manufacturing processes, utilized to provide a product with better quality, higher-performance and therefore higher price point. A typical example is that consumers' preferences and pursuit of luxury goods with exclusive and precious materials and complicated manufacturing processes, consumers are pleasure to be informed of the uniqueness and scarcity of these products. (Becerra, 2016.)

Design localization

Perceived value can be created in order to provide a product with appearance of being high-end. This purpose could be achieved through the use of low-cost novelty surface finishes, eye-catching color combinations, or by creating an overall aesthetic composition with a resemblance to a luxurious object. It is possible to convey a sense of prestige at affordable price without necessarily using expensive materials or technologies. For example, the application of trendy color in products are perceived with extra value than ordinary or outdated ones, even with the same color processing. (Becerra, 2016.)

Understanding the cultural background of the targeted consumers and engaging with the context in which the product will be placed. Different from the physical environment, the discussion of cultural factor here is the market places in different regions with its cultural background. (Becerra, 2016.)

There are different and ever-changing influences for each consumer group, even those groups are constantly shitting merging and evolving. In this circumstance, products need to support different aesthetics value and aspirations according to the different influences of trends which could be global or local, a fusion of both.

[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish,* pp. 22.
[21]. Jennifer Escalas. (2013), *Self-Identity and Consumer Behavior*. Journal of Consumer Research, Volume 39

With the development of communication, the cultural background dominated by regions is gradually changed by the Internet and the media, and the emergence of subcultures may various of geographically influenced, this makes it possible for a strong visual elements to be perceived in a wider range and in a shorter time, to achieve preference or unpleasant. The same color or material would be perceived differently depending on culture, and the localization strategy in design become extremely important for a success in the local marketplace.

Besides the different understanding of colors and materials in cultural consideration, there is a general appealing of the natural sense. Traditionally, the materials that better seem to maintain the real and perceived value through time, from culture to culture, are those derived from natural resources.

Plastic is widely used as substrate in products, however, since the lower cost in mass-production with cheaper price , it incline to recognized with lower perceived value in products, and minerals like diamonds, crystal, glass and precious metals such as gold, platinum and titanium are at the top of the list when it comes to high real and perceived value, thus, a large number of contemporary finishes such as coating, which emulate visual characteristics of this original materials in order to invoke a feeling of high-end. (Becerra, 2016.)

In addition, some other plastic processing methods can create visual appearance of natural wood or leather, and even imitate the responding tactile sense. This changes the nature material from lower perceived value to higher.

Visual design languages are the overall composition of forms, lines, materials and in general visual cues of products. Sometimes these elements because iconic representation of technology and time in products. The visual design language has the vital importance when positioning products on specific market tier or consumer segments. (Becerra, 2016.)

Within the field of brand-based visual design language, CMF design contributes with iconic and instantly recognizable visual identity in products, brands will form their own unique visual language, thus establishing consumers' associations with them to distinguish their products from other competitors, and this visual language has also become the connection between the product lines, and such, it will be reflected in the product according to the changes in branding.

The visual language of color and material normally indicates the relevance of different product families in the same generation or the same product family in different generations.

Visual identity

An interesting phenomena of iconic aesthetics is a certain constant desire to re-visit the past by looking back to the previous decades, the contemporary reference to vintage is deeply charged with images of affection and memorabilia of the recent past, generally influenced by the non-digital era. The functional attributes of color in the material are weakened, instead the emotional stories and narratives in this way are emphasized, which to convince consumers with the certain visual language. (Becerra, 2016.)

And other visual languages are a sequence of technical material innovation and performance which has radically changed manufacturing processes from factors or functionality. In this research of case study, a chromatic film which originally designed by 3M[1] are widely used in consumer-products by different brands, which could be an example to describe the influence of the visual language. (Becerra, 2016.)

[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.

1. The 3M Company is an American multinational conglomerate corporation operating in the fields of industry, worker safety, US health care, and consumer goods.

CMF CREATION

4.0 CMF Creation Process

The research of CMF creation in this thesis mainly based on the indication in *The Fundamental Principles of CMF Design: Colour Material Finish*[1], and an attempt to represent the relevant information. Starting from design approaches in CMF creation, taking the CMF design as the main clue in product design (the product design process contains many other parts, CMF design accounts for a part of it), analysis of design approaches with descriptions are introduced in this creation process. All those design approaches are classified into six important stages, which finally visualized into a process distribution map.

CMF design should be conducted in parallel with product ideation and development so that it can support any has physical aspects such as scale form and functionality . (Becerra 2016.)

The author believes that CMF designer should participate in the early stage of product design, and in some professional institution, they provide a more comprehensive tasks for CMF designers.

The tasks of a CMF designer begin from industry research to the creative process, strategic portfolio design, eventually to the execution and finally to design quality supervising. CMF designers need to be aware of the upcoming consumer and design trends, but also the new innovations in processes and materials. They need to be capable to supervise the production and application of the techniques. Understanding production processes enable creation of the most functional and beautiful product[2].

In the past, the application of color and material was considered with less priority than the appearance and shape in product design, however, the functional attributes are not the only dominance in products, especially in such a market full of products with the same functionality.

Sure, CMF design can be applied last in the process, but then you are not utilizing the full power of the discipline. To create differentiation for a product to be competitive – or even disruptive – CMF design is vital in the early stages. As a CMF designers, research is the key to understand WHAT problem are we finding a solution for. Our business is to create the next generation product propositions and creating tangible solutions[2].

[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish,* pp. 36.
[2]. Omuus.com. (2018) , *From the beginning to unknown*. https://omuus.com/from-the-beginning-to-unknown.

4.1 Information Gathering

The aim of gathering information is to help designer to depict accurately the expectation for product. One of the process could be in the interview with targeted consumers. Formulating questions focused on functional fitness related to colors, materials and finishes, which could be the foundation to draw the consumer insights related to functional elements. This interviews may not directly ask the question about the specific product, instead a deep research of different objects that surround the users to understand the context.

And before the development of new product, relevant tasks and risks have been analysis in order to form a team and to communicate effectively with other teams or departments.

The project brief is a short summary document outlining the overall scope of this project, the specific task at hand, the budget and the expected timeline, it is the single most important pieces of information required in order to initiate the CMF design process. Without this premise, the project could not be clearly defined into the successful goal, that means the clearer task, the better design. In this stage, professionals from different fields such as branding marketing are all involved, the information of consumers' aging, gender, geographical location, type of market and product categories are discussed as much. (Becerra 2016.)

More over the market research and competitors information with potentially interesting and competitive features are also very useful, some emerging technologies are considered, actually professional suppliers are usually invited from the early strategy to the final development.

For some independent consultancies, the project brief comes directly from the client, within the larger organizations or companies they prefer to build their own CMF teams, it may come from the product planning the marketing department or it can be created in conjunction with the overall product design team. This form of organization is sometimes because companies want to keep their leading place in exclusive products among competitors, for some innovative attempt, they may looking for cooperations with independent consultancies. (Becerra, 2016.)

The product brief also indicates the possible accomplishments in terms of manufacturing technologies within a given time frame and budget. Generally creating completely new CMF design will automatically increase the project complexity and will most likely result in a higher manufacturing costs as well as the longer production and time to market.

The CMF design involvement is classify in different levels. The most basic level consists of supporting the "refresh" of the existing product portfolio. This can be achieved by creating new colors, materials or finishes variants without necessarily changing the existing product design.

This approach mainly concentrate to address the “quick updates” with the emerging aesthetic and consumer trends, especially in the FMCG industry (fast moving consumer goods), this approach could help the fast product turnaround in new looks while operating under very tight budgets.

The most complex level consists of specifying many different new parts and components for a single product. Such as the case in projects involving the CMF design for aviation and automotive interiors, where besides the many different parts — a car interior typically has more than 350 parts — there are also many different materials, finishes and technical requirements for every part according to industry standards. The CMF design process for automotive interiors typically begins about 42 months before initiating its production. Information from an interview in this research with the senior practitioners could introduce more or less. (Becerra, 2016.)

Surveying and analyzing the market is a fundamental grounding exercise to get closer to the target consumers. Before the detailed comparison in the competitive product, general competitors' analysis and market research are conducted by experts with professional backgrounds in marketing, statistics, and business strategy, in order to see the gap and opportunity.

Gaps/Opportunities Identification

Market positioning

This work consists of mapping or positioning existing and future products according to market tiers and target consumers. (Becerra, 2016.)

Within large organizations, this information is generally available through the consumer insights or portfolio planning departments. Within smaller companies, this process is normally outsourced to external consultants. In such consultancies, researches of clients and industries are truly important as their advantage.

Baolab conduct an on-going broad research for a wide range of our clients, global players in their respective industries. We inspire them first and jointly develop novel product concepts, in different fields.[1]

This process can be conducted through different methodologies and existing sources, bibliographies and references. Key is that the market survey processes conducted by designers will by nature focus more on qualitative, rather than quantitative methods of assessment. One approach is to visit the market place to observe, photograph and purchase similar products or potential competing products, designers devote themselves into the actual consuming activities, both as the consumers and designers to think the product. This process gives an idea of existing functional features and aesthetic trends currently happening in the marketplace. (Becerra, 2016.)

Compare with the data and information from consumers interview, designers could process some judgements more accurate on the design purpose, designer concentrate existing innovations out there worth to be noted and in some cases improved — an approach that can avoid wasting time and resources, that could be thought as the preliminary field research. (Becerra, 2016.)

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[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish,* pp. 36.
1. https://baolab.net/

Visiting and surveying the market can also involve cross-pollinating ideas from different industries and anticipating similarities of product preferences and usage. For example, some innovations from smart electronic devices were applied for the general home appliance, and this brought new looks in the design of home appliance, the emerging smart refrigerators with touchscreen and AI assistant, changes the user experience in a certain way, however, those smart features were used to be recognized only in the application of electronics devices. (Becerra, 2016.)

Cross-pollinating idea

The “key node” in the first stage and relevance of the context in CMF are represented orderly in the map to depict the general design process in early period, which consists of the project establishing and information gathering from different professionals. (Fig.4.1.01)

4.2 Establishing a Narrative

Besides the technical and practical work that lies beneath CMF design, it is equally important to create and develop an engaging narrative for every project. (Becerra, 2016.)

In view of the fact that most of the information currently on social networks is transmitted visually. Attractive visual identity of products with compelling storytelling, which engages clients and ultimate consumers. This process is more effective if the stores are based on real world events, emerging consumer behavior or current market trends, in order to make the story more reliable, more relevant and more engaging.

For the product, different ways could be applied in storytelling, however, most of them initiate by creating a general context or a framework, which consumers are normally familiar, and then connecting the initial problem or challenge in this situation, finally, the solution with design strategy would be proposed to complete the story and to convince the functionality.

Fig.4.1.01 The early stage of CMF creation process.

[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.

Storytelling is in itself an entire discipline, but key for CMF design is that the message of the story, besides being relevant to actual market events, also has to be intriguing, creative and unique from a color, material or technology perspective. (Becerra, 2016.)

Storytelling

Such as the brand could build the storytelling about the performance of materials, innovation technology in products or the exclusive design philosophy, etc. Stories need to be carefully organized for the right purpose, in some cases, story has been already part of the brand, and must be transferred into different CMF elements, such as the iconic color or material in the brand. In other cases, new messages will be applied for the brand with a fresh CMF story. However, the information in stories should be perceived properly by consumers, in a certain time.

All of them are rooted in a collective return to consciousness that we are experiencing at the moment, which is pushing us to re-evaluate how products are made, where they come from and what their actual environmental impact is. Storytelling could also create an easier way for consumers to create information and remembers, instead of throwing facts, statistics, and testimonials, focus on making the brand thoughtful, memorable, and real[22]. (Becerra 2016.)

Trend tracking and analysis is considered to be a very important content in CMF design.

By analyzing heterogeneous sources, Baolab recognize the emerging formal languages and on-going trends that we translate into appropriate tools of interpretation: mood and material boards, color palettes, personas profiling.[1]

This process happens now naturally on an on-going basis almost like a trained intuition. The main essence when working with trends is to understand that they are not static, but a fast moving, living entity which is always changing, merging and diversifying. That is the reason why searching on the Internet, there would not be an exact same result for the trend in specified period, and even in the same industry.

There are different labels of trends, ranging from the macro level, which involves big picture changes and events, to the micro level, which focuses on tangible and quantifiable manifestations of the macro trends. For instance, the institution Design Group Italiain[2] indicated the 2018 CMF trend as the revival of Minimalism. (Becerra, 2016.)

Big-Pic trend tracking

MicroTrend tracking

Minimalism, the most enduring global style, has trained our eye using elegance, essential shapes, balanced geometry, neutrality in all aspects, uniformity in textures, and absence of decoration. From time to time and with moderation, minimalism is the perfect base for displaying the color of the year or the retro inspiration having its moment. At Salone del Mobile, commercial brands employed this logic of minimalism, somewhat reconsidering its application, yet maintained its reassuring perfection.[2]

Actually, consumer products respond to the quick shifts in technologies, socio-cultural attitudes and general dynamics of offer and demand within the market place. The indication of the trend above looks like a proclaim of a general aesthetics or style in products design, this implied a time-sensitive market preference. But for the practical strategy of trends in products, the trend tracking process is based on constant observation, documentation and analysis of different shifts within the market context, it is necessary to understanding, managing and leveraging the context in the professional field.

Since this is an ongoing process that runs in parallel with the design of products, it also allows us to look back in time in order to discover patterns of evolution which can in turn, help anticipate possible future scenarios, as well as emerging consumers' needs, desires and aspirations. And this is Micro-trend tracking, in smaller scale and concentrate on products. When designing colors, materials and finishes, all levels of trends are important. Although some brands tend to connect colors and materials with micro-trends only, it is important to also understand the impact that big picture level trends will have on the products we are designing. Several companies, who are also suppliers, create color forecasting on a seasonal basis, in order to promote their brand and innovations to potential clients. Such as Pantone[3] or Les Couleurs® Color[4]. (Becerra, 2016.)

[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.
[22]. Celinne Da Costa. (2019), *Reasons Why Brand Storytelling Is The Future Of Marketing,* Forbes.
1. https://baolab.net/
2. http://mdw.designgroupitalia.com/2018/cmf-trends/
3. https://www.pantone.com/
4. https://www.lescouleurs.ch/en/the-colours/colour-keyboards/

Creating personas is one of the many different types of design ethnography tools, utilized to obtain and communicate cues and insights about consumers. it is a representation of the goals and behavior of a hypothesized group of users, which are synthesized from data collected from interviews with users[23]. They are captured in 1–2-page descriptions that include behavioral patterns, goals, skills, attitudes, with a few fictional personal details to make the persona a realistic character. (Becerra, 2016.)

User personas

Mood board

The main difference between personas and mood boards is that personas focus on the lifestyle context — social activities, environments, culture — while mood boards focus on key and concrete aesthetic cues to support the design process. Usually a mood board is the visual presentation or a collage consisting of images, text, and samples of objects in a composition. It is recommended to create personas and mood boards in parallel when working with CMF design. This process could help designers to materialize and articulate values into visual and functional aesthetic elements, then delivering these elements with colors and materials on the product. (Becerra, 2016.)

The “key node” in the second stage, which consists of the narrative building, trend tracking in products, methodology of user analysis and design element materialization . (Fig.4.2.01)

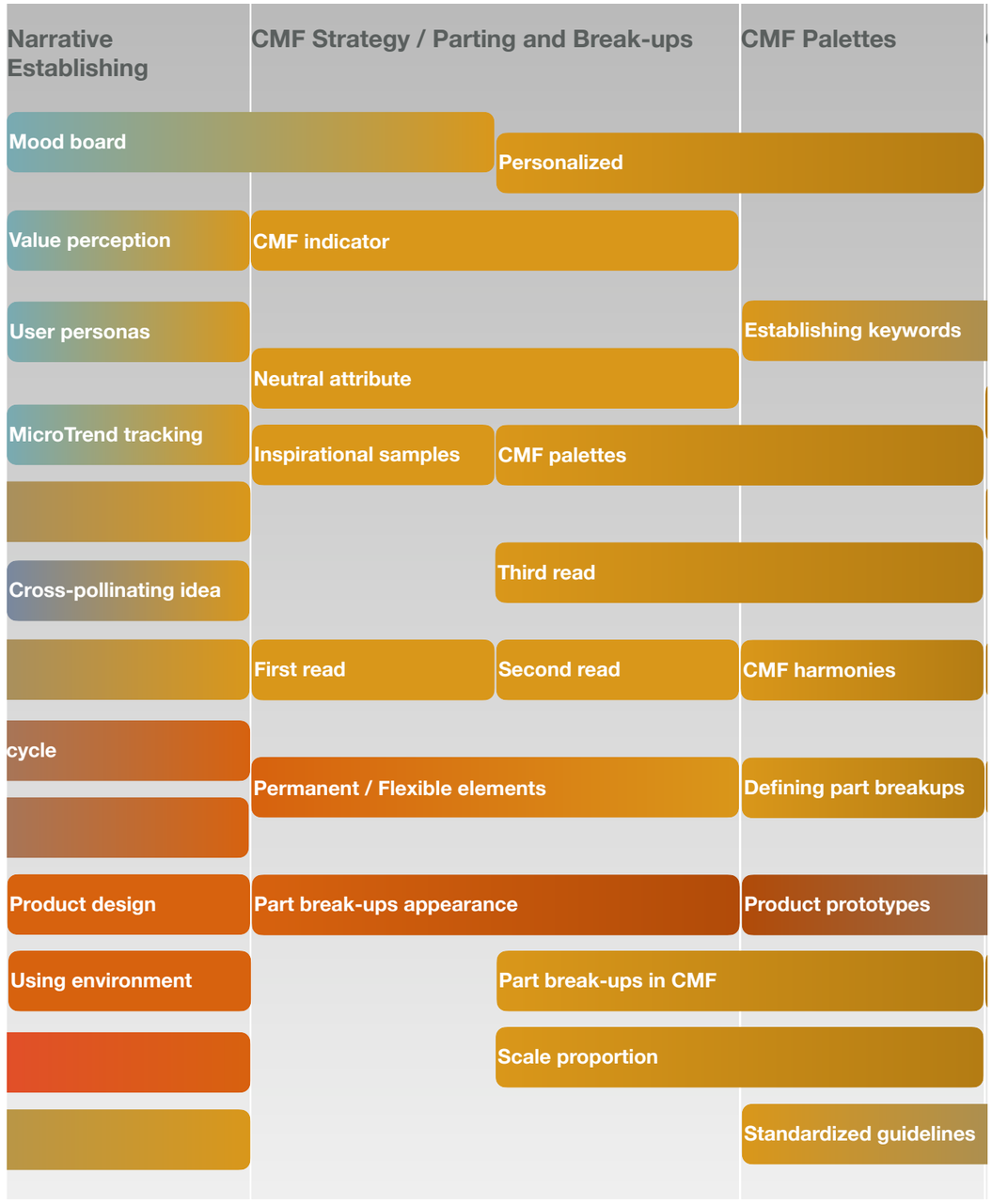

Fig.4.2.01 The medium stage of CMF creation process.

[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.
[23]. Humphrey, Aaron. (2017), *User Personas and Social Media Profiles*. *Persona Studies*.

4.3 CMF Strategy

A CMF strategy carefully considers how users relate to products through a series of touch points: from first interaction to long-term usability, and ultimately the product re-purchase. (Becerra 2016.)

A touchpoint is any interaction that customers feel about the product, brand, business or service[24], through this interaction, the value of the products could be perceived in order to generate the actual using experience. In consumer-products, this partly determines whether consumers are willing to re-purchase this product for this next time.

There are several existing Qualistic[14] tool to position and map out sensorial at a functional attributes in products, which to imply the perception of quality from a subjective point of view[14]. Liliana Becerra, the author of this book, proposes an indicator that considers the qualitative nature of CMF in terms of emotional and functional attributes. This chart has two major dimensions to analysis these attributes in the product, in order to create a general strategy for the color, material , and finish in the CMF design. (Becerra 2016.)

The functional attributes are related to rational elements and characteristics of design, which tend to have a more permanent nature, represented by tangible, quantifiable measures. The technical and physical performance requirements such as: durability, rigidity, flexibility and strength. These features are highly related to the expected lifespan in products. This is from the functional category to discuss the application of color, material and finish in products, to meets expectations and requirements.

Considerations also include how to make consumers perceive these fictional attribute in applications. For example, visual strength used to he connected with heavy and robust materials, however, with current developments of high-tech material, structural surfaces of products are becoming thinner, lighter and stronger, deceiving preconceived visual aesthetics.

CMF indicator

Generally, functional attributes here could be recognized not only the CMF related physical performance in products but also corresponding perception by consumers.

As the parallel dimension in the indicator, emotional attributes tend to have a more flexible or changing nature depending on external influences, emotional values and market trends, which correspond to aspirational and evocative elements. All concepts are based on the external perception of how colors, materials and finishes present a story and tend to change and evolve over time, depending on various influences, such as classic, contemporary, luxurious, natural, etc.

In most cases, the emotional attributes of products are not achieved only with the selection of one color, one material or a specific finish effect, but rather through the combination of all of them together with the final product and marketing strategy. The emotional expression through CMF will be amplified and easily recognized through this combination and generating relevant association or impression. (Becerra, 2016.)

Some attributes are neutral could be highly functional or highly emotional, depending on product requirements. Beside the visual elements, tactility, as the representative feature in CMF can effectively enhance the visual appearance of a product and simultaneously support its functionality. In many cases, tactility is an inherent characteristic of a material or a surface, but not directly effects the specific performance. Tactility can also be an "added" property, achieved through different finishing processes, which could highly enhanced the experience of interaction while keeping the original features of the material.

Neutral attribute

Comfort is another required property for most products, but especially in close contact with body or the skin. Materials or finishes must provide users with high-performance properties as well, such textiles are utilized somehow beyond providing comfort, they can comply with specific regulations and requirements, like fire retardancy, water resistance, breathability and acoustic isolation.

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[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.

[24]. Interaction design foundation./www.interaction-design.org/

[14]. Mitchell, C. T. *New Thinking in Design: Conversations on Theory and Practice*, Wiley Publisher, p. 62-71.

4.4 Parting and Break-ups

The appearance design in products, the parting purpose is largely restricted by the material characteristics and processing technology. In CMF, different parts of the product are processed separately, and part breakups should go beyond simple aesthetic styling of products, and into value propositions that users can recognize intuitively through universal cues. The consumers should perceive the purpose conveyed by the application of the color or the material in the product. (Becerra, 2016.)

Part break-ups in CMF

Besides the intended product functionality, part break up can also be a driver or a consequence of the manufacturing processes. This approach is currently growing in product design, bringing an entire range of opportunities and constrains. Especially when thinking of the entire life cycle of a product — design for disassembly — or when maximizing manufacturing processed and design functionality. (Becerra, 2016.)

Part break-ups in appearance

Permanent Versus Flexible Elements Part break up can also be utilized as a way of moving products up or down different market price points and consumer segmentation tiers. In product design, certain elements designed to be permanent components and others designed to be more flexible or upgradable through different CMF variants. For technical consideration, some permanent components attend to be processed with higher performance, and some flexible smaller components are considered as changing parts. This strategy allows more variations with certain number of parts. (Becerra, 2016.)

Permanent / Flexible elements

The flexible elements are mainly classified into entry level and exclusive level, in entry level the lower cost processing technology are normally applied for easier mass production, and in a higher or more exclusive level, variants with special or limited CMF edition that include expensive manufacturing technology or handicraft details which are hardly reproduced. These classifications are different in every product and industry, for some product design, it doesn't classify samples in this approach. The first read is usually corresponds to the visual perception of main area or the most visible part for a considerable distance, this indicates the size and the overall shape of silhouette, with general color. In CMF driven product innovation, the first read will be the material technology and its finish effect, especially when it makes a strong and iconic visual statements. (Becerra, 2016.)

First read

Second read

Second read corresponds to the elements and functional parts products, which are normally integrated to the main form. These require a closer look with interacting, such as operating keys and buttons in the products. The second read also could be the texturing detail or specific finish effects of the first read, such as the matte, glossy or metallic or pearlescent. The third read corresponds to specific details of the product, such as borders trims and accents to emphasize the functionality of form to evaluate the perceived value of products. This details l normally applied in high-end products, with extra time manufacturing and handicrafts processing, which the features could not be easily reproduced in mass-production, thus, that's applications are rarely seen in entry-level products, or design with lower-cost processing. (Becerra, 2016.)

Third read

[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.

The personalized details and the third read provide at the “added-value”, which could be generally understand the extra quality for more emotional perception rather than accomplishment of functionality.

Personalized

Scale proportion

Each read with corresponding proportion in the product, normally the third read I tend to be smaller to emphasize the precise of manufacturing and the first read are always have a larger scale. The colors, materials and textures should be perceived in good as whole, and also in the level of details.

The “key node” in the third stage, which consists of an indicator of CMF classification, permeant/ flexible elements in parting and break-ups and how elements could be read with different scale or proportion in the product. (Fig.4.4.01)

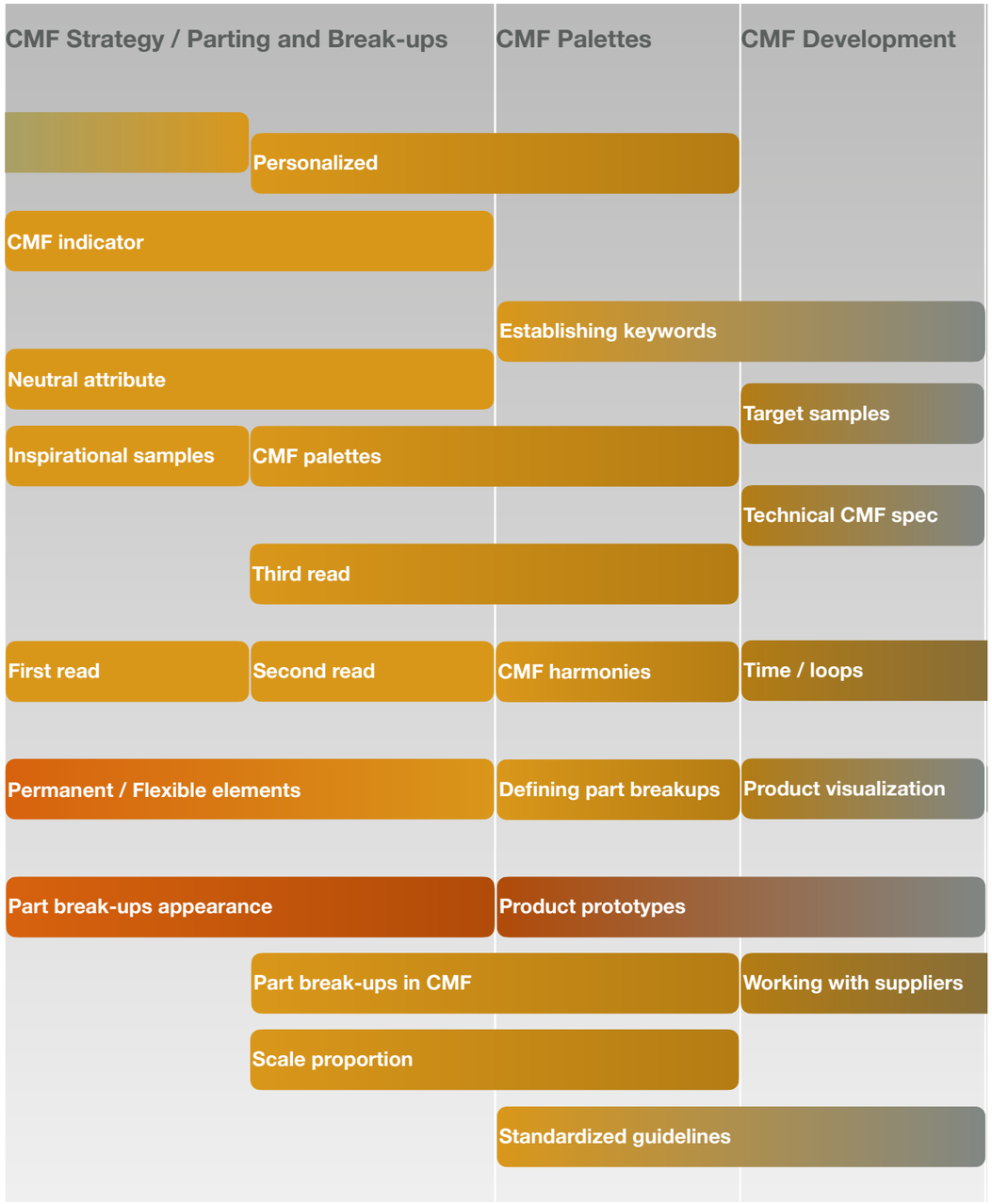
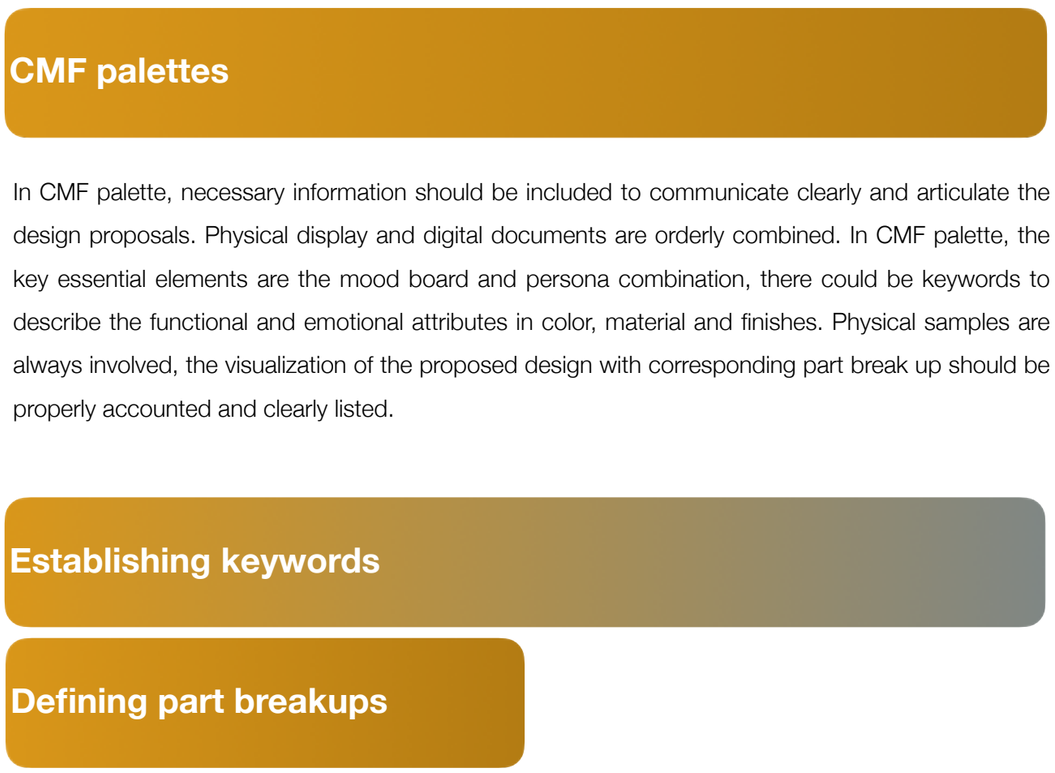


Fig.4.4.01 The medium-late stage of CMF creation process.

4.5 CMF Palettes

CMF palette is the physical collection of samples or tangible representations of color, material and finish corresponding to each of the product parts. Depending on the level of complexity of the product, palette can vary in size and overall level of detail and complexity. (Becerra 2016.)



In CMF palette, necessary information should be included to communicate clearly and articulate the design proposals. Physical display and digital documents are orderly combined. In CMF palette, the key essential elements are the mood board and persona combination, there could be keywords to describe the functional and emotional attributes in color, material and finishes. Physical samples are always involved, the visualization of the proposed design with corresponding part break up should be properly accounted and clearly listed.

Establishing keywords to support the product narrative and its functional characteristics. Every proposed CMF variant needs separate palette. The functional to the emotional attributes in the CMF indicator could be translated into keywords, using actual dictionaries to communicate and further guide the process. Meanings and associations of descriptive words and visual elements can be vary different understanding among culture and product, and each industry has its own technical terminology or jargon with CMF attributes.

Defining and analyzing the application with part break up of the product, in order to calculate the amount of actual parts and the amount of corresponding colors, materials or finishes need to be specified. Since this can be a complex process, it helps to number each of the parts to be specified and to organize them either under permanent/fixed elements or under first, second or third read. (Becerra, 2016.)

It often helps to request an expanded view with all the external parts from the industrial designers or the product engineers as well as orthographic views of the products (front, back, sides, top and bottom), in order to begin the CMF exploration. Ideally, each of the parts that will change color or material should be isolated in a separate digital layer. (Becerra, 2016.)

When creating an initial and more inspirational palette, the samples can vary from any source, such actual objects, existing material and surfaces effects ,etc. However, as the palette becomes more grounded on tangible manufacturing technologies, there must be standardized guidelines and references. Every material and finish industry has their own guidelines and standards. It is crucial to work with the suppliers when ideating a CMF Palette in order to achieve within the given project brief and the most immediate manufacturing constrains.

Large organizations incline to obtain and utilize samples from current suppliers, already pre-approved for mass production, in order to shorten and maximize production time. For this purposes, companies have own internal materials library and CMF design team to organize processes.

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[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.

Before committing to a final design, physical material and color samples might look good together, but completely different when applied to the product, in different compositions and distributions. There would not be an accurate impression without visualizing the CMF in digitally or physically on the product. A process of visualizing different palette options is the creation of CMF harmonies. These are defined as the composition, which representing the overall distribution and combination proportion of colors, materials and finish, according to the product part break up. The CMF break up of the harmonies should correspond directly with the first, second and third read or the fixed and permanent elements of the products.

CMF harmonies

Product visualization

The physical prototype could be a visualizations as "appearance models". Although computer programs are able to stimulate the realistic visualization with corresponding color and materials variants, creating physical prototypes are really important, especially when products have complex forms and detailed part break ups. This indicates a more realistic sense of scale, composition, look and feel, or the tactile features could not be evaluated without physical model.

Product prototypes

4.6 CMF Development

Once the CMF palettes have been concluded, the process of development begins by identifying suppliers for samples preproduction of new designs. The amount of samples to be developed depends on the complexity of the proposed CMF design elements. Suppliers of different materials and technologies tend to work separately yet simultaneously and in order to properly manage this process. (Becerra, 2016.)

An accurate and clear specifications document should be created for each supplier. Visual and written technical specification document created by designers to guide suppliers. The CMF specification normally consists on an exploded view of the product's elements with corresponding callouts and numbers per part. It is always recommended to include a target sample with the supplier's spec and to keep a duplicate sample as a reference to check back on the results once the development is done. CMF specs tend to be complex documents that take time to be created and require a lot of attention to be prepared. (Becerra, 2016.)

Technical CMF spec

Target samples

Once the CMF specs are done, the next step is to brief the suppliers, which the requested color or finish effect can in fact be achieved with the specified materials. Usually the first loop of development is not satisfying, thus, working with suppliers and manufacturers should be seen as a process of trial and error where new opportunities and restrictions are discovered along the way. In terms of CMF development time frames, it is recommended to calculate for about three loops of sample matching until a satisfactory outcome can be approved for mass production. Product innovation within CMF design truly resides in the accurate allocation of time and resources for R&D, especially when development time and costs are not underestimated or under planned. (Becerra, 2016.)

Working with suppliers

Time / loops

[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.

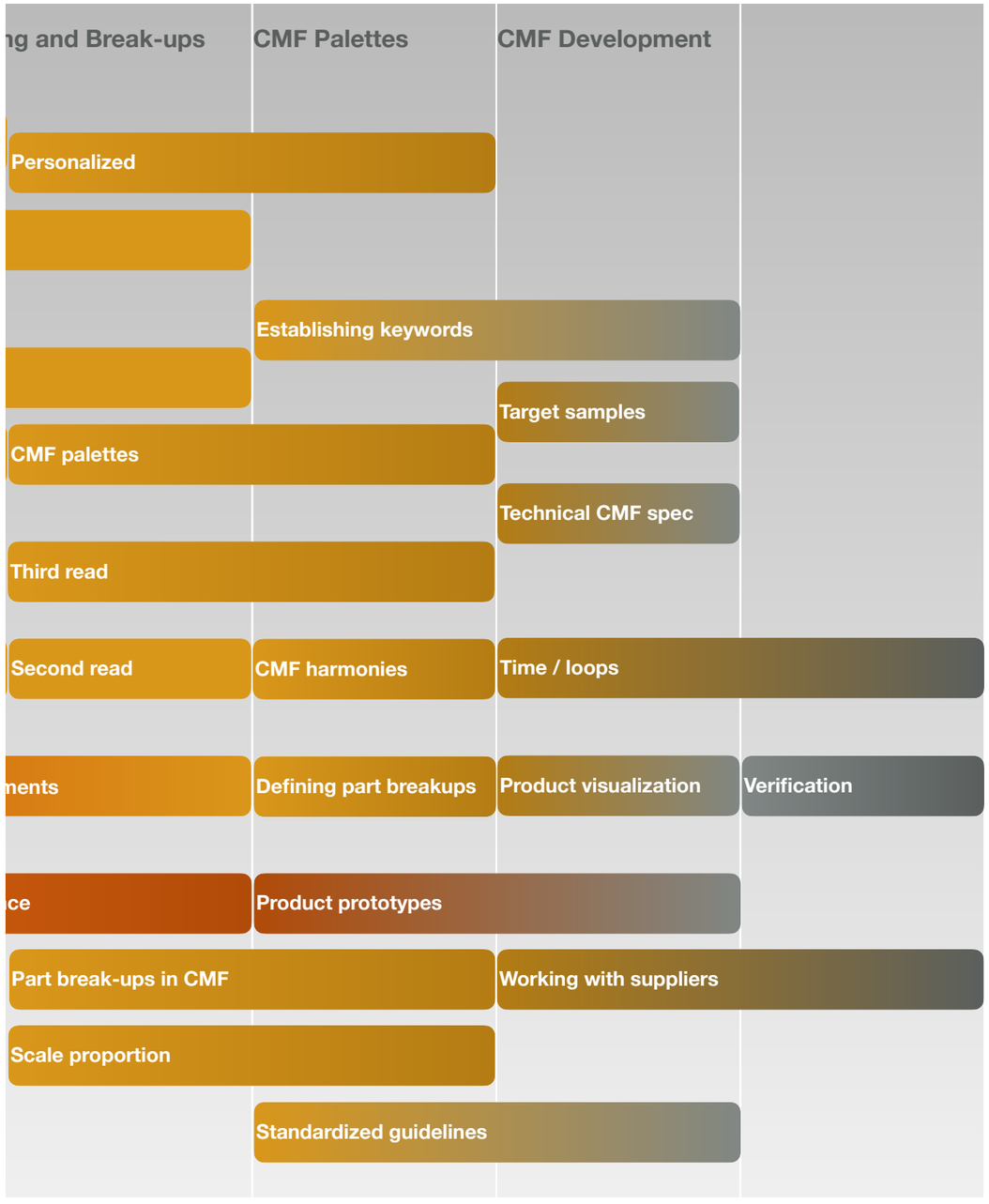

Fig.4.6.01 The late stage of CMF creation process.

The “verification” process is not originally suggested by the author in reference, however, after discussing with practitioners through interviews, they certainly pointed out the importance of verification process, which could be recognized as the premise before committing the delivery for next stages. Sometimes, the verification process could involve professionals or experts from different departments, which participate the meeting to evaluate whether the design meets expectations and what kind of technical support is required from many aspects.

CMF is considered with more flexibility in design process, which often needs to be compromised or changed according to existing restrictions, thus, for CMF designers, the “verification” becomes truly important, not only because parameters and indicators that need to be determined in collaboration and subsequent processes, designers also need to ensure the original design intent could be properly delivered in the “verification” process. (Fig.4.6.01)

Verification

4.7 CMF Process Mapping

There are two maps with representation of CMF design process, “Key nodes” are organized from the initial stage to the completion. The overall structure of the chart has been already explained in chapter 3.0. In addition to the map with “Key nodes”, another version with brief descriptions was represented for quickly retrieving relevant information, which could be more effectively identified for the counterpoint of different “Key nodes”, in order to roughly form an impression of the CMF design process. (Fig.4.7.01)

Since CMF is considered as in Meta-design, the correlation and stages of each process are not fixed, but dynamically based on their respective approaches and external factors, and in real projects, the design processes are often carried out in parallel, the map could only represent a very limited scope. (Fig.4.7.02)

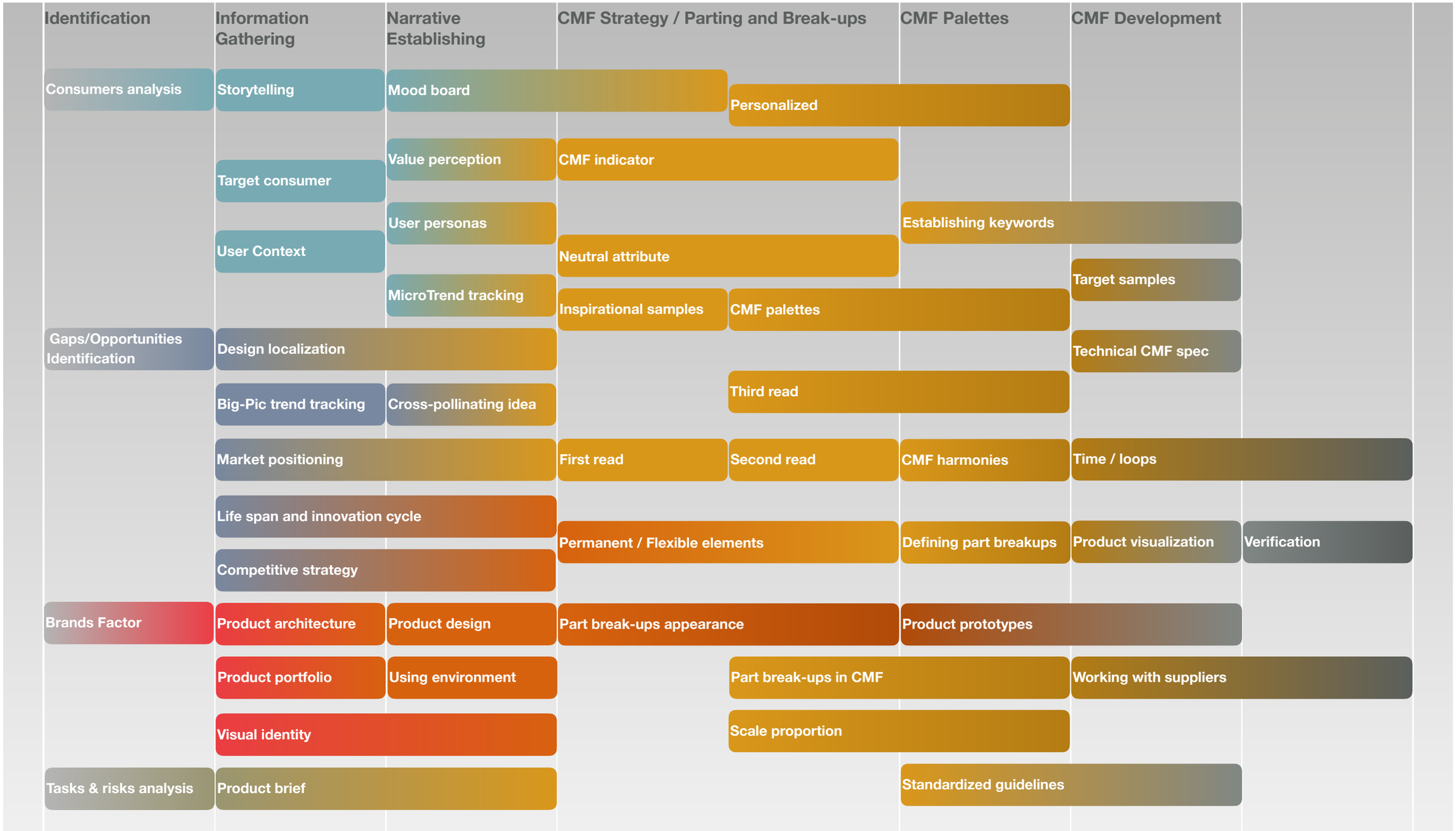

Fig.4.7.01 The map of CMF creation process.

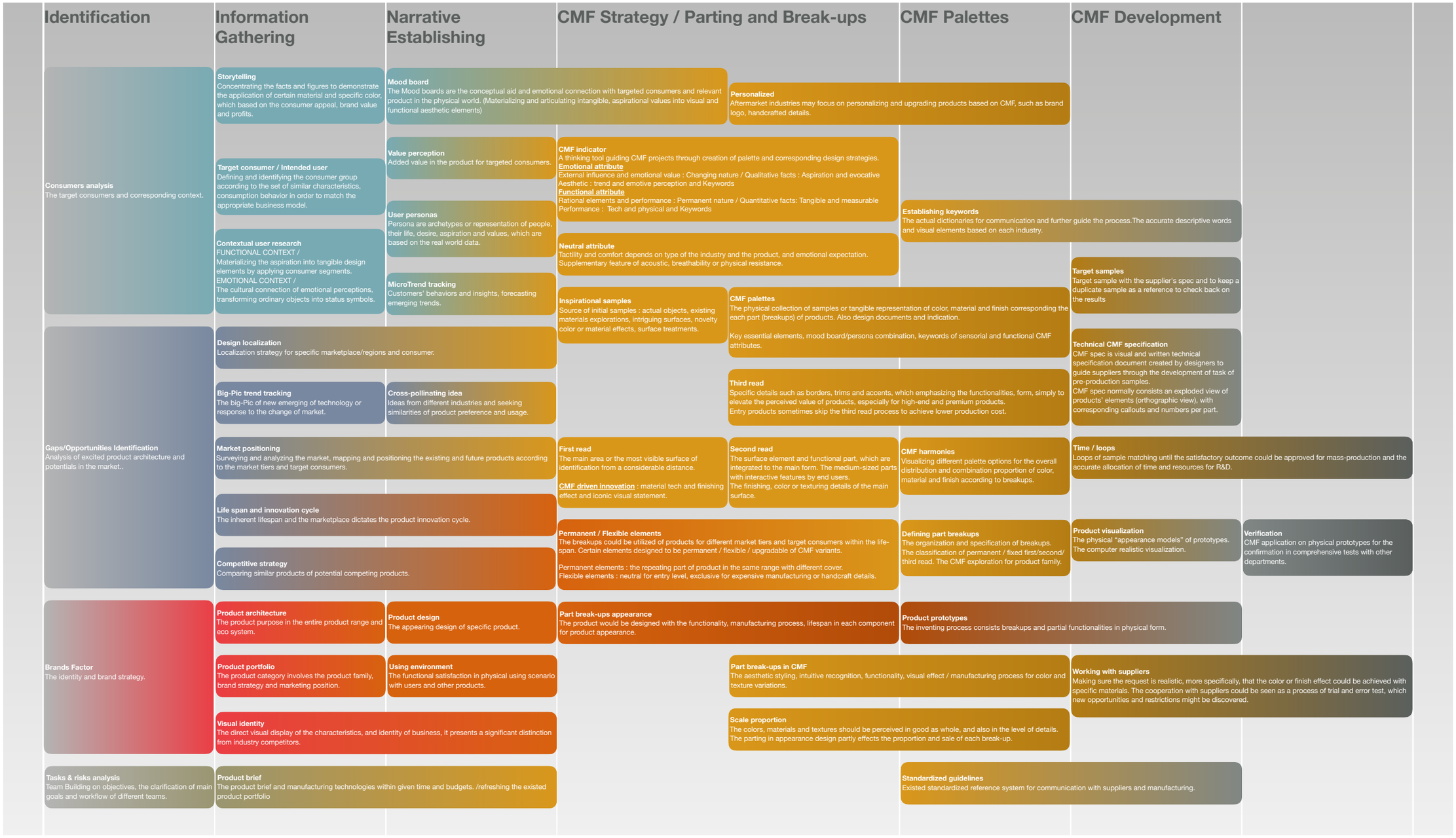

Fig.4.7.02 The map of CMF creation process with the brief description for each.

4.8 CMF Process Mapping (Interview Feedback)

What do you think of this representation of CMF design process in actual work?

Zhang GuoJun (Principal Designer of Geely CMF Department):

First of all, I think that the flowchart you gave is very comprehensive, it accurately describes the actual process of our work.

Compared with the three perspectives provided in your chart, our design process mainly introduces five important factors, including (people) consumers, (machines) products, (materials) specific colors and materials, (methods) It contains processing technical details and engineering related, and finally (context) environmental factors, which largely include market factors.

As the internal design department of an automobile company, we consider a lot of product sales and costs, which is why I think the workflow in the chart is very ideal, because of the cost of consideration, it is difficult for us to comprehensively identify every product in actual operation. However, we will consider all the above factors, but it depends on different projects.

From the user's perspective, the content of "consumer segments" is very important, it is a valuable indicator for us to consider users. It includes analysis of users. For example, companies regularly organize events to collect user's feedback and opinions, but those feedbacks could not directly determine design ideas, not all users provide professional suggestions. But these feedbacks will serve as important references in the design.

In addition, we will create "persona" for the user's lifestyle, such as the user's preference for interior style and fashion preference, which can be considered as the color and material reference for the user's portrait.

In terms of the market, we will carefully analyze the existing competitive products, such as other brands of cars of the same level, and also forecast the industry trends. At the same time, the innovation of materials and processing technology brought by different industries "cross-pollinating", such as electronic consumer products, those will also inspire our ideas in design, which should be regarded as "inspirational samples" to some extent.

For the study of the material itself, we have our own R & D team and laboratory to conduct small batch production and design prototype matching of potentially attractive materials. We call this type of material "x-marks", which represents materials that require a lot of investment to develop. There are also some materials that have been widely used in large-scale production, and we are very familiar with their characteristics. These materials are called "non-x-marks". In the project, these two types of materials will be designed with corresponding proportion according to the different models. In relatively high-end models, the new materials will be more likely to be used in vehicle interiors.

For product considerations, or how to apply materials to products, "part and break-ups" is a crucial part of our work. We need to define the material of each component and be very clear that it is in production. The cost is closely related to the process.

As a simple example, our team and Volvo design team participated in the development of the CMF interior of the new "Lynk & Co" car. Before the specific design work, we did a lot of user research, new material research, market trends Research and how to define this emerging brand, I mean the identity. There are many functional and emotional considerations in this.

Obviously, the interior design in the car is the crucial part that the user needs to contact frequently. In such a small space, any unharmonious factors will remind the user during daily use, this includes visual and tactile consideration, Thus It is a failed design. Therefore, we are very thoughtful about the use of each piece of material, and bold and innovative materials will be more popular than younger users. Their curiosity about new things allows them to accept more cutting-edge designs.

Of course, communication with suppliers is another complicated process, and we will have professionals to coordinate the corresponding work, some of which are closely related to mass production.

What do you think of this representation of CMF design process in actual work?

Wang YuanHao (Senior Designer of COMAC interior design team):

Actually, this seems to be much more complicated than the process I have encountered in my actual work. Thank you very much for sharing this part of the research.

First of all, our work has little to do with the consumer electronics industry or product design, because the parts involved in our work are not mass-produced, or the conventional cabin is partly shaped and not very complicated If it is an innovative design, it is more concentrated in high-class positions in business class seats and first-class cabins. For economy class, our primary design task is to ensure the comfort and functional requirements of seat textiles, and the aesthetic approach is also very simple.

If it is the conceptual design of the seat part of business class or first class, we will consider it more carefully. The design methods involved can be seen in the flowchart, so I think this shows a very complete process. We often use inspiration from the fashion industry and consumer electronics industry to obtain materials and colors, especially the innovative application of certain colors and patterns in textiles.

In addition, since our customers and most of them are various airline companies, they have a very distinctive brand identity, so we will also consider this as an important reference in the design process of colors and materials. The brand factor has a large proportion in the design.

From the perspective of the market environment, because the manufacture and production of aircraft are mainly by two companies, Boeing and Airbus, our company currently does not have many commercial aircrafts developed. Therefore, in this monopoly environment, product innovation and iteration is certainly slow, airlines would like to invest a lower price to upgrade the visual experience, rather than the overall replacement, I think this is an important part of our work in the CMF design process. If this can also be defined as "Permanent and flexible parts”.

At least in my daily work, the functional requirements of the materials are not particularly high, because some materials that require specific performance, such as the frame and support structure of the seat, which industrial designers consider more, and what we provide is from textile with comfort and safety performance considerations, such as flame retardancy and water resistance.

There are some soft materials in the cabin that also undertake specific acoustic functions. Because the entire airport environment is difficult to simulate in a physical manner, it is difficult to imagine dropping an airplane in the office. Therefore, the effect of using computer graphics to simulate colors and materials in actual use has also become an important part of our work. "Material visualization" We will also introduce virtual reality or augmented reality technology to simulate the final effect to evaluate the CMF quality.

CMF PERSPECTIVE

5.0 CMF Perspective and Case studies

The research of “CMF perspective” are mainly based on various case studies of existing projects, by analyzing the design strategy of colors, materials and finish effect from three perspectives, which mainly enclose the approach in brand, market and user experience. Each “perspective” may involve several relevant case studies, through the induction of existing information, reasonable inferences or deductions of the design approach would be proposed, with the analysis of relevant “Key nodes” in CMF creation. The analysis would be considered to provide a different perspective to understand the design intention of color and material in products or in interior space.

The perspective / 1 starts form the **Japanese brand MUJI**, which the idea of color and material plays an important role in its brand philosophy, so that from its products, retail space, various commercial business to the hotels or even home design services, all above are considered as implements of this idea. Several cases studies are introduced to depict the CMF with the "brand attributes" in its products and interior space of its various businesses.

The perspective / 2 concentrates on an eye-catching finished effect, the gradient and **dichroic color trend**. Since trend tracking and forecasting is a representative professional work in CMF, this research including relevant case studies of this color preference by introducing a timeline of its popularity in various fields. This can offer a perspective on how a certain color or finish effect has become a trend or a visual state, widely exists in products and interior spaces.

The perspective / 3 was inspired by **innovations of user experience** through establishing **emotional perception** between people and CMF in products. From the three major categories of aluminum, wood and textiles in Bang & Olufsen’s products, focusing on how the CMF design evokes innovative user experiences and perceptions through products and using contexts, normally interior spaces. The research emphasizes how user experience was formed by engaging a close connection between “emotional attributes”in CMF and human perceptions.

PERSPECTIVE / 1

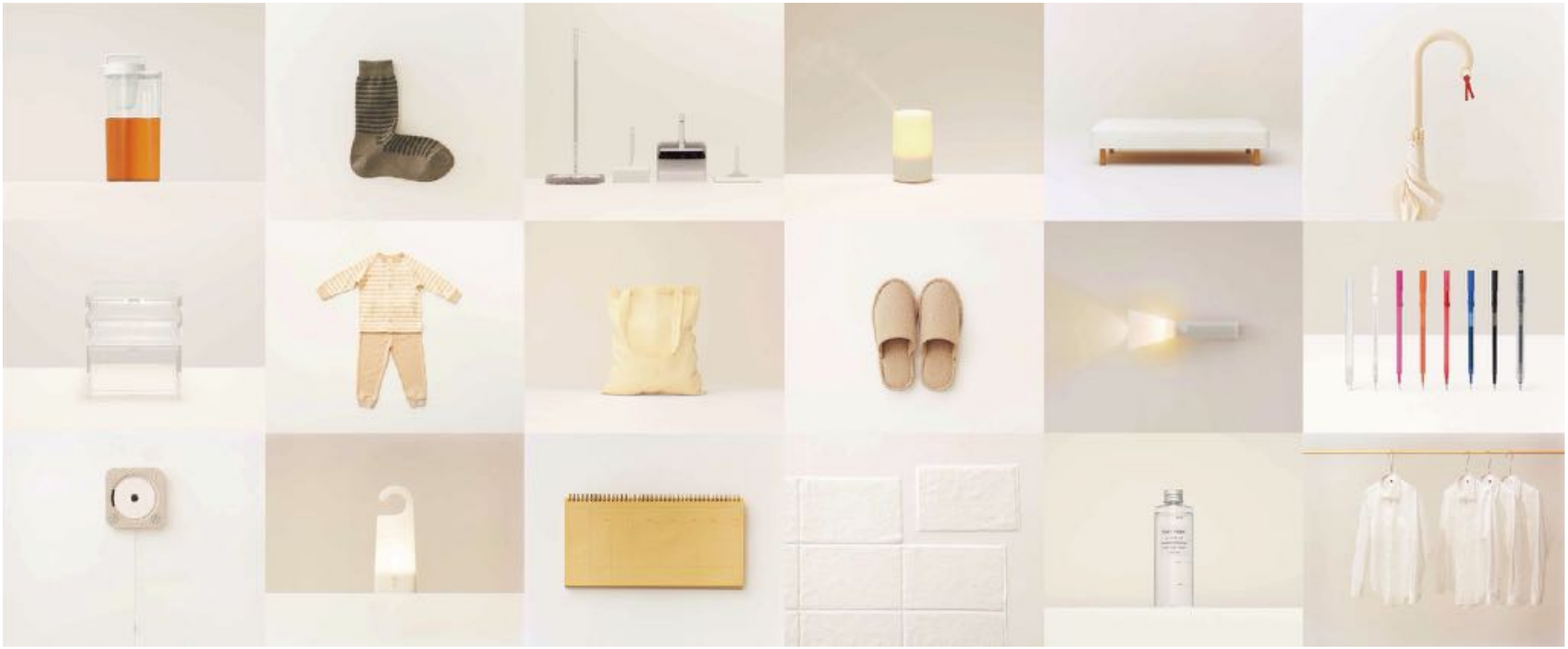

Fig.5.1.01 Typical products of MUJI.

5.1 MUJI

In today's marketplace, brands prefer to process the eye-catching marketing strategies for more attention, Muji keeps its own design philosophy of functional, quality design with the Japanese minimalistic aesthetic offered at a reasonable price, "MUJI is enough" is the key phrase to encapsulate this concept. The brand's relentless focus is on the product and does away with any unnecessary decoration or ornamentation. (Fig.5.1.01)

However, such a "de-branding" company has a unique and strong visual identity of its brand, Muji today carries more than 7,000 items ranging from clothing and household goods to food and even houses. Behind such a huge product system, the consideration of colors and materials in design has been usually talked about with several well-known designers, such as Naoto Fukasawa(深澤 直人), Kazuko Koike((小池 一子) and Kenya Hara(原 研哉). Muji's stores and hotels have consistently implemented the design language of their products, which provides an easier access to research the CMF concept in products and relevant spaces.

5.1.1 The identity of MUJI

Since the 1950s when brands were born in the age of modern marketing, companies have tried to differentiate themselves from their competitors through branding and identity creation. To succeed in the marketplace today, it is not only mandatory for companies to offer high-quality products. In addition to that, a strong brand management practice needs to be in place. Today, it is almost impossible to identify a category leader that does not also embody a certain personality in the marketplace. In comes the Japanese antithesis – Muji 無印良品 (Mujirushi Ryohin むじるしりょうひん), which means "brandless quality goods[25]".

Launched in 1980 with only 9 household and 31 food products, Muji started as a product brand within supermarket chain The Seiyu in Japan. The Muji product range was designed to offer cheap and good quality products and was marketed using the slogan "Lower-priced for a reason". Wrapped in clear cellophane, with labels of plain brown paper and red writing (Fig.5.1.1.01), the original range focused on ways to save the customer money. While other shops only offered intact, perfect slices of dried shiitake mushrooms and threw the remainder ends away, Muji decided to package the ends and sell them. While other shops only sold straight spaghetti and threw away the U-shaped ends, Muji decided to package the U-shaped ends and sell them[26].

Fig.5.1.1.01 The early poster of Muji.

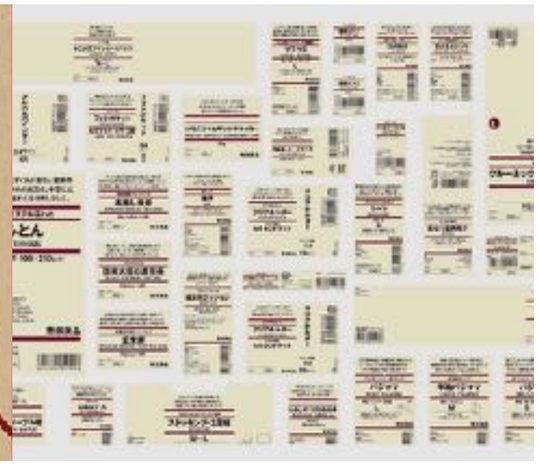

Fig.5.1.1.02 The sample tags of Muji products.

Therefore, the brand is also distinguished by its emphasis on recycling and its avoidance of waste in production and packaging. From its refillable pens, notebooks, bottles to soap dispensers, Muji is indeed making a loud statement in today's world of consumerism.

At that time, Japan was going through the consumer spree brought by the post-war economic take-off. Because of a high conscious of brand effect in consumption. Japanese consumers were willing to pay extra prices for branded products, and their love of brands sparked the emergence of a mass-luxury market where owning expensive, exclusive products seemed essential rather than aspirational.

Muji's generic, brand-less and anonymous products were a statement against the excessive labeling and high price tags accompanying luxury goods. While it was popular at the time to buy a brand-name product regardless of its practicality, Muji had foreseen that a growing segment of the population placed a premium on functionality, affordability and quality over marketing hype, inflated price tags, and status symbols[26].

The philosophy of simplicity and universality has indeed seen in all products by this company through its entire development. With the absolute basic specifications available. The company's persistent non-branding effectively became its unique identity. With packaging kept to a bare minimum and limited natural colors, products are aesthetically attractive to customers who prefer unbranded products. It examines products through three lenses, as articulated in its three product development priorities: material selection, process streamlining and packaging simplification. Muji searches worldwide for the most suitable quality raw materials, even materials that are typically discarded by other manufacturing companies. Processes that have no bearing on a product's quality are eliminated.

For instance, if the bleaching process for pulp is omitted, the resulting paper is light beige in color. Muji realized that this paper can be used for its packaging and labels as there is no additional value in bleaching the paper to turn it white (Fig.5.1.1.02). The resulting paper is remarkably pure, natural and refreshing when combined with its products – a large contrast to the over-embellished products in the marketplace[26].

[25]. Ryohin Keikaku. (2016), 企業情報 *Corporate Information.*

[26]. Martin Roll. (2019), *Muji – The Global Strategy Behind The Japanese No-Brand Brand.* www.martinroll.com.

5.1.2 MUJI's Philosophy

Muji's "conservative" strategy of CMF has compressed the practical use of colors and materials in thousands types of commodity to a very limited extent, which is directly related to its unique design ideas and brand philosophy. Muji's products are not attributed to individual designers. While it has stated that some of its products have been the works of famous international designers, one of the most well known is Naoto Fukasawa and his "Without Thought " design.

In this concept, by observing the people's subconscious behavior, the design of products has to achieve an object "without thought", that is able to meet subconscious needs rather than create new ones or attract unnecessary attentions. There are examples that is always taken out to explain this design concept, the banana packing and the notch on the umbrella handle.(Fig.5.1.2.01/Fig.5.1.2.02)

"Finding ideas in people's spontaneous behavior and realizing these ideas in design is what Without Thought is about." Said notable Japanese designer Naoto Fukasawa. As Naoto Fukasawa explained, Unconscious is not equal to without thinking, but a reaction made by parts of body based on the prior or existing daily experience and knowledge stored. It does not take long for this "unconsciousness" to surface. This belongs to a natural way for people to interact with products[27].

The approach that Naoto Fukasawa wanted was to observe and to distinguish people's spontaneous behaviors in design, in order to stimulate a natural unconscious interaction between people and objects. In this way, the appearance of a product will no longer to tell people how to use with detailed instructions, but a trigger that encourages people to do something and to be engaged in the action when they see the product.

Take the MUJI CD Player as an example (Fig.5.1.2.03). The original design intention of this Cd player with shape as the kitchen fan attached on the wall. There is a string hanging down from the main box and that reminds you a switching operation like the fan in the kitchen. When you attempt to pull the string, and once you do that, this behavior has an interesting coupling with your previous simple operation, like the same action of switching, the player will be turned on successfully[28]. In this case, the key point is using the string of the kitchen fan to remind users of the intuitional action , pulling the string. And this design philosophy was applied to Muji's products, which Nato Fukasawa explained:

"The first thing I designed for MUJI was this CD player. Everything in our lives is integrated. In other words, unified. It's not just a thing. You pull the string and the music flows out as air flows. It's the entire physical sensation. From the perspective of MUJI fulfilling the consideration aspect of this experience, I think this CD player expresses this thought in a straightforward way[29]*."*

Fig.5.1.2.01 The sample tags of Muji products.

Fig.5.1.2.02 The sample tags of Muji products.

Fig.5.1.2.03 Muji CD player in Muji Hotel, designed by Naoto Fukasawa.

[27]. Naoto Fukasawa (09, 2006). *Naoto Fukasawa: Without a Thought.* Design Dwell magazine.

[28]. Peizhong Xu (2013). *"Without Thought" Philosophy of Design Applied to Product Design.*

[29]. MUJIglobal.(2015), 深澤直人 Naoto Fukasawa. *Micro Consideration*. https://www.muji.com/us/flagship

"Without Thought" is a phrase that I like to use. MUJI starts by thinking of things that we do naturally and without thought, always thinking about what is most appropriate for day-to-day living. Oftentimes, people regret buying too much or eating too much. Therefore, MUJI achieves the ultimate level of comfort in what is "Just Right[29]*."*

"This is how MUJI thinks of all of its products, such as the mattress with legs, rather than a bed, or a shelf with a minimum amount of structure, and polypropylene boxes that make organization easy. MUJI is continuously counter balancing its position against society in order to give harmonies to people's lives[29]*."*

"I think the making of a product is about drawing a line within a space. It is the line in the center that remains balanced no matter how much pressure is applied from either side. All of us at MUJI are united in drawing this one harmonious line. Of course, finding the size that is "Just Right," and for example, a thickness for table legs and tabletops that is "Just Right," is what we are constantly considering[29]*."*

Nato emphasized the a connection of the experience, from the interaction between users and products to the integration between individual products and series. When the single product is weakened to just meet its basic requirements, the combination of products achieve a certain compatibility, to avoid the abrupt between. Muji's design attempt to build the using experience with a reasonable expectations for the product instead of highlighting the product's own characteristic.

In terms of processing and materials, MUJI chooses the easiest processing methods and the materials that are "Just Right." As a result, MUJI offers a very compact lifestyle without things being too big. Let's take a look at the complete modules and the lifestyle that comes from our ideas about this kind of compact living, or what we call "Compact Life[29]*."*

"In the project, we have standardized basic dimensions of storage products, which were initially varied, based on our module design concept. In addition, thinking about the "Compact Life" concept. In the project, you can see the very minute level of detail with so much micro consideration. MUJI believes that people deserve the leading role in life, not things. MUJI aims to provide the background, to play a supporting role to you, the leading actor[29]*."* (Fig.5.1.2.04)

Fig.5.1.2.04 Muji's products in its "compact" storage system.

5.1.3 Color and Material in MUJI's Products

This directly determines the CMF approach in its design strategy of products. The color and materials in Muji's products are normally processed into the state, which the substrate conforms to its most familiar appearance in people's impression.

For example, the colors of almost wooden components in Muji's furniture are classified with only two types to commit the demand of "Just right". The lighter Oak to create the general sense of natural, which are largely applied as the main tone with numerous application in Muji store and Muji Hotel. (Fig.5.3.04) This beige wooden finish with open grain, which is in line with people's overall impression of the color on wood products without fine processing. This expressed the original state of natural wood. And about this consideration, Nato Fukasawa indicated:

The Japanese word "manma," which means "as-is," has been used for a long time. Materials, as they are. Natural flavors, no flavors added. Based on this concept of natural appearances, with no dressing up, product development begins with the materials. Linen is one of these. There are some products in which wool from animals is also used as-is, without any added colors. Material coloring is another point of definition. MUJI uses natural dyes that are made of plant parts that are usually thrown away. Rose stems, for example[29].

[29]. MUJIglobal.(2015), 深澤直人 Naoto Fukasawa. *Micro Consideration*. https://www.muji.com/us/flagship

Fig.5.1.3.01 Muji’s packing paper.

Fig.5.1.3.02 Muji’s Pulp storage units.

Fig.5.1.3.03 A collection of Muji’s products.

Another iconic color is originally from the kraft. In terms of packaging, Muji uses bulk, standardized packaging(Fig.5.1.3.01) to highlight the natural colors and shapes of its products, while at the same time conserving resources and reducing waste. Either Kraft paper products or the pulp[1] furniture system (Fig.5.1.3.02), the slightly rough surface and color is recognized as a more direct relationship with raw materials, with a visual similarity to the beige color of wood products.

For artificial materials, "White product" is another visual identity of Muji, made of different plastic materials or even metal, such as SOFT Polypropylene and Polyethylene. Unlike the current large number of products that give plastic items a higher sense of value through advanced surface processing technology, this uncolored “plastics” are not intended to emphasize the added value of the material, but to meet the common perception of plastic by users, so this “white plastic” product has a sense of prototype with a lower processing degree. Compared with plastic products that are delicately camouflaged, Muji's products appear more natural and closer to the original texture of the raw materials.

However, even if they are all white substrates, different processing techniques create a variety of finish effects, the senses and using experience will also become rich. (Fig.5.1.3.03) This simultaneously satisfies the unified visual perception and differentiated use experience in details.

In the analysis of CMF approach with functional, emotional and neutral attribute in Muji’s products. An obvious emotional attribute of color and material in Muji is the natural perception in the product. Not only the raw materials are taken from nature, wood, bamboo or rattan, but even the processing methods of natural materials are treated as "minimalism" to ensure their functional properties of “Just right”, so that the original surface characteristics of the materials could be displayed.

And the “Just right” philosophy of artificial materials in products could be seen as environmentally friendly or recycled materials with the most basic processing methods to reduce the burden on the environment in manufacturing, is a design concept with anti-consumerism thought. About the functional attribute in the design strategy, Muji does not shape its products to extremely high quality and durability, but defines its material design strategy to just meet the product's life cycle.

In the Muji's complex product families, the different components are made of corresponding materials with each approach, for example, the compact storage system could disciple a lot. In the steel unit shelf, this modular system, the steel frame as the skeleton with several specification (Fig.5.1.3.04), the corresponding modular storage units are flexibly installed in this frame, Muji introduces this diemsion with the concept of Japanese building size units "saka(尺)" and “ken(間) [30].”

1. Kraft pulp is darker than other wood pulps, but it can be bleached to make very white pulp. Fully bleached kraft pulp is used to make high quality paper where strength, whiteness, and resistance to yellowing are important.

[30]. MUJI. (2020), *Standard Module Design,* https://www.muji.com/hk-en/campaign/20SS_storage/size.html

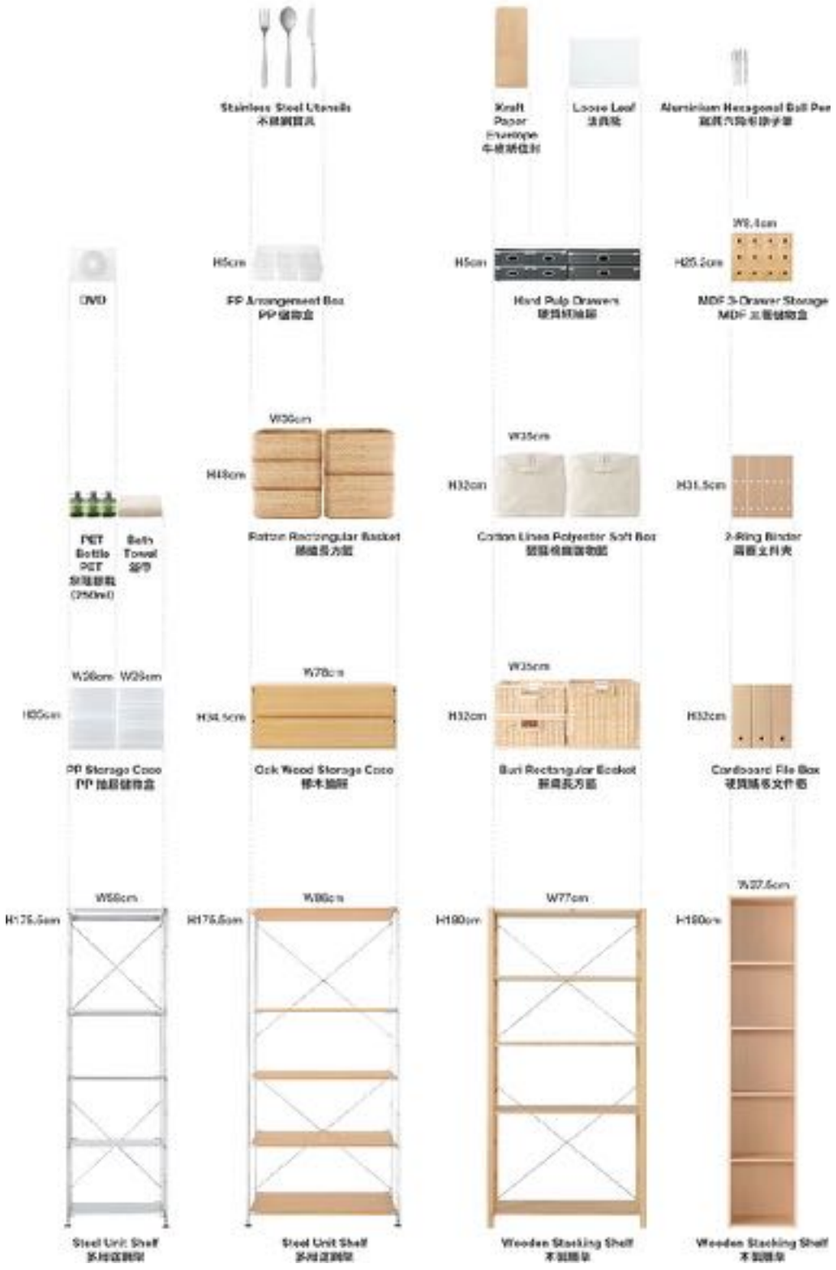

Fig.5.1.3.04 The schematic diagram of Muji's storage shelf and its product matching.

Fig.5.1.3.05 The Muji *Compact storage* components.

Fig.5.1.3.06 The Muji *Compact storage* components.

These metal frames form the main stress-bearing components in the system and are also the parts that require the most durability and rigidity. In this way, the polished stainless steel with metallic luster is in line with people's understanding and expectations of metal performance, the steel frame has only this finished effect.

And the internal components such as shelves or side panels have more flexibility, which are made by medium rigid and durable materials, in contrast to the main frame, both the wooden laminate and the bent metal sheet are processed by matte finish rather than glossy reflective surfaces[31]. The relatively smooth surface provides enough friction while also having a certain degree of wear and scratch resistance. (Fig.5.1.3.05)

The storage units are made of light and softer materials such as PP plastic, kraft paperboard, woven rattan or bamboo products. The durability and rigidity of these materials are far less than the above. As the most frequent and interactive parts with users, the design approach of these materials is closely related to the sense of touch and weight. The colors and materials application of these parts form a direct visual and tactile experience. And compared to the shelf, the lifespan of these components are shorter. (Fig.5.1.3.06)

[31]. MUJI. (2020), *Muji Furniture Catalog.*

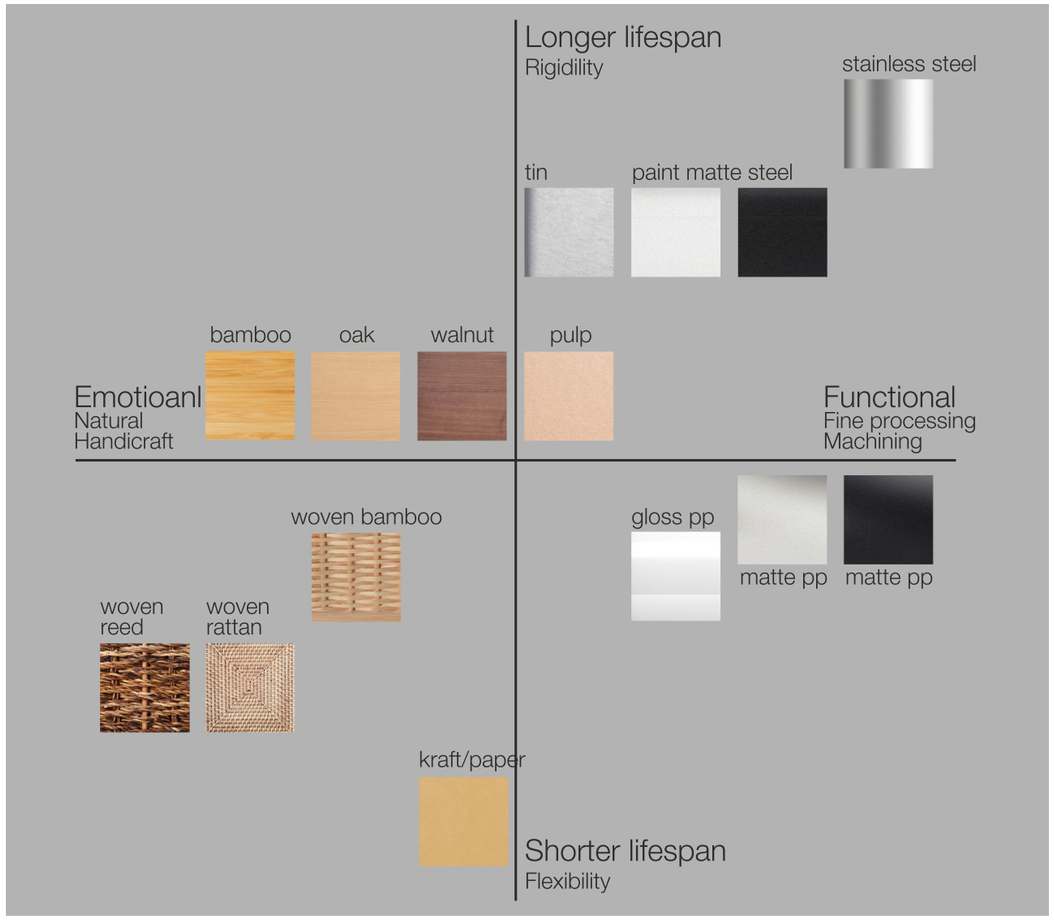

Fig.5.1.3.07 The general materials in Muji *Compact storage* components, distributing in lifespan and functional/emotional dimension.

Based on this example, a chart (Fig.5.1.3.07) briefly represents the weight between functional / emotional attributes and lifespan might be helpful to understand this approach. In this diagram, the materials are placed in two orientations, one indicates the general performance like the rigidity or the material strength. In this dimension, the paper and Kraft components tend to designed as consumables that need to be changed frequently, natural woven and plastic PP components are mostly designed as moveable storage units. In contrast, wooden panels and bending steel plates as shelves are mainly bearing the contents and installed to the frameworks, which are processed in glossy stainless steel. Distributions on emotional / functional axis are classified from most natural perception to fine manufacturing appearance, or in tother word, a sense of artificial and machining. The materials in this diagram only involve the relatively common materials in “Compact Storage” and home furniture. This may partially reflects the application approaches of materials in products.

In a wider range of Muji's products, colors and materials are orderly applied on daily products, clothing and furniture etc. A research of a general color appealing of Muji’s products provides some interesting aspect of its color design approach. This research was held by three students at China Academy of Art, 420 different products are selected as samples in the Muji store, after merging some similar colors on products, 44 representative colors were chosen for further research with proportion analysis, to roughly describe the frequency of colors in the Muji's product system. Since there was no practical and professional color extraction equipment in this study, samples would be considered as the color that roughly represents the products.

In the map of “Proportion of the colors”, selected samples were classified into the increasing sequence of color frequency in products, which the length of colored bar indicates the number of occurrences of the corresponding color. Another map at the bottom indicates the same result with the proportion represented into the block diagram with scaled areas. (Fig.5.1.3.08) Each one has a specific title to briefly disciple this color with material, because some of them are pretty similar, which are originally from different materials, such as wooden beige and Kraft beige.

The 44 colors were later reorganized into 8 larger categories with the number of color application in 420 items, which based on the similarity of hue, named from top to bottom in the chart, according to the proportion from larger to smaller. (Fig.5.1.3.08) They are “(Approximate) White”, “(Light) Grey”, “Beige (Sand)”, “Dark Grain”, “Terra-cotta”, “Rose Quartz and Serenity”, “Greenery”, “High saturated points (Various hues)”. Among them, transparent or translucent application in products are classified as (Approximate) White category and the smallest proportion with high saturated colors has been taken separately in this map.

Since complex patterns rarely appear in Muji’s products, which makes color prefer to play a more important role in the visual identity of products. This color strategy is also inseparable from the consideration of materials and finishes in Muji’s design approach.

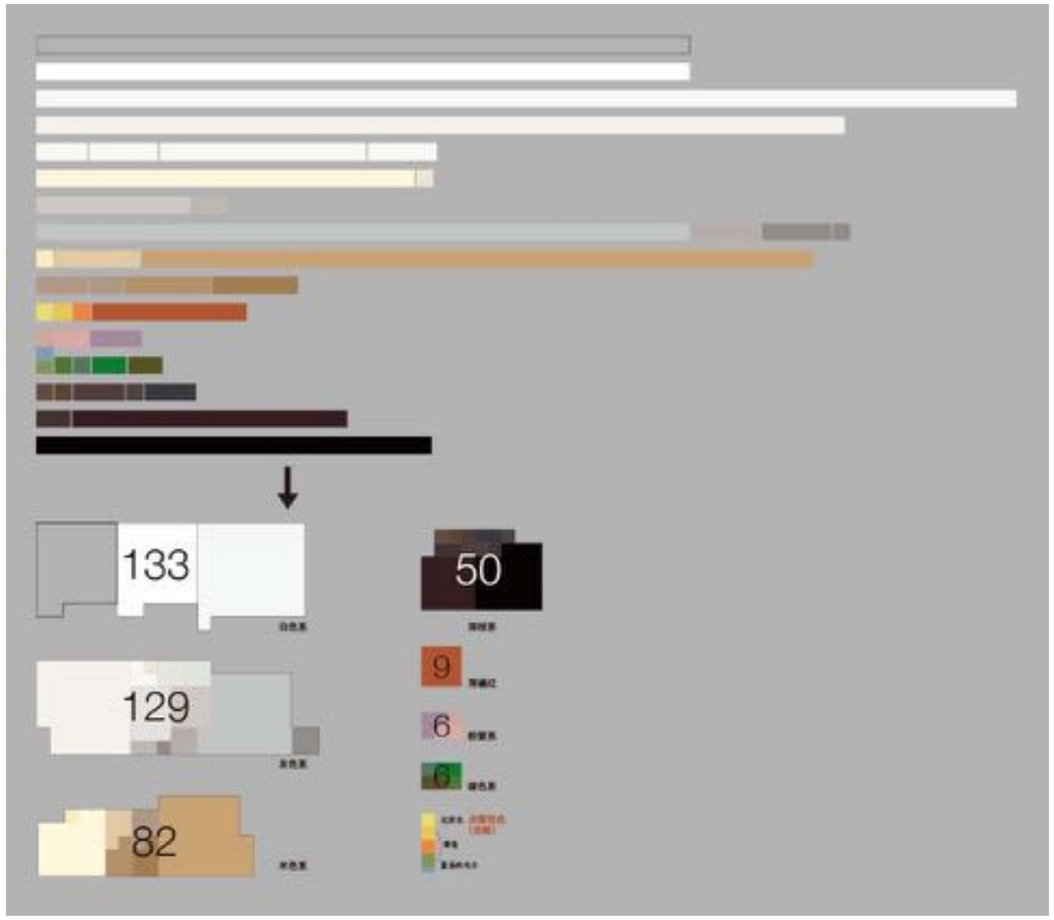

Fig.5.1.3.08 The color categories and frequency in 420 products with amounts, statistics by Zhu Ningli, 2013.

This map depicts typical colors with lager area, such as white series, lighter grey and beige. Although there might be subtle deviations in specific color collecting in this study, and the coverage of samples was not even comprehensive, especially considering the total amounts in Muji's product architecture. However, this chart could still represent the the color appealing in products to a certain extent.

A rough classification has been organized according to the materials and finishes appealing of Muji products on its official website and catalogue[31]. All conventional products in retails have been

Fig.5.1.3.09 The cover of Muji Furniture Catalogue .

Fig.5.1.3.10 The inner page information of Muji Furniture Catalogue.

published on the website with product manual, which provides relevant information of dimensions, materials and finish treatments and installation notes. (Fig.5.1.3.09)

However, the specific materials and processing technology of some "wooden" furniture are not clearly marked, which is different from IKEA's detailed labeling with each product. Some curt indication of material information causes some question or suspension of the actual use (Fig.5.1.3.10). Steel unit shelf as the example, the internal unit named "Stainless Unit Shelf Oak 2 Drawer", no clear information to indicate whether the practical use of the shelf board in this furniture is the crude oak product with cutting process or fiberboard/multi-layer board with wood veneer.

In Muji's products, a large number of light-paint oak products or oak grain veneer finish effect have become the main appearance of Muji's wooden furniture, and some of them have another choice by darker paint of walnut colors, and the wood grain effect are prefer to be unified as similar on different components. For example, both the components of solid wooden frame and multi-layer boards covered with veneer, the surface effect of light oak is surprisingly consistent.

Colors like beige, sand or light brown are normally seen in some appendix or storage units, which are made by kraft paper, natural rattan harmoniously combined with the wooden furniture.

[31]. MUJI. (2020), *Muji Furniture Catalog.*

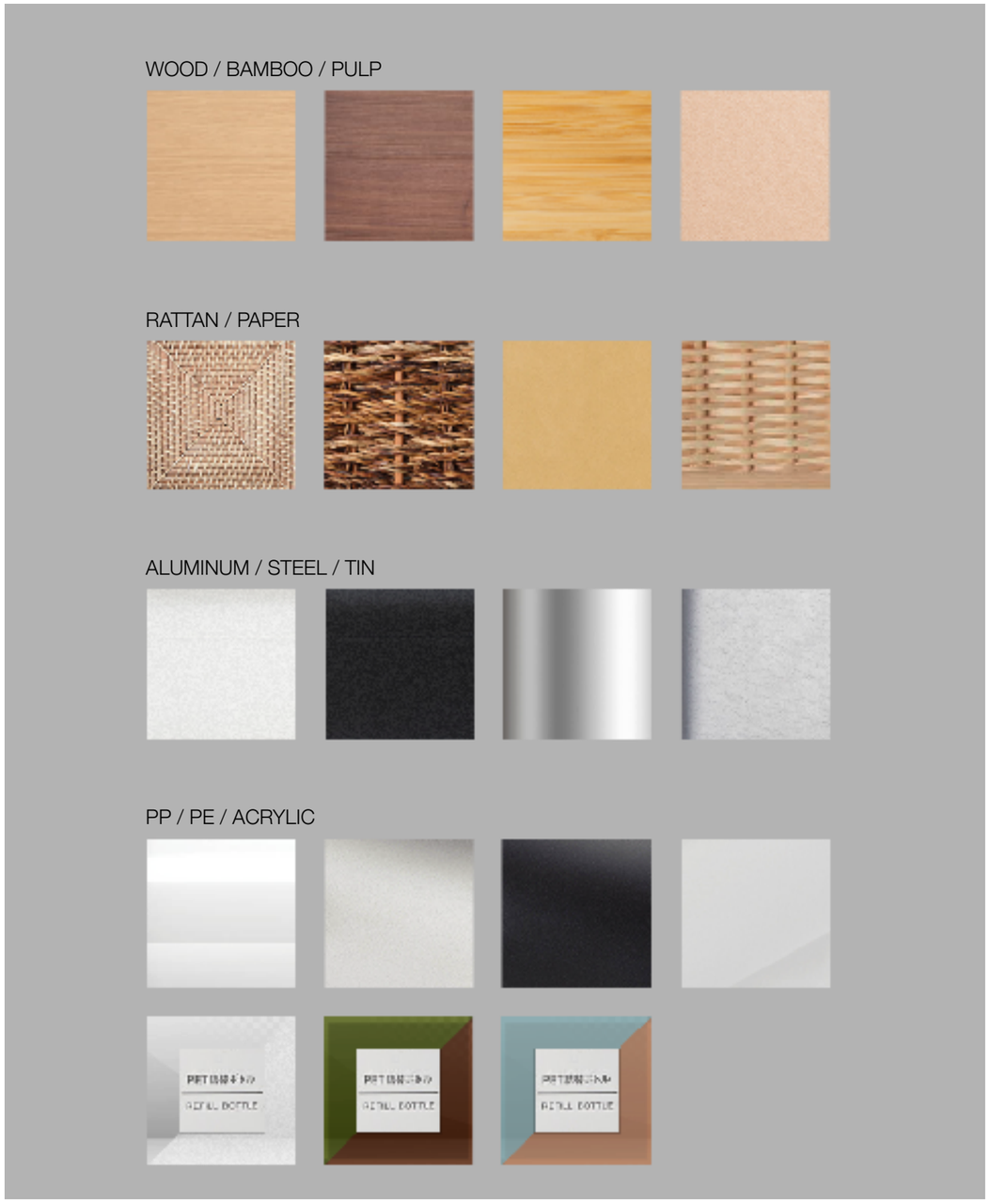

Fig.5.1.3.11 The brief classification of representative materials in Muji's products.

Despite a certain variation of colors in textiles, only a few representative colors and finish effects in the chart (Fig.5.1.3.11) could almost cover the appealing of Muji on natural materials, metal structure and plastics products. The material of many accessories and appendix in the regular modular furniture, which are woven by rattan or bamboo.

On the one hand, it enriches the visual and tactile experience while using raw natural materials. On the other hand, the weaving process is direct exposed to evoke a feeling of reminiscent of traditional Japanese culture among the craftsmanship. Even if with this simple process, it can create a rich perception experience, and there is no disharmony to match the furniture system with an industrial sense.

The types of color and finish effect of metal parts in products are also very limited, mainly including white / light gray or dark gray / black matte surface with powder coating or polished stainless steel. In addition, a large number of plastic products (the ingredients include PP and PE) are also designed as white or translucent to transparent products with different smoothness or gloss. (Fig.5.1.3.12)

Metal components are weakened into functional components in the furniture system, and the finish effects are usually treated as black and white powder sprayed or polished stainless steel for easy maintenance and cleaning. A few tin alloy products are mostly used in outdoor environments.

Fig.5.1.3.12 A typical composition of Muji modular *Compact* storage.

Beside Muji’s iconic “white plastic” (Polypropylene and Polyethylene etc). The packaging design of Muji's cosmetics are developed with more colors to indicate the difference among various effects, however even these emerging color preference are still within the existing color and material approach, with frosted surface effect and lower saturation. (Fig.5.1.3.13) In addition, Muji's color strategy on fabrics and textiles is also more incline to natural materials with low saturation dyeing or monochrome blended materials, sometimes, dark denim fabric could be seen in products. Of course, the fabric here does not include the fabrics of the Muji clothing brand. (Fig.5.1.3.14)

There are more than 7,000 different products[32] displayed in an orderly manner in Muji's global stores, and the types of products are constantly increasing or updating. For this, Muji spent a long time to sort out a set of their own management manual “MUJI GRAM”[33]. This manual series of more than 2,000 pages of business management guidance contains detailed specifications from how to establish a store, team building to daily operation and maintenance. It is very detailed, but the content in this manual belongs to the company's management confidential and is rarely disclosed.

The manual mentions how to help customers understand the product information to the greatest extent. The expression on the product display is the similar products and their regular arrangement, and the label of each product is consistent on the shelf. (Fig.5.1.3.15)

Fig.5.1.3.13 Muji’s cosmetics package.

Fig.5.1.3.14 Muji *Beads Sofa (Bean Bag).*

[32]. Ryohin Keikaku. (2009) *What is MUJI?*.

[33]. 松井忠三 (2015). 解密无印良品, p. 46-50

[34]. MUJIglobal. (2015). *Takashi Sugimoto Works for MUJI.*

Fig.5.1.3.15 Neat shelves display in Muji stores.

5.1.4 Color and Material in MUJI Store

There are more than 900 Muji stores around the world, and it is still expanding. Although Muji has carried out appropriate localization work according to stores in different regions, which contains the language translation of product information, printed products, etc., however, any where inside the store, the design of the interior space is always surprisingly consistent, and customers will clearly feel the specific atmosphere created by Muji. (Fig.5.1.4.01)

“The first MUJI store opened in 1983, a little over 30 years ago. It was a fairly small store, and it was from this small space that MUJI started. The biggest difference between then and now is that MUJI didn’t have as many products. Since the first store, we grew to the hundreds of stores we have now. But we still use the same materials, and our concepts have not changed.[34]”

As one of the Muji’s founders, Takashi Sugimoto suggested the design of Muji stores.

The interior design of the store is proposed to provide a space for communication between consumers and Muji’s products, and he also mentioned another very inspiring idea about how the single product disappears on the shelf, thus forming a customer's general impression of Muji rather than only focused on specific commodities. (Fig.5.1.4.02)

Fig.5.1.4.01 The cashier in Muji store.

Fig.5.1.4.02 Neat shelves display in Muji stores.

“Products may end up going off on their own. For example, say we sell a certain product in our stores this summer and then again next year. We can’t always sell the exact same thing. So we end up perfecting products… trying to add a competitive edge to a product. When the number of products increases and they sell well, these products end up moving on their own toward perfection. They take on a life of their own. A certain “allure” that doesn’t naturally exist with a single product is inevitably present when products are set in rows on store shelves.[34]”

This statement provides an interesting perspective on how to view and think about the display strategy of shelves in Muji stores. When the products are very neatly arranged on the shelves, people's impression of the product is more inclined to engaged with a specific color or material, which could be attributed of the CMF strategy in Muji's product design, most of the single product is applied with the same or similar materials or colors. When they are formed into a group on the shelf, a unified visual experience will be perceived by consumers from a certain long distance. Therefore, consumers were initially attracted to a certain color or material, and then getting closer to find more information about this product. (Fig.5.1.4.03)

People’s attention not to be distracted too much on all products, but more on needed ones. For those are out of sight, which are prefer to be well integrated into the surrounding environment.

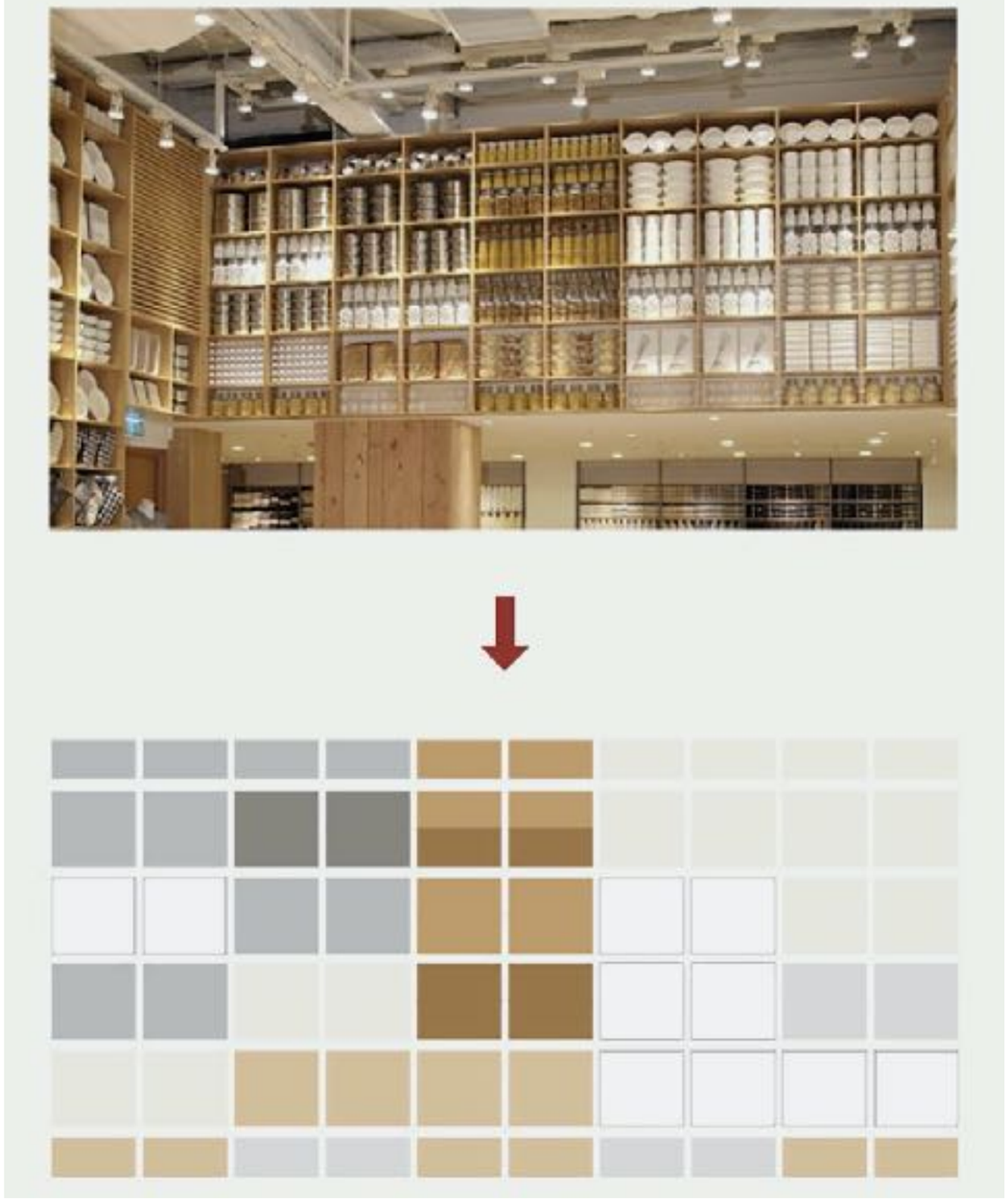

Fig.5.1.4.03 A diagram to Simplify the shelves display into color blocks, statistics by Zhu Ningli, 2013.

[34]. MUJIglobal. (2015). T*akashi Sugimoto Works for MUJI.*

So as far as the application of colors and materials in interior space is concerned with the original intention to serve the products. Takashi Sugimoto also affirmed this premise.

“The theme I most want to address in all of my work is “living life.” Needless to say, for MUJI, it all comes down to the products we sell. We have to sell products, and to do that, we have to keep prices down and get rid of the frills.[34]”

In such an environment, the product becomes the main interface and interacts with consumers. The ceiling surface and the ground are extremely weakened into a single color or material. Normally, the electromechanical facilities in the building are exposed and there is no additional suspended frame.

You would rarely see any complex pavement on the ground in Muji store or any settings with strong visual elements. The colors and materials that originally applied to the interior design were replaced by the colors and materials of products themselves, and the shelving from the ground to the top formed the concept of the "wall" in interior space. (Fig.5.1.4.04)

From the Similarity and Proximity principle in Gestalt laws of grouping[35] (Fig.5.1.4.05), human perception tends to observe repeated things as a whole within a certain distance, a natural and calm color preference in Muji's “conservative” CMF design could effectively avoid the messy feeling when the products are organized in similar colors and materials, a large number of products share the similar colors or materials. Once they are placed on the shelves uniformly, they are visually integrated, and tightly packed with the grouping strategy strengthen the overall sense in visual perception, even if the shelves have occupied almost vertical space of the interior. (Fig.5.1.4.06)

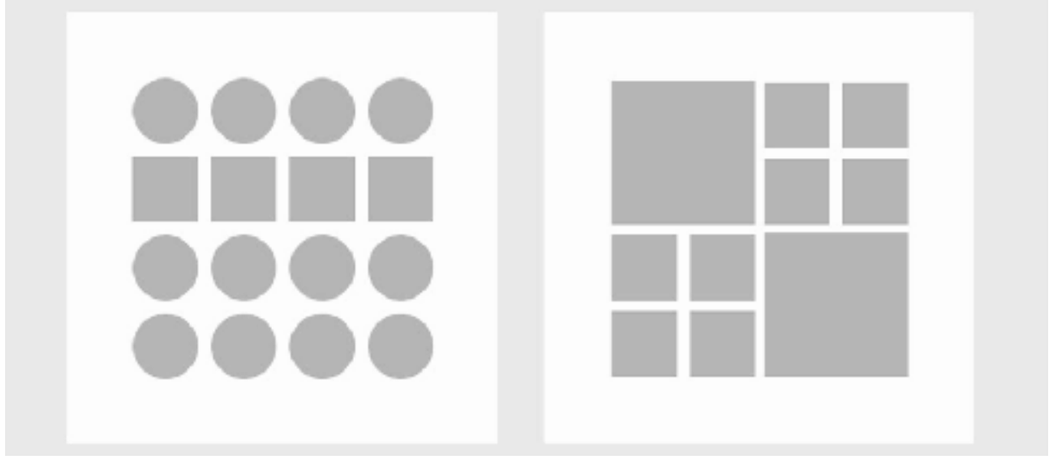

Fig.5.1.4.05 Gestalt laws of grouping / similarity.

Fig.5.1.4.04 Muji Promenade, Santa Monica, California, US, 2018

Fig.5.1.4.06 Muji Promenade, Santa Monica, California, US, 2018

[34]. MUJIglobal. (2015). T*akashi Sugimoto Works for MUJI.*

[35]. Soegaard, Mads. (2012). *Gestalt Principles of form Perception*, Interaction Design.

Fig.5.1.4.07 Muji Promenade, Santa Monica, California, US, 2018

When trying to summarize the most visible colors in MUJI stores, the results are often strongly linked to the color systems of their products. In the interior space, the visual perception of strong colors will be enlarged by the size, for example, the color setting on the ceiling, the ground and large-scaled walls. The light beige, darker grey/ black is most seen in the product system has been widely applied to the main visual surface. (Fig.5.1.4.07/ Fig.5.1.4.08)

Fig.5.1.4.08 Muji Promenade, Santa Monica, California, US, 2018

A brief representation of color and material strategy in the interior of Muji Promenade suggests a similar tone between the colors in the space and the colors of products (Fig.5.1.4.09). This effectively blurs people's perception of interior space and rather to pay more attention to products.

Indeed, Muji has many other business types, in line with its brand design philosophy, more innovative attempts of colors and materials are applied to the latest interior spaces.

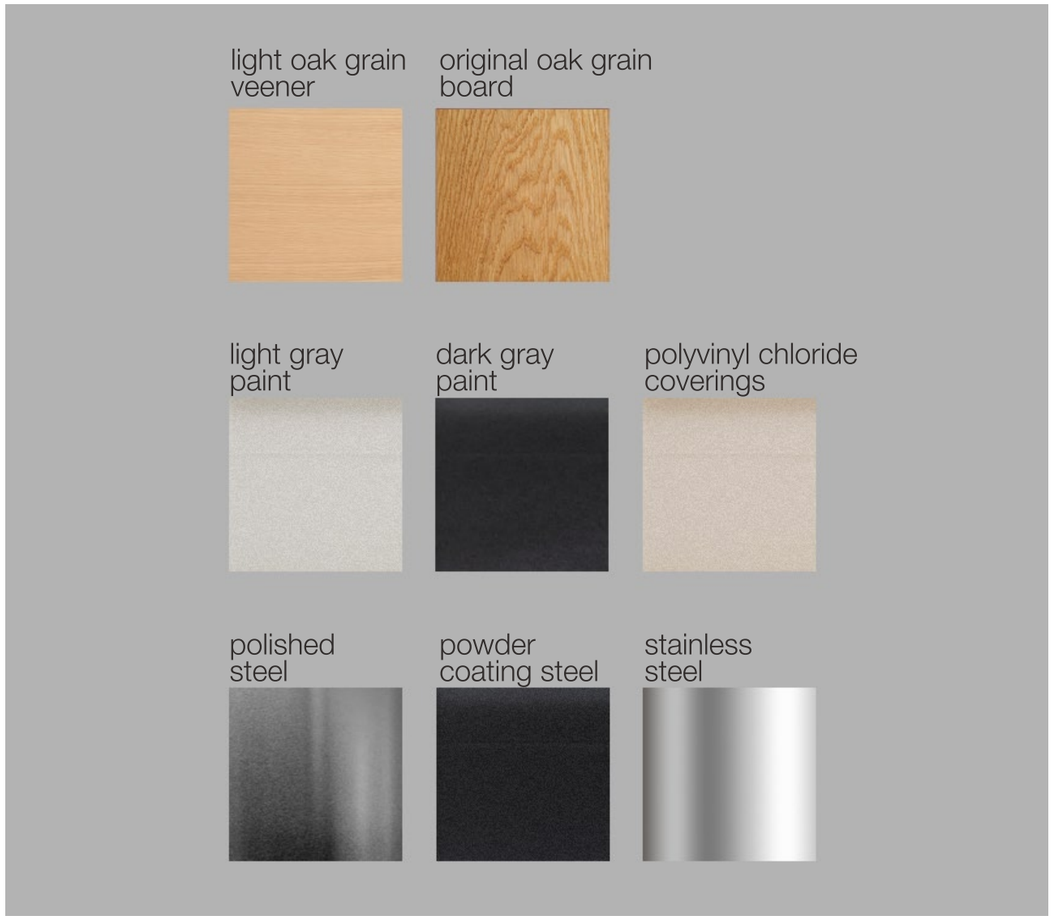

Fig.5.1.4.09 Main materials representation of Muji Promenade.

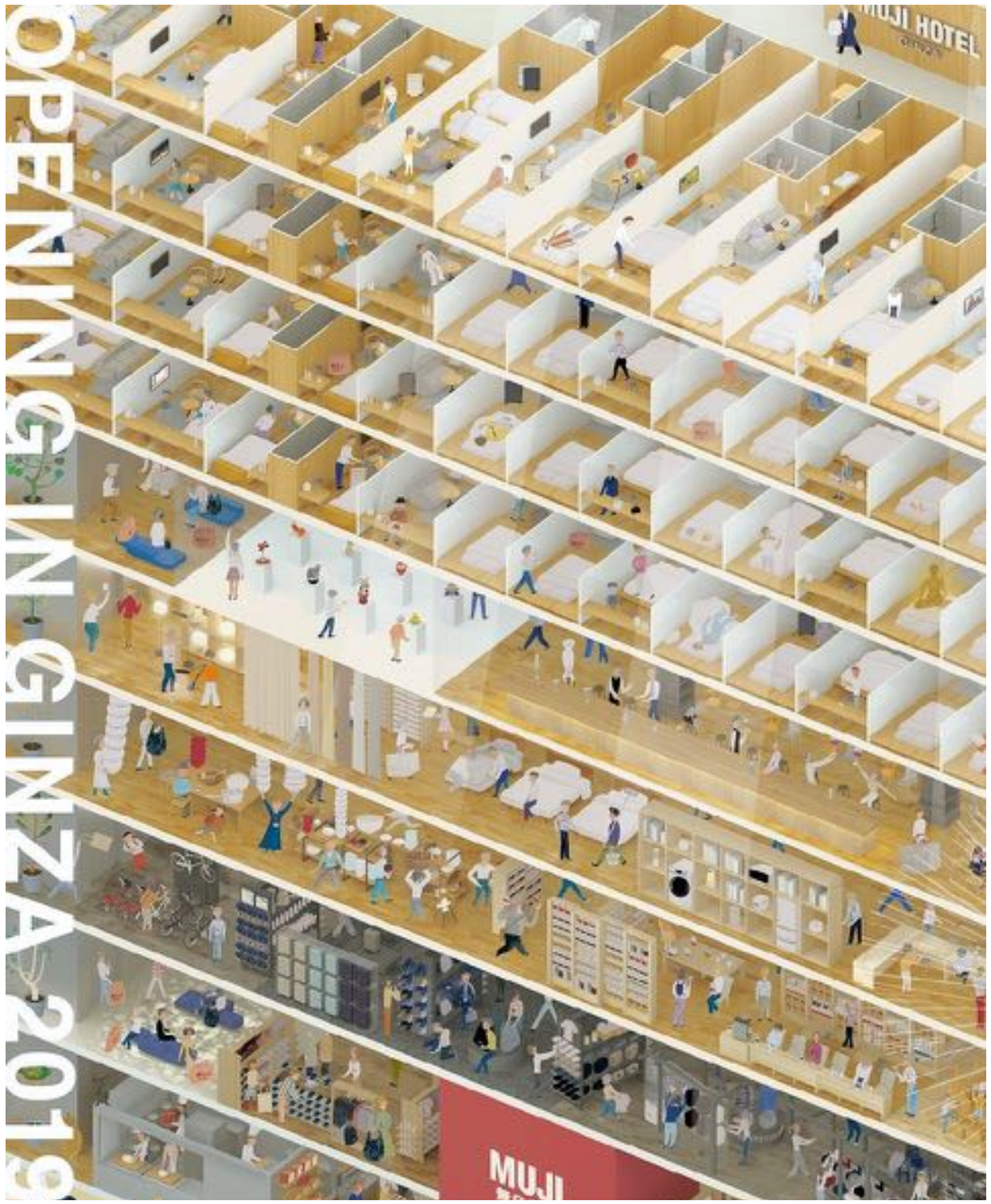

Fig.5.1.5.01 The opening poster of Muji Ginza.

5.1.5 Color and Material in MUJI Complex

Since it launched in Japan, Muji has always stuck to its roots of providing functional, value-for-money products. As a result, the brand has always enjoyed success from positive consumer perceptions of its beautifully simple, useful and affordable products. It has followed an expansion strategy using the same core principles into other product categories. As at May 2019, the Muji brand portfolio consists of 5 brands. (Roll, 2019)

Muji retail store: This is Muji's primary brand where it offers all its home products from socks to luggage bags to food items. This represents Muji's original offering.

Café&Meal Muji: Café&Meal Muji is a cafeteria dining concept that aims to cook food as simply as possible to bring out the natural taste of fresh ingredients, amidst a relaxing and clean ambience. (Roll, 2019)

Muji Outdoor: As part of Muji's sustainability efforts, it operates three campgrounds in Japan across Niigata, Gifu and Gunma, three scenic areas well known for outdoor recreation, occupying a total of approximately 230 hectares of forest. (Roll, 2019)

Muji Home: In August 2017, Muji launched the Muji Hut in Japan, its brand-new prefabricated house. It is designed to be functional in any landscape, including mountains, oceans and gardens. (Roll, 2019)

Muji Hotels: Muji has opened hotels in Shenzhen, Beijing, and most recently in Ginza, Tokyo on the 6th–10th floors of Muji Ginza in March 2019. (Roll, 2019)

Muji, Ginza, as the global flagship with the largest scale of Muji store and includes almost indoor business of Muji brand. The official posters intuitively introduce the brands and business types included in the Muji Ginza center by drawing an architectural section with vivid human activities, as well as the representative Muji colors on the poster(Fig.5.1.5.01). There is an obvious correspondence between the render of colors in this poster, the overall tendency and proportion are very similar to the color system in the product. (Roll, 2019)

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[26]. Martin Roll. (2019), *Muji – The Global Strategy Behind The Japanese No-Brand Brand.* www.martinroll.com.

The focus is on the quality of ingredients, as seen in the brand's 16 Grain Rice, 100% raw sugar and fresh yuzu juice from Kitagawa-Mura. Colors and materials in its emerging brand of dining experience tends to render the beige and wood sense with different materials in interior spaces, which responds the fresh ingredients in food. Beige stucco plasters and various types of wooden panels are engaged for the rich and warm perception in the space. (Roll, 2019)

The rough stucco plaster applied on the wall easily reminds people of fertile soil and crops, in this contrast, beans of different colors are neatly placed in glass bottles and displayed on the shelves, and its natural color matches the application adopted by the tone in this brand. All bright and eye-catching artificial colors are avoided in the space as much as possible, this brings a kind of space atmosphere in which all things are not deeply processed and maintain their original state. No matter the unprocessed original scar on the wooden panel or the rough surface of the wall, all these seemingly random material treatments are providing a comfortable context for an orderly expression of products.

In some places that require people's attention, color and material applications in such points tend to apply higher contrast. For example, the white table-top with exquisite samples of food, dessert tray with matte black paint and the important notes on blackboards. (Fig.5.1.5.02)

Fig.5.1.5.02 Muji Café&Meal, Muji Ginza.

Fig.5.1.5.03 Muji Café&Meal, Muji Ginza.

In the space environment dominated by real natural texture, the use of smooth metal finish could well balance the "rural state" in this interior atmosphere and the surrounding city context, with the reflection of interior colors, such a surface would not be perceived too obtrusive, however it is indeed full of modernity with various visual experience. (Fig.5.1.5.03)

Fig.5.1.5.04 Muji support, home design service, Muji Ginza.

[26]. Martin Roll. (2019), *Muji – The Global Strategy Behind The Japanese No-Brand Brand.* www.martinroll.com.

MUJI support is a new service that helps people design their home with professional solutions. Color and material settings in this space deliver a considerable neutral preference, the dense arrangement products on high shelves in the retail store were replaced by prefabricated wooden panels with looser installed components by Muji. The obvious white folders are treated as an element and placed on the shelves, which suggested a “working space” for discussion and communication (Fig.5.1.5.04).

The application of colors and materials here is lighter and represents with symbolic imagery in interior design and home installation. And when Muji's products are properly installed in this environment, this application gives people a hopeful expectation with Muji.

Fig.5.1.5.05 Reception, lobby of Muji hotel Ginza.

According to the introduction on Muji hotel official website[36], a large portion of the stone sourced for the hotel comes from recycled materials, some of which in a previous life were old paving stones from Tokyo’s old trolley-way system (Fig.5.1.5.05). Other parts of the hotel were crafted from recycled ship debris. All those materials arise people’s memories of the Tokyo use to be, a bustling port in the Showa era. Beside these particularly attractive materials with meaningful emotional attributes, wood are normally used in both public areas and guest rooms.

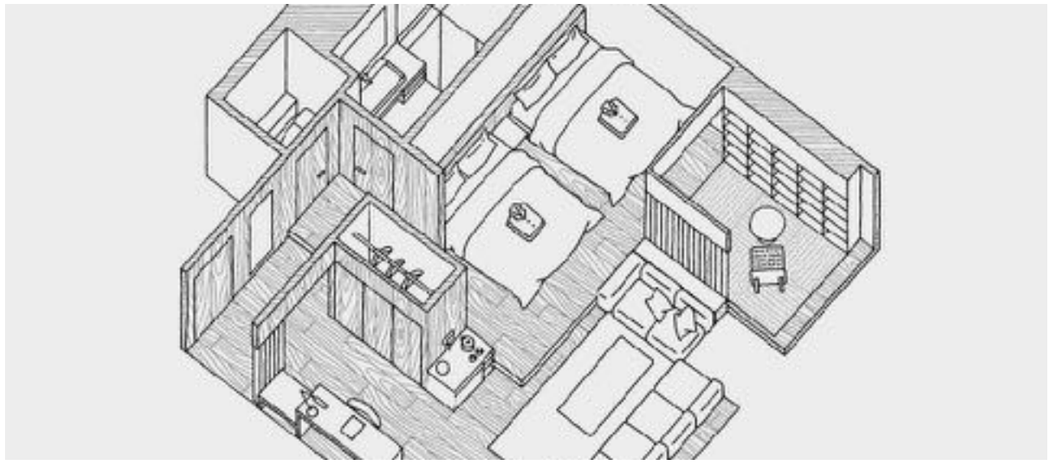


Fig.5.1.5.06 Printmaking style of Guest rooms indication, Muji hotel Ginza.

The guest rooms indication has been painted with a traditional Japanese printmaking style (Fig.5.1.5.06), which particularly figures out the large amount of wooden finish in guest rooms. In the schematic, only natural materials such as wood, rattan and tatami are more finely depicted as textures, which people could easily read the natural preference and then be satisfied in the real space. (Fig.5.1.5.07)

Fig.5.1.5.07 Guest rooms of Muji hotel Ginza.

[36]. Muji. (2020), *Muji Hotel Ginza.* https://hotel.muji.com/en/

Fig.5.1.5.08 Mini bar, Guest rooms of Muji hotel Ginza.

Fig.5.1.5.09 Mini bar, Guest rooms of Muji hotel Ginza.

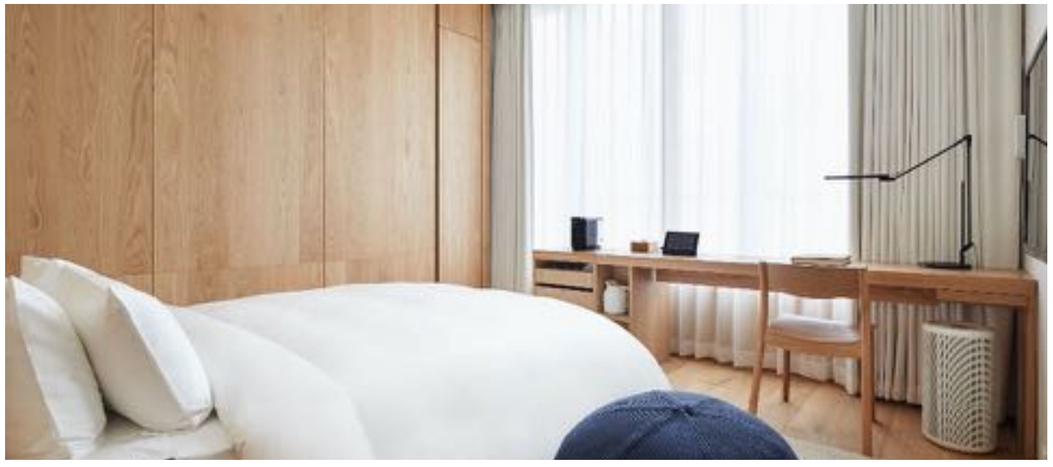


Fig.5.1.5.10 Guest rooms of Muji hotel Ginza.

Since Muji covers almost all daily necessities in life, that means all the products you can see and touch are made by Muji (Does not include some electrical appliances, fire emergency equipment). The colors and materials become “invisible again” in this space, In the general hotels, the eye-catching decorative paintings or striking artworks could rarely found in this guest room. The attractive elements in common hotel environment are replaced by the “Just right” products. Therefore, it is easy to understand that the application of colors and materials in interior space gives way to the products, and become the background. (Fig.5.1.5.08)

Walls, floors and some fixed furniture are decorated with very similar wooden finish to form a unified visual experience. And the gap between horizontal and vertical spatial perception are gradually diminished in this design approach. However, Muji’s white or black products have become particularly conspicuous, the industrialized smoothy texture is particularly delicate against surrounding natural materials. (Fig.5.1.5.09)

The visual perception of fabrics and textiles is somewhere in between, as the soft material in the space, it contributes a considerable importance of touch and tactile. Beside the universal white bedding, the colors of textiles in sofa, seats and carpet are still considered within the color system of products. (Fig.5.1.5.10)

The application of the natural wall covering or plaster attempts to imitate the finish effect of recycled pulp and beige paper. In this situation, the colors and materials in interior design is limited to the design approach based on the brand's CMF appearance in products. (Fig.5.1.5.11)

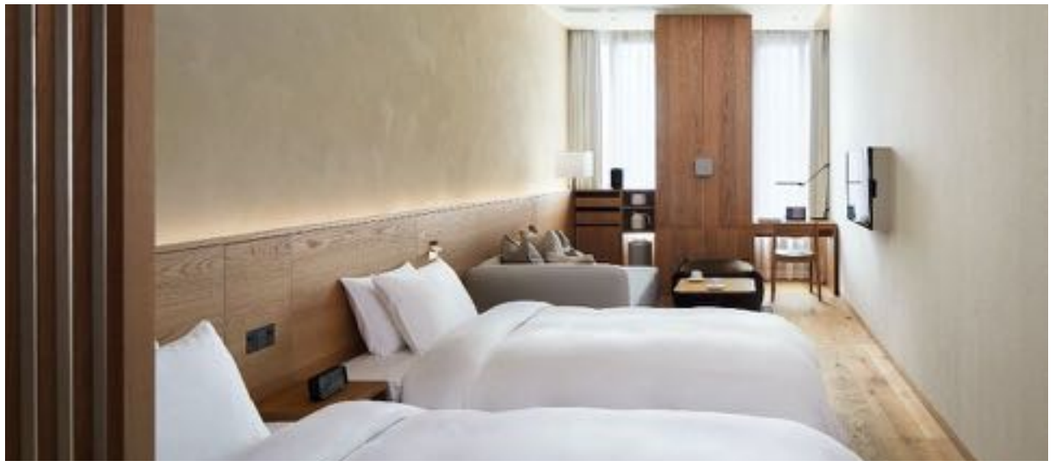


Fig.5.1.5.11 Guest rooms of Muji hotel Ginza.

Fig.5.1.5.12 Guest rooms of Muji hotel Ginza.

The Muji hotel provides several room types with various layouts, however, the design approaches in colors and materials are very similar. Generally, the floor paving (Except for the bath area) is uniformly light oak with open grain, which the color and visual effect is consistent with fixed furnishings and wall panelings, the actual materials and exact finish may differ according to the divergence in installation process. For example, the wooden sheets in fixed wardrobes maybe applied with oak veneer on synthetic panels, or the wooden surface on desktop was processed with much more smoothy than flooring, in order to achieve the delicate touch. The wooden materials of movable furniture are matching for the fixed ones and general atmosphere. (Fig.5.1.5.12)

The wall effect normally consist of the beige wall covering with a paper-like tactility and the rough plaster in s similar beige mood, thus, a contrast between two finishes has been created to rich the experience both in visual and tactile. (Fig.5.1.5.13) The ceiling and few wall space present a pure and matte white paint.

The colors in textiles are also very restrained in guest rooms, various shades of neutral grey and navy are normally seen on sofas, cushions and carpets. Despite the similar color and tone, a variety of fabrics can enrich the visual and tactile perceptions, thereby avoiding the monotony. The warmth created by the guest rooms is reflected in materials and finishes as more textiles and the versatile in tactilities. Colors tend to be less saturated with the contrast in lightness, beige and navy blue are complementary colors in hue to balance the warm and cold mood in the interior atmosphere. Unevenly painted plaster creates a unique “natural value" and sort of Japanese aesthetics, such as “wabi-sabi (侘寂) [37]”, this could be considered as the “uncertainty” in such restrained space environment.

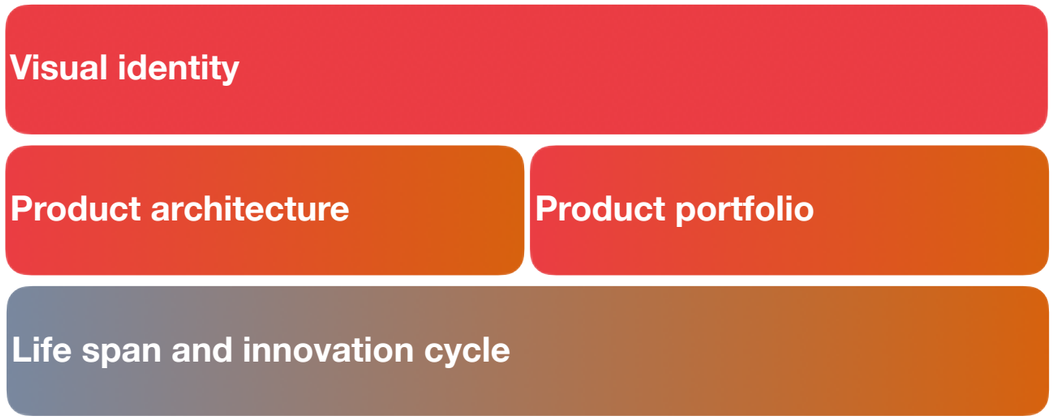
Fig.5.1.5.13 Main materials representation guest rooms of Muji hotel Ginza.

[37]. Koren, Leonard. (1994), *Wabi-Sabi for Artists, Designers, Poets and Philosophers*.

5.1.6 CMF in MUJI

With the analysis of the Muji design philosophy and the colors/materials in products and interior space, some valuable information can be sorted out and discussed in the conjunction with some specific approach in the CMF design process.

The discussion mainly involves the contribution and thinking of **CMF in brand relevance**, some may involves marketing or user experience, but would not be emphasized here. The analysis of listed items the “Key nodes” are distinguished with certain relevance to Muji in CMF design strategy, or Muji's design strategy could be recognized as the effective information to supplement it.



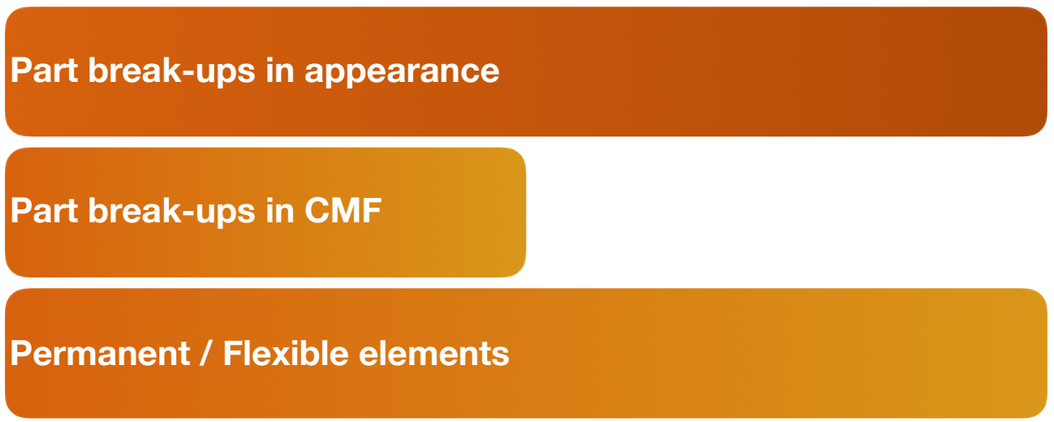
The influence of Muji's brand image on CMF design in products could be derived from its **“conservative” or “restrained ” color and material strategy**, which is closely related to its **“Just right” design philosophy.** Getting inspiration from nature, the process of colors and materials in products are highly uniform, versatile and intuitive, which makes Muji represent a **brand identity** against consumerism. Products in Muji are distinguished into different families, with the high compatibility in size and function, and unified colors are normally seen in application, thereby, different families could match easily with each other for versatility, especially in the modular system.

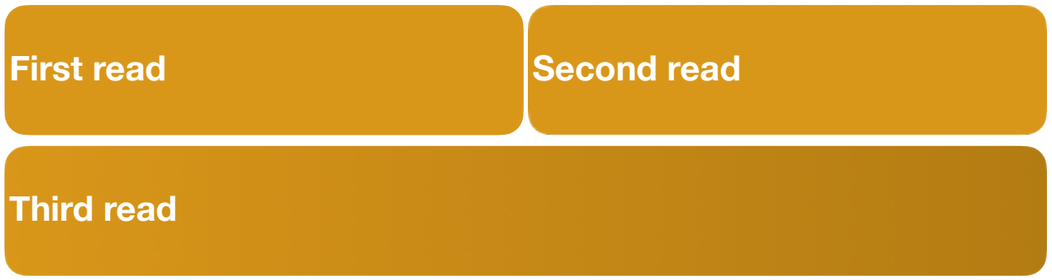
CMF design strategy is classified according to functional attributes such as durability and rigidity, emotional attributes such as cultural association and handicrafts. At the same time, carefully calculating the life span in **product architectural**, to form a complete systemized product with minimal types of color and material. The approach of such color and materials continues in its brand-based space.

The CMF approach of interior space incline to represent the **similar quality from products to the atmosphere in space**. The color preference in interior design and products design are highly overlapped. In space, most visual elements create a sense of retreat or restrained through colors, the contrast are usually to emphasize the interacting with the product. Based on the philosophy of “Just right”, the strategy of materials and treatment methods in space tend to be presented with **considerable tactility and convenience with concise states**. Decorative elements not related to the brand rarely appear in interior design, instead the **cultural symbol is tend to be invited**.

The general principle of the design is to reduce the complexity of modeling and shaping, thereby to enrich the visual experience through redesign specific materials, installation art composed of products, or natural objects. In addition, like the strategy of its products in stores, the sense of order produced by the repeated arrangement of the same items is very common in interior design.

MUJI tends to invite the modular design to organize the combination of colors and materials between different products. Different partings in single product are usually designed with the same or similar colors and materials, unless the contrast for indication of operation or specific performance of components. For the single product, the permanent and flexible elements are usually distinguished as the some replaceable consumables, and in modular products, the permanent components are designed with solid and rigid materials with more durable and easy-to-maintain surface effect.





MUJI's product design is to discard unnecessary details as much as possible, and the user's intuitional operation is encouraged. Because of its CMF strategy, the **First read in Muji's products are usually pure and direct**, and the Second read would be the highlight in the product, which represents the **functional design concern** of use experience, such as tactile feeling and natural value. This approach in interior works with a sort of similar appearance from product, the priority of color and material are organized with different scales, normally the application of CMF in interior has the **First read to create an overall sense, and the Second read generate interactions with the certain information.** This visual suggestion could be seen in interior design to help people manage their attention from the overall impression to the closer distance with more details. The third read is rarely emphasized in Muji's products, especially considering its "Just right" philosophy and market positioning, personalized design is not also seen in Muji's products.

For a long time, MUJI was not considered a trendy brand and its market positioning and price strategy does not encourage from choosing the most cutting-edge technology in products. However, MUJI is constantly expanding new business models. Innovative projects are launched with many professionals form different field. The basic color and material system of the brand has not been changed significantly by the market, but it dose mean there is no innovation in Muji, two new colors have been introduced in its cosmetics series. The Muji Hut prototypes as the topical design show some exploration of emerging life style with Muji.

With an extensive and expanding supply **chain of 200 suppliers with 800 subcontracted manufacturers across 20 countries in Asia**[26], Muji's scale of production of various apparel, household goods and food products. Only in China, some manufacturers that used to process Muji products have started to develop their own brands through the online marketing.

Many of these products are very similar to the original design of Muji with some minor changes. Compared with other manufacturers, these brands with rich OEM experience have obtained valuable guidance from Muji's strict production regulations. This partly proofs that Muji emphasizes the standardization of processing in its communication with suppliers, thus meeting the quality of brand production. As a result, we see highly consistent colors and materials in the goods processed by various manufacturers. This is due to the strict quality control of Muji.

The same operation is also retained during the space design and installation process of Muji, its recent home renovation business has upheld the rigor of its brand on colors and materials, and promised strict requirements in the design and construction process. Based on the CMF specification in product processing design, this greatly promotes the standardized workflow of colors and materials in interior design and installation with different supplier.

[26]. Martin Roll. (2019), *Muji – The Global Strategy Behind The Japanese No-Brand Brand.* www.martinroll.com.

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Fig.5.2.01 3M™ DICHROIC™ film, 2014.

5.2 Trendy Iridescence

The design world is having an iridescent moment. You may recognize the “French Touch” chair, which pays homage to experimental artists like Daft Punk, Cassius and Etienne de Crecy on modern electronic music in 2016. Or the collection called “Iridescence” by Tom Dixon, inspired by the rainbow sheen of an oil spill. Moreover in 2019, the dichroic effect could even be considered abused as the marketing visual concept in smartphones by larger amount of brands. This prismatic visual finish effect of light, color, and chromatic reflection has also made its way into the fashion industry, commercial furniture design and also in architecture worlds, such as Apple revealed a temporary new look for the “Cube” on the 5th Avenue that makes it shine with a rainbow iridescence. (Fig.5.2.1.01)

5.2.1 A Trend in Various States

As the executive director of the Pantone Color Institute, Leatrice Eiseman has been watching the trend since its conception. Eiseman traces the popularity of translucent designs rendered in glass and plastics back to Philippe Starck's famed Louis Ghost Chair, designed for Kartell in 2002 as a modern update to the Louis XVI chair [38].

Originally produced in clear acrylic, the chair has since become available in various colors, and other designers been influenced by the concept. *"Over the years [the style] has gotten more and more sophisticated and more beautiful,"* Eiseman says of iridescence[38].

Experimentation and technological development over the past decade have made the materials, glazes, films, and finishes that produce these effects more refined and accessible. However, As the story behind the iridescence trend, it may has a certain related to a matter of perception.

Inspiration form Starck's could be seen in the works of furniture pieces and home accessories by colored glass and plastics to create. In 2017, the Japanese design studio Nendo[39] has created pieces in a similar style, with its plastic rocking horses for Kartell and elegant glass cubes for Glas Italia. (Fig.5.2.1.01/Fig.5.2.1.02)

Fig.5.2.1.01 *H-Horse*,Philippe Starck, Ferruccio Laviani and Nendo design for Kartell, 2016

Fig.5.2.1.02 The *soft* for Glas Italia*. 2015*

[38].Meg Miller. (2017), *The Weird And Fascinating Story Behind Design's Iridescence Craze, Co Design,* https://www.fastcompany.com/

[39]. Guido Minciotti.(2016), *Bestiario di design. Nendo mette Kartell a cavallo sull'H-Horse*.https://guidominciotti.blog.ilsole24ore.com

Originating in California in the 1960s and '70s, the Light and Space movement[1] was concerned primarily with the use of light and geometric objects in creating ethereal environments that affect the viewer's perception. These artists were influenced by their own environs, both natural and artificial; the quality of L.A. light, the changing surface of the nearby ocean, and the materials at use in the city's ubiquitous car culture were all inspirations. Because of their innovative manufacturing processes and pioneering uses of acrylic, resins, and paints, these artists also earned the label "Finish Fetish[38]."

Many of the most prominent members of the movement have enjoyed a resurgence as of late. Over the past couple years, for example, Bell, Robert Irwin, and Doug Wheeler have all had major gallery retrospectives (Fig.5.2.1.03). In 2013, the Guggenheim put on a huge Turrell exhibition, and his immersive piece Light Reignfall opened at the Los Angeles County Museum of Art[38]. (Fig.5.2.1.04)

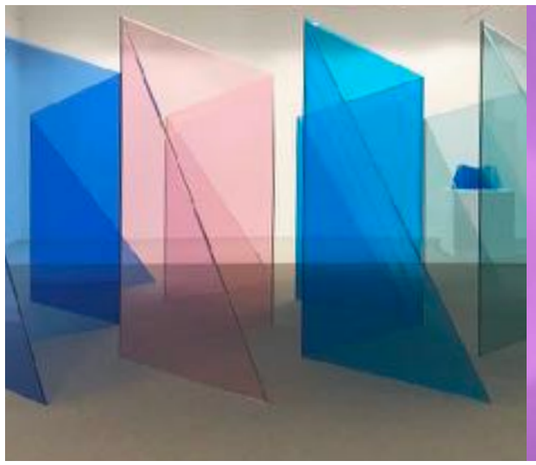


Fig.5.2.1.03 Larry Bell's *Still Standing* at Hauser & Wirth in Chelsea, NYC, 2020.

Fig.5.2.1.04 Light Reignfall, James Turrell, The Guggenheim, NYC, 2013

Diogo and Juliette Felippelli, named their studio JOOGII, think that a subliminal affect on their iridescent acrylic furniture by Turrell piece at LACMA. The "French Touch" Collection with geometric shapes, and coated with a dichroic film by 3M that changes hue and saturation with varying light. They indicate the furniture was inspired by '90s French house music and early Daft Punk. "I feel like there's been a lot of call backs to '70s, '80s, and '90s, when the world was a little more colorful." Juliette says[38]. (Fig.5.2.1.05/Fig.5.2.1.06)

1. Light and Space denotes a loosely affiliated art movement related to op art, minimalism and geometric abstraction originating in Southern California in the 1960s and influenced by John McLaughlin. It was characterized by a focus on perceptual phenomena, such as light, volume and scale, and the use of materials such as glass, neon, fluorescent lights, resin and cast acrylic, often forming installations conditioned by the work's surroundings. Whether by directing the flow of natural light, embedding artificial light within objects or architecture, or by playing with light through the use of transparent, translucent or reflective materials, Light and Space artists made the spectator's experience of light and other sensory phenomena under specific conditions the focus of their work.

Fig.5.2.1.05 *French Touch* Collection, studio JOOGII, 2016

Fig.5.2.1.06 *French Touch* Collection, studio JOOGII, 2016

Eiseman relates recent popular interest in the hyper-color aesthetics with things that mutate and change based on how the light hits. In her point of view, the fascination can be traced back to infancy, that the human field of vision is still developing and starts to incorporate colors first, then textures and finishes. Being intrigued by shimmering, shiny objects is “intrinsic to human development, which makes it more compelling for artists and designers to try to recreate that effect[38]. And for the reason why such popularity in recent years, she thought the technology is the great enabler.

Before this super thin film with dichroic effect, dichroic glass was originally created by adding small traces of gold and silver to a glass melt. In the 1950s and 1960s, NASA revitalized the production of dichroic glass as a protection mechanism for astronauts, which was used as an effective barrier against harsh radiation[40].

There’s no uniform process for creating the iridescent effects today. While the original glass finish may be par for the course for established designers, for younger designers or architects working on a large scale, proprietary processes aren’t financially or logistically feasible. As Eiseman points out, the proliferation of a trend relies heavily on economic accessibility—the point at which the aesthetic becomes attainable for those outside of the exclusive, high-end market. In effect, the rise of a trend plays out like a feedback loop: The more a material is applied and experimented with, the more affordable it becomes and the more it can be used[38].

One major driver in democratizing the iridescent effect is the manufacturing company 3M, the makers of Scotch Tape, Post-it notes, and many other adhesives, abrasives and laminates. In 2000, 3M released a dichroic finish that is used in a variety of products, from fishing lures to expensive glass furniture. The latter typically requires an advanced manufacturing process that sandwiches the finish between two glass sheets[38]. In 2013, the company had noticed an increased demand for iridescent coating, so they developed a dichroic adhesive that can be applied with heat and easily removed. It feels a bit like cellophane wrap, and has the same visual effect as the finish, but at a fraction of the cost. It’s what gives JOOGII’s collections its disco vibe[38].

In 2014, 3M™ released the DICHROIC™ Glass Finish DF-PA film (Fig.5.2.1.07) which offers a way to create unique, ever-changing color to many interior building surfaces. Influenced by the color of the light, this transparent film provides a dichroic color effect, meaning it appears to change color when viewed at various angles. The “Blaze” films shift colors in the warm and chill tones films. The PVC-free film has a clear, pressure-sensitive adhesive that can be applied to glass. A hard coated surface layer helps resist scratching during normal use.

Fig.5.2.1.07 3M™ released the DICHROIC™ Glass Finish DF-PA, 2014.

[38].Meg Miller. (2017), *The Weird And Fascinating Story Behind Design’s Iridescence Craze, Co Design,* https://www.fastcompany.com/

[40].Jennifer Geleff, (2020), *Kaleidoscopic: 7 Mesmerizing Dichroic Glass Structures,* https://architizer.com/.

Although, based on the detailed introduction of 3M™ catalogs, it indicates that this film would only be attached with flat and bent hard surface such as Glass, acrylic, polycarbonate or Interlayer glass, the fashion industry has the quick response to introduce this emerging visual impact to the seasons.

Almost in the same year, Nike posted the Sportswear's Women's Nike Blazer Mid sneaker, which represented the exact same effect if the sneaker's surface, while instant customization made the Blazer stand out on the court, the latest fabrication would make it shine on any surface. Upping the ante with color, Nike Sportswear's (Fig.5.2.1.08) newest version features a completely iridescent upper, combination white/ice outsole and metallic laces. and also in 2014, the Japanese fashion designer, Issey Miyake[1] released the "BAO BAO" series tote bags (Fig.5.2.1.09), which are composed by triangular fragments in sense of metallic iridescence.

This dichroic finish effect on the fabric or soft textiles could not be directly acquired by the application of the 3M film, this at least implies that such impressive visual effects was starting to lead the popularity in consumer-products from 2014.

At that time, CMF design has been developed in consumer-electronics, and for the smart devices, brands have their own color preference, such bold effect could not be seen in the smartphone. However, there was a revolutionary change of the user's interface in the operation system called "Flat

Fig.5.2.1.08 Sportswear's Women's Nike Blazer, 2014.

Fig.5.2.1.09 BAO-BAO, Issey Miyake, prism rainbow, 2014.

Fig.5.2.1.10 The iOS 7, Apple, 2013.

design"[41]. Google had introduced their 'Material design' and Windows had their 'Metro'. It looked cool & refreshing compared to the detailed skeuomorphic designs that were a rage at that time. They were great for low-resolution mobile devices where the designs looked clean, and variety of colors and with the advent of higher resolution mobile devices- it didn't have the same aesthetic impact[42].

In 2013, Apple unveiled iOS 7 (Fig.5.2.1.10), which shifted to a flat UI design with use of brighter colors, typography, as well as blurred, translucent overlays[43]. This "prescient" approach caused a lot of criticism at the time, some people believed that Apple's visual interface from the detailed skeuomorphism[46] styling design to chromatic flattening is an aesthetic retrogression[45].

In the iOS 6 or earlier version, the interface were draw with detailed in specific effect such in the real world, for example, the "Note" application has a beige background with the real texture of the paper, even including the color of the grid lines during the printing process and the uneven edges caused by the tearing, and the application of the "Calendar" is also rendered into the leather textured near the screen edge of the interface, to simulate the context as writing the schedule in an advanced leather book. Metaphors of varying scale are employed to liken digital actions and ideas to real world counterparts[44].

1. Issey Miyake is a Japanese fashion designer. He is known for his technology-driven clothing designs, exhibitions and fragrances, such as L'eau d'Issey, which became his most well-known product.

[41]. Carrie Cousins. (May 28, 2013), *Flat design principles*, designmodo.com.

[42]. Quovantis. (2018),*Why Gradients are back to rule in 2018?,* https://uxplanet.org/

[43]. Seifert, Dan. (2013), *Apple announces iOS 7, 'biggest change' since the introduction of the iPhone, coming this fall*.

[44]. Phil Ohme. (2016), *Smart Depth is the end of flat design,* https://blog.prototypr.io/

[45]. ARTery. (2013), *iOS7.. When Flat Design Goes Wrong,* http://fredrickroyster.blogspot.com/

[46]. Connor Turnbull. (2013), *Flat Design, iOS 7, Skeuomorphism and All That,* https://webdesign.tutsplus.com/

As technology advanced, the flat design seemed to fit well in the scenario too. The screens became high-def, and the need to display crisper imagery doubled. Displaying boxes and textures without drop shadows was a lot easier. Hence, flat designed seemed to accommodate in the present world[47]. This refreshment in the visual interface has also significantly conducted the user's preference towards more Iridescent color of smart devices.

However, bolder effects with gradient or exact dichroic visuals were not widely used in smart devices at that time, which more or less were limited by processing technology, especially like the common effect in today's phone case with the nano-scale coating could not be processed in reasonable price[48].

However, more artists and brands were starting to sate this fascinating effect in products or artworks. The Italian brand GLAS which mainly concentrate in the new processes and possibilities of glass manufacturing has announced their new collection named Shimmer, which was firstly presented at the Salone del mobile 2015.

By employing an iridescent multi-chromatic finish, the designer Patricia Urqiola added an ethereal element to her 'shimmer' series (Fig.5.2.1.11). the tables, consoles and shelves designed for GLAS italia transform themselves when exposed to various light sources or when viewed from a variety of angles. Refracted hues and tones give the impression of transparency and density, changing based on the viewing position. each unit os constructed from laminated glass glued together at intersecting planes, which cause their profiles and compositions to change drastically when seen from different perspectives. the shelf, for example, appears to intersect, yet is actually formed by individually glued parts. the 'shimmer' series features rounded corners — both with curved bases for tables and semi-circular shapes for shelf edges[49].

These were several items comes in opaque or transparent glass with micro-dot finish to create the change of translucent colors. And the design of smoothy gradient changes were also involved in other items[49].

Although the designer did not clearly point out that the concept of ink dots similar to screen printing and pixels-shaped dots (Fig.5.2.1.12/Fig.5.2.1.13) was added to such a gradient effect, but from the items has direct gradient effect, it can be seen these details are processed intentionally (Fig.5.2.1.14).

This magic effect was later transferred into new thought by a talent Italian design team "Formafantasma", in 2016 they created a set of lighting installations with dichroic glasses. This art installation named "ANNO TROPICO" for exhibition in Peep-Hole Art Center[50].(Fig.5.2.1.15)

Fig.5.2.1.11 *Simmer*, Glas Italia, designed by Patricia Urqiola, 2015.

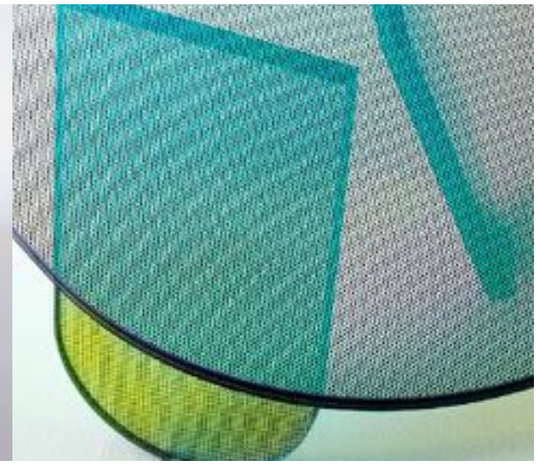


Fig.5.2.1.12 *Simmer*, Glas Italia, designed by Patricia Urqiola, 2015.

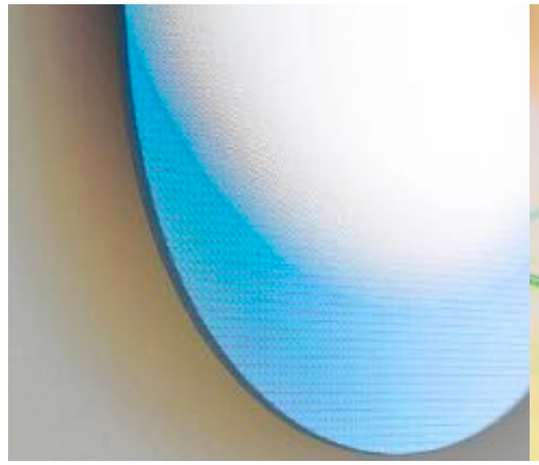


Fig.5.2.1.13 *Simmer*, Glas Italia, designed by Patricia Urqiola, 2015.

Fig.5.2.1.14 *Simmer*, Glas Italia, designed by Patricia Urqiola, 2015.

[47]. Evie Harrison. (2019), *All ThatFlat Design is in and Gradient Design is Gone for Good – Is This True?,* https://www.business2community.com/.

[48]. Alicja Stankiewicz. (2019), *Self-healing nanocoatings for protection against steel corrosion.*

[49]. Designboom. (2015), *Patricia urquiola designs shimmer furniture collection for glas italia.*

[50]. Edoardo Tescari. (2016), *Formafantasma Anno Tropico.*

The whole project is inserted in an environmental situation, which through the construction of wall-diaphragms corresponding to several windows screens and modulates the intensity of daylight. The nature of this work transforms not just the architecture but also the functioning of the exhibition space, in which the opening hours will vary depending on seasonal changes of the lighting[50].

These models narrate the path that comes prior to the invention of the finished objects: dichroic glass, optical lenses and a parabolic mirror, assembled with industrial materials like bricks and iron rods, shape the light, generating reflections and shadows in the space. On the walls 3D renderings printed on millimeter paper reproduce details of the objects on display, superimposed on graphics and numerical data drawn with a pencil[50]. (Fig.5.2.1.16)

Other talented art works or something could be recognized as furniture made by Germans Ermičs, his “Shaping Color” series (2015–16) is similarly conceptualized. Uninterrupted rectangular panels of glass come together neatly to form a low table, a shelf, console, or mirror. In the first iteration of the series, Ermičs married two complementary tones; in the second, he pared down his palette further, playing with the density and richness of a monochromatic tint. In those designs, a single hue bleeds out from a corner, shifting from dark to light; or it fades upwards, as if a momentary breath of color had fogged the surface[51].

Fig.5.2.1.15 *ANNO TROPICO* in exhibition in Peep-Hole Art, 2016.

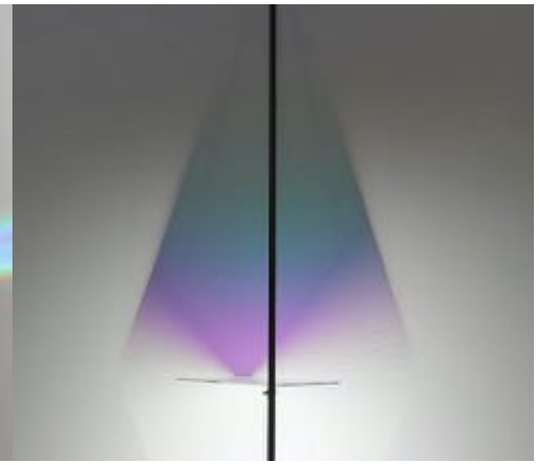


Fig.5.2.1.16 Colore - Test 1LED, dichroic glass, concrete, electrical materials, 2016.

[50]. Edoardo Tescari. (2016), *Formafantasma Anno Tropico.*

[51]. Jacqui Palumbo. (2018), *Designer Germans Ermičs Reimagines What Glass Can Be.*

Fig.5.2.1.17 Germans Ermičs and Lonneke van der Palen, *Sample for Raf Simons*, 2016.

Fig.5.2.1.18 *Ombré Glass Chair*, Germans Ermičs, 2017.

Then he was no longer satisfied with processing only with monochromatic, iridescent trend we are gradually seeing in his works.

Though glass is currently his focus, Ermičs—who was born in Riga, Latvia—began in print, experimenting with graphic design while in school, and later landing an internship at the esteemed Rasmus Koch Studio in Copenhagen. From there, he took an interest in interior design, he said, is when he began working hands-on with materials and conceptualizing larger-scale projects. His background in two-dimensional design, he conceives of his glassworks as “two-dimensional thoughts materialized in objects[51].” (Fig.5.2.1.17/Fig.5.2.1.18)

The color is one of the main drivers of his work, he takes cues from the world around him, synthesizing hues into RGB, and lets one color lead him to the next. And with these poetic and conceptual expression in pioneering attempts, which gave more confidence for a larger amount of application with this iridescent color trend.

5.2.2 The Dichroic Addicted

In larger scale such as architecture or interior space, there were some impressive cases with the 3M film. In 2015 cooperation among the SOFTLAB worked with 3M and BBDO to create the 3M LifeLab at SXSW.

The structure was not simply a space that showcased 3M products, but was created using some of the amazing materials created by 3M. The design was a multi-functional structure that acted as a ceiling, spatial divider, and custom interior display elements. The modular structure was designed to turn the interior of the 3M pavilion into a kaleidoscopic prism using 3M's dichroic film[52].

As visitors move through the space and the sun passes over the tent during the day the color and reflectivity of the film changes. All of the interior elements were laminated with glossy white Di-Noc, a 3M architectural finish. The Di-Noc captured the light cast by the sun through the dichroic film above creating a dynamic landscape (Fig.5.2.2.01) of light that changed throughout the day. The exterior of the tent was clad in a custom surface made of triangles of Scotchlite fabric that were held together using zippers. It is one of the first times the retroreflective material was used at an architectural scale[52]. The various elements and details in 3M LifeLab were designed to work together to create a cohesive and dynamic experience echoing the same work that goes into the material science used to develop many of 3Ms products. It was considered that the interior as an atmospheric material created through light and program that visitors would walk through. The detailing of all these elements was driven by the need to deploy the structure very quickly and retain a tactility that is both playful and innovative. The structure was made by over 3000 3M (Fig.5.2.2.02) cable ties to construct the display and bar elements as well as the complex dichroic ceiling. The modular structure was made of aluminum pipe that snapped together quickly using over 1200 unique 3D printed joints and sockets[52]. (Fig.5.2.2.03)

Fig.5.2.2.01 3M LifeLab at SXSW, Austin, TX, United States, 2015.

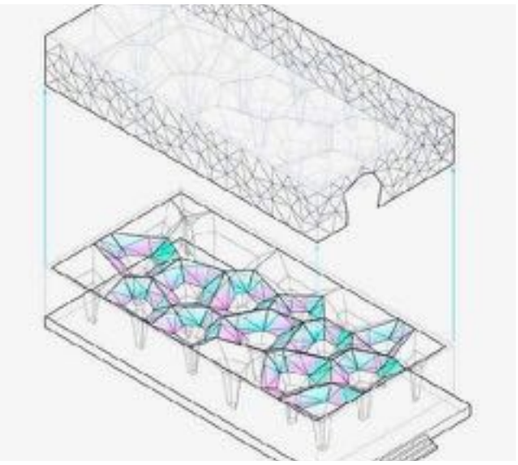


Fig.5.2.2.02 3M LifeLab at SXSW, Austin, TX, United States, 2015.

Fig.5.2.2.03 3M LifeLab at SXSW, Austin, TX, United States, 2015.

And in urban landscape, this film were popular for artists. Nova was commissioned by the Flatiron 23rd Street Partnership through a competition held by the Van Alen Institute. The installation takes its initial inspiration from the traditional gazebo ("I shall gaze") as a pavilion within in a landscape that looks out in all directions. In such rich historical context of the Flatiron Plaza site to frame the various landmark buildings and pedestrians through a series of scopes[53]. (Fig.5.2.2.04/Fig.5.2.2.05)

These scopes create a pavilion that is different from all sides at street level, but from views above the pavilion looks like a seven pointed star. The structure is made up of aluminum that gains its strength through a cell-like structure similar to a sponge or soap bubbles. Each cell acts like both a stone and part of a three dimensional truss. Each cell is unique, exposing a crystalline interior[53].

[52]. Architizer. (2015),*3M SXSW 2015 Austin, TX, United States.*

[53]. Architizer. (2015), *Nova - Madison Avenue, Manhattan, New York, NY, United States.*

Fig.5.2.2.04 Gazebo “I shall gaze”, Flatiron Plaza, NYC, 2015.

Fig.5.2.2.05 Gazebo “I shall gaze”, Flatiron Plaza, NYC, 2015.

Fig.5.2.2.06 Gazebo “I shall gaze”, Flatiron Plaza, NYC, 2015.

On the interior the aluminum structure is clad in acrylic laminated with 3M Dichroic Film creating a kaleidoscopic affect. The dichroic film changes color and reflectivity depending on the viewing angle. The dichroic along with the mirrored finished composite aluminum panels cladding the exterior turns each cone into a pedestrian scale kaleidoscope that remixes the surrounding buildings, urban context and pedestrians in fun and unexpected ways[53]. (Fig.5.2.2.06)

The overall structure is made of a modular system we developed with the help of ARUP. Each cell is made of two dimensional panels that get attached together to form a three dimensional cell. These cells come together to form a structurally stable dome in the center with each scope acting as an arch. This expressed both a very stable shape and a surface with many different angles to take advantage of the kaleidoscopic affects produced by the 3M Dichroic Film[53].

Soon, as a raising trend, this was perceived as a global preference. In 2017, during the Festival design week by Nanjing University of the Arts, their students purely invited the same 3M Dichroic Film as the main visual elements to create the art installation called, the floral pavallion(花之亭)[54]. The creative concept of the work is derived from the "Flora (FLORA)”in the myth.

The design team used the pavilion as the meaning to give it a new construction poetry. By applying parameterized tools (Fig.5.2.2.07) , the "flower" shape is reinterpreted and expressed by digital means Temporary exhibition pavilion with visual tension, space interest and hierarchy. This work consists of 272 hollow stainless steel balls as structural positioning nodes, and a total of 703 stainless steel round tubes with various lengths to form a simple support structure system. The triangular grid formed by the structural system is obtained by the computer by subdividing and optimizing the special-shaped curved surface[54]. (Fig.5.2.2.08)

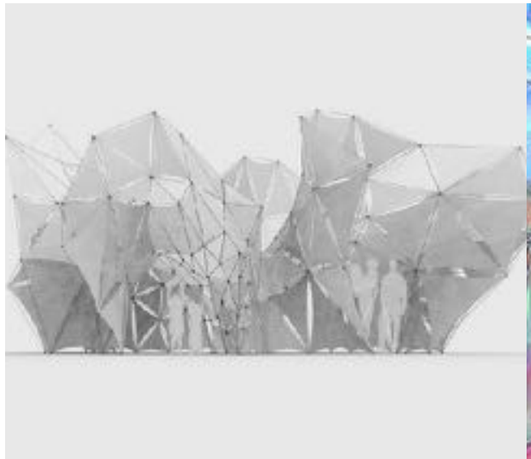


Fig.5.2.2.07 Parameterization design of The Floral Pavilion / Nanjing University of the Arts, Nanjing, China, 2017.

Fig.5.2.2.08 Floral Pavilion / Nanjing University of the Arts, Nanjing, China, 2017.

[53]. Architizer. (2015), *Nova - Madison Avenue, Manhattan, New York, NY, United States.*

[54]. Arch daily. (2017), *Floral Pavilion / Nanjing University of the Arts* 花之亭 / 南京艺术学院设计学院.

Fig.5.2.2.09 Floral Pavilion / Nanjing University of the Arts, Nanjing, China, 2017.

Exposed to sunlight or cloudy weather, completely different visual experience would also vary from viewing angles by the dichroic film. After the installation was completed for pubic visiting, it was loved by viewers of different ages due to the artistic visual expression and the fantastic space field composed of the sun's epidermis and colored shadows. (Fig.5.2.2.09)

This is the metaphor of the traditional mind of beauty could be acquired by a technological material and finish effect through initing the architectural parameterization design.

This dichroic film has been also applied to create a dynamic spatial impression in interior, the glass inside the creative media agency Canvas Worldwide‘s new Los Angeles office (Fig.5.2.2.10) does change throughout the day. Like a visual mood ring, the iridescent expanse changes its gradient sheen depending on the time of day and the angle you see the glass. If Rainbow Brite were an account exec, she’d request this for her office[55].

The architects at A+I–the same firm behind Squarespace’s monochromatic N.Y.C. office–used color as a metaphor for Canvas’s brand. Most of the 36,000-square-foot office in the Silicon Beach neighborhood, in west L.A., is austere, and the vibrant glass is offset by a white box, which represents the blank slate of each client coming to the firm. The jolt of color from the glass represents the creative energy Canvas brings to its work[55]. (Fig.5.2.2.11)

[55]. Diana Budds. (2017), *If Rainbow Brite Had An Office, It Would Look Like This,* https://www.fastcompany.com/.

Fig.5.2.2.10 Canvas’s office, L.A., US, 2017.

“The [office] was conceived as a space where the content and imagery of [clients] could take the foreground, but would always be seen through the active shifting energy of Canvas,” Peter Knutson, A+I’s director of strategy, says. “To this end, the dichroic glass offers reflection of and transparency to the activity within the space but through an ever-shifting dynamic veil of color[55].”

Fig.5.2.2.11 Canvas’s office, L.A., US, 2017.

Druing the Salone del Mobile 2019, this exhibition called “Affinity in Autonomy” by Sony was first presented and later received a success at the London Design Fair 2019, “Affinity in Autonomy” represents a glimpse of the future of AI and how it will grow to create meaningful and positive emotional connections with humans.

“Affinity in Autonomy is an interactive exhibition by Sony Design that envisions the relationship between humans, emotions, AI, and robotics[56]*.”*

The impressive illusion was acquired by the application of the DICHROIC™ (The officials indicates the support of 3M™) created the visual identification from physical / digital graphics to space atmosphere, such in the website appearance, glass curtain of facade and big-sized posters in the exhibition exterior (Fig.5.2.2.14).

This visual elements was highly emphasized through every corner in this exhibition, beside the conceptual part of the sensorial experience, installations were built around two of Sony's sensor technologies: the CMOS (complementary metal oxide semiconductor) image sensor and the back-illuminated Time-of-Flight image sensor, which calculates the distance to an object by measuring the time it takes for light to reach it and reflect back to the sensor (Fig.5.2.2.15/Fig.5.2.2.16). The

Fig.5.2.2.14 *Affinity in Autonomy,* Sony, Milano, Italy, 2019.

DICHROIC™ to some extend could be recognized as a simulation of the visual effect on CMOS surface. (Fig.5.2.2.17/Fig.5.2.2.18)

Fig.5.2.2.12 *Affinity in Autonomy,* Sony, Milano, Italy, 2019.

Fig.5.2.2.13 *Affinity in Autonomy,* Sony, Milano, Italy, 2019.

Fig.5.2.2.15 *Affinity in Autonomy,* Sony, Milano, Italy, 2019.

Fig.5.2.2.16 *Affinity in Autonomy website,* Sony, 2019.

[56]. Eduardo Simoes. (2019), *Affinity in Autonomy – An interactive experience by Sony,* https://designwanted.com/.

Fig.5.2.2.17 *Affinity in Autonomy website,* Sony, 2019.

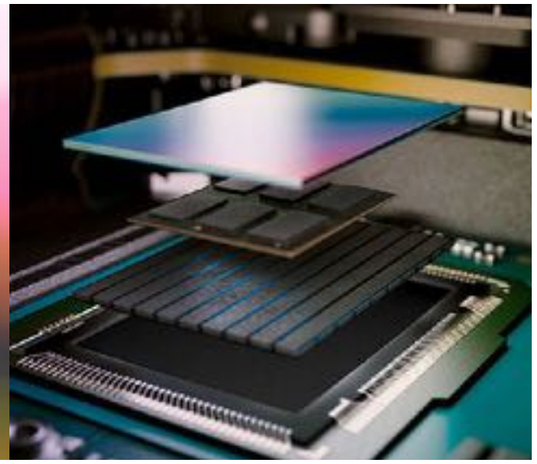


Fig.5.2.2.18 CMOS indication,Sony.

Fig.5.2.2.21 *Resonance,* Samsung, Milano, Italy, 2019.

Same in the Salone del Mobile 2019, coincidently, another exhibition named “Resonance” by Samsung, which intended to provide a smilier Iridescent experience for visitors, while showcasing Samsung's design philosophy under their slogan: "Be Bold. Resonate with Soul[57]". (Fig.5.2.19/Fig.5.2.2.20)

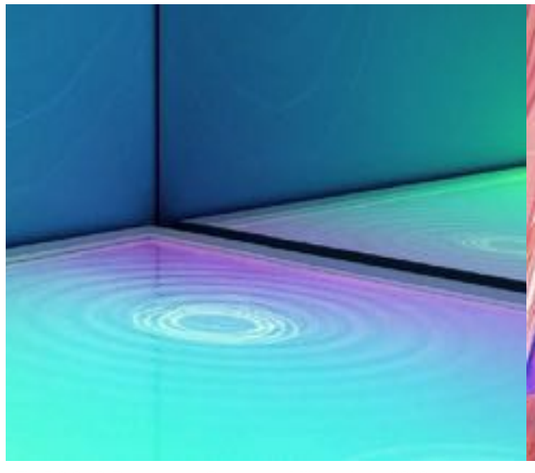


Fig.5.2.2.19 *Resonance,* Samsung, Milano, Italy, 2019.

Fig.5.2.2.20 *Resonance,* Samsung, Milano, Italy, 2019.

"The Resonance exhibition is composed of empathy, discovery, and moments of deep immersion," explained the company. The audience will interact with the artwork based on everyday behaviors – from breathing, making sound, and movement that completes an exhibition both created by and dedicated to the audience themselves.” Three installations are housed within the Empathy and Discovery zones[57]. (Fig.5.2.2.21)

Although the gradient colors on the wall were mainly created by the change of the lighting system and dynamic effect in Samsung’s LED monitor, the dichroic films were also massive applied on the windows as the film to generate a fascinating effect by the natural light, in order to match a similar atmosphere in interior space. The preference for this specific effect has a strong connection with its bold CMF design in the 2019 product line, a full perspective of this would be introduced in next part.

It is not only Samsung and Sony that were engaged to this trend, the famous “Apple Cube” (Fig.5.2.22) as the landmark on the 5th avenue in New Your city, has been covered with the 3M dichroic film, to celebrate the reopening of its Apple store[58]. The new look is gorgeous, but also not permanent, that the iridescence is caused by a wrap covering the glass that is “temporary”.

[57].Dezeen Staff. (2019), *Samsung's Resonance installation invites visitors to make art with "everyday behaviours”,* https://www.dezeen.com/.

[58]. Jay Peters. (2019), *The dazzling iridescence of APPLE’S rainbow cube on fifth avenue,* https://www.theverge.com/.

Fig.5.2.2.22 *Apple Cube 5th Avenue,* NYC, US, 2019.

This was the first Apple Store with 24 hours open, the same iridescent color effect in the iconic Apple logo, as an evident for the direct connection between the physical dichroic trend and the visual preference in virtual interface. This legend of effect has never stopped in the 5th avenue, recently in Saks Fifth Avenue. (Fig.5.2.2.23/Fig.5.2.2.24)

Fig.5.2.2.23 *Apple Cube 5th Avenue,* NYC, US, 2019.

Fig.5.2.2.24 *Apple Cube 5th Avenue,* NYC, US, 2019.

Saks shopping center has been completely renovated in the ground floor and mezzanine. Saks has moved its boisterous cosmetics section up one floor and now displays their real money-makers (handbags and accessories) on the ground floor. And the undeniable showstopper here is the dichroic-clad central escalators along with the surrounding glass railings. The design is compliments of Dutch architect, Rem Koolhaas, and it shows that his immense talents are not limited to just exterior architecture. This escalator redesign is part of the $250 million that Saks spent on their recent renovations. Brick & mortar retail has seen a decline in recent years and it's in a brand's best interest to make that in-person shopping experience as impactful as possible. This installation is by far the best use of dichroic glass we at Paris Forino have seen[59]. (Fig.5.2.2.25)

Fig.5.2.2.25 Saks shopping center 5th Avenue, NYC, US, 2019.

Obviously, this psychedelic color effect can form a visual identity in architecture and interior spaces, on the one hand, compared to the common interior atmosphere, the high saturation spectrum and reflection produced by the dichroic film leading a priority in people's perception. On the other hand, the changing color effect produced by dichroic feature according to the light and viewing angle generates a strong visual state, which is much different from the relatively constant visual characteristics of traditional materials in interior, and the emotional perception by this finish effect could be amplified due to the larger-scaled application in interior than in products.

[59]. Paris Forino. (2019), *Trends We Love: Dichroic Glass,* https://www.parisforino.com/.

5.2.3 Trend Tracking and Following

In 2019, almost Android operation brands were emphasizing their quick response to innovations of this trend. This particular finish has experienced a rave in the consumer-electronics market. As the leading brand of electronics, Samsung keep developing series of smart devices by their own design teams all over the world. The SDE team involves:

Product Design Team / Product Innovation Team / User Experience Team / Trend Experience Team, and in Milano, Material Experience Team mainly concentrate on exploring the world of materials through research, analysis, and studies that investigate how manufacturing technology can trigger and amplify interaction. As early in 2018, Samsung has applied the gradient color effect on the smartphone case of A9 series, however, at that time the surface of the case just invited some eye-catching color without dichroic effect.

As the strong competitor, another consumer electronics brand in China, Huawei introduced their latest Smartphone series P20, which also involved the gradient color in a darker tone, called “Aurora”. This finish effect is similar to the polarization reaction that occurs in metals during electroplating, and it has been widely recognized by the market after its introduction.

Just one year later, Samsung was not satisfied to only apply the gradients effect, in order to stay ahead of the competition, the new Galaxy S10 introduced the effect, which was delivered radical change with a magical feel “prism colors”, the design team aimed to create iridescent hues that change depending on how they catch the light, so each device refracts light to produce a vast spectrum of colors. (Fig.5.2.3.01/Fig.5.2.3.02)

“To create Prism White, we overlaid around 1,000 sheets of nano-films together, each with different reflectivity,” explained Duyeong Choi, a member of the Design Team’s CMF Group responsible for color. “It was especially difficult to fine-tune which colors would stand out the most[60].” (Samsung newsroom, March 29, 2019) (Fig.5.2.3.03)

This trend of consumers’ preferences was not only applied by Samsung, same year, the Huawei immediately released their next generation smartphone P30 series with similar finish effect and new storytelling. This finish which named “realm of the sky” (Fig.5.2.3.04) is processed by 15 layers, of which the progressive plating process composed of 9 layers of nano-vacuum optical coatings. And innovative use of micron-level inkjet printing process, a micron-level inkjet prints a colorless layer to protect the glass before coating[61].

Fig.5.2.3.01 *Affinity in Autonomy,* Sony, Milano, Italy, 2019.

Fig.5.2.3.02 Samsung *Galaxy S10,* 2019.

Fig.5.2.3.03 Samsung *Note10,* 2019.

Fig.5.2.3.04 Huawei *P30 Pro*, 2019.

[60].Samsung newsroom. (2019), *[Interview] How the Galaxy S10’s Design Team Created a Galaxy for Everyone,* https://news.samsung.com/.

[61]. 二楠ErNan. (2019), *The changing Huawei P30 and the “realm of the sky” ,* https://club.huawei.com/

Fig.5.2.3.05 One plus *8 Pro*, 2020.

Fig.5.2.3.06 One plus *8 Pro*, 2020.

Other consumer-product brands and manufacturers have also joined this trend with different narratives. Even the consumers could recognize those effects are almost same, actually there must be some subtle difference, for each brand, they are willing to introduce engaging stories of their design to differentiate their identity through the trend. One interview was held with the CEO of One plus smart phone (Fig.5.2.3.05/Fig.5.2.3.06). He pointed out their design philosophy:

Fig.5.2.3.07 One plus *prototypes of phone case*, 2020.

[62]. Alessandro Scarano. (2020), *Smartphone design explained to those who think it's all the same.* https://www.domusweb.it/

Fig.5.2.3.08 Xiaomi *Mi 9*, 2020.

Fig.5.2.3.09 Vivo *X23*, 2020.

It's not just fluid software and durable hardware that makes a good phone, explains Lau in *Beautiful to (Be)hold*, but design is important too - and by design he doesn't mean interaction or whatever, but pure CMF (Color, Materials, Finish), according to the traditional definition given by another great Italian designer, Clino Castelli, in the early eighties. He is proud of the effort on design of how they examined “over 300 combinations” (Fig.5.2.3.07) of colors in order to identify the best ones that could be obtained with new kinds of glass[62]. Although the color and finish effects were carefully considered by CMF team during the development of a smart phone design, and hundreds of samples were made to find out the colors and effects that are most suitable for their own brand expression, as the final results, the market preferences and trends are always need to ingratiate. (Fig.5.2.3.08/Fig.5.2.3.09)

Since the main functionalities in consumer electronics are extremely similar, products are the most direct way for consumers to distinguish the identity of the corresponding brands in daily using, as the competitive strategy from various brands, similar visual effects are designed to meet consumers’ preferences for the trend in product design, normally the general visual appeals by the tread with subtle differences from each brand. In addition, the renewal and innovation cycle of consumer electronics is also closely related to the trend, and the rapid iteration of smart phones also invites bolder design for such quick change in the market.

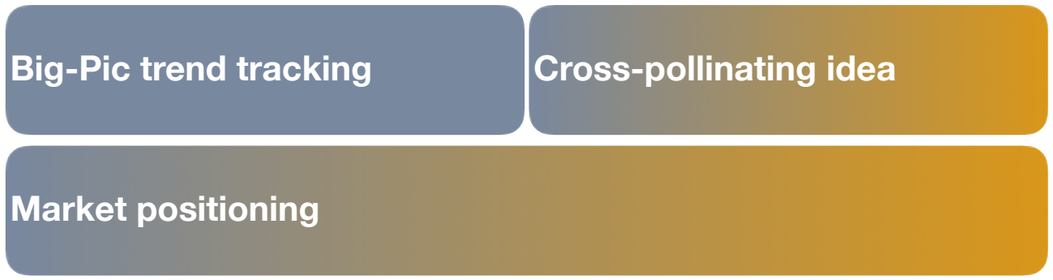
5.2.4 CMF in Trend

If this particular visual effect stays only due to the gorgeous color gradient, it may be possible to glimpse one or two in a series of futuristic works by Giacomo Balla[1] with the saturated pink and green, such as *Transformación forma-espíritu,* early as the 1910s, or the psychedelic lighting effects in 1970s, from Dan Flavin[2] with his visual arts. However, when “dichroic” became a trend, there were two another characteristics in terms of materials and finish effects, not only in color. A fragile but strong visual effect built on plastic-likes materials, and changing rainbow colors with on glossy surfaces.

The physical characteristics of plastic-likes have the specific Fresnel values[3] which different from metal lic or crystal, which shows its particular reflection and refraction effect, the “cheaper sense” of plastic. The functional attribute in plastic are perceived with fragile or not rigid, especially artificial invention for quicker mass-consumption, thus, this attribute was leading a general perception of plastics. In addition, when this changing “rainbow colors” was invited on this artificial surface, the glossy effect represents an affordable enjoyment, which the uncommon “natural wonder” could be easily reproduced. And the lifespan of plastic just like a rainbow is short and with the uncertainty.

The realization of such surface effects on different products stems from the innovation of materials and processing technology, which would be different with various application in each industry, such as this effect on textile in fashion wearings, and totally different processing with a similar effect on the furniture. Th dichroic film in this research provides a general solution for larger-scaled application in interior spaces with a reasonable price.

Due to the wide application of this eye-catching visual effect in different fields, **it gradually evolved into a trend realized** by more people, then was introduced in consumer-products with a new state. Samsung and its design team firstly introduced this visual effect in its flagship product family *Galaxy S* series and later with a sublet optimization in *Note* series, with its success in market, almost other competing brands immediately released new devices with similar effects in its flagship product line. These products form a competitive relationship with the high-end market among different brands.



This situation could be considered as the trend stems from its application in other industries, which was optimized by the designers and engineers with the **particular processing technology in consumer electronics**. The technical requirements of processing such effect on the smart phone case are much higher than the accomplishment on the general film, in addition, some other functional features need to be considered including durability, tactility and layer thickness. At the beginning, this finish effect was mainly applied in flagship products in each brand, normally with **the concern of processing costs**. With the optimization of processes and the reduction of costs, such trends were widely introduced into mid-range products which counties this trend in a lower market position, thereby, the high-end product line will be reserved for the next emerging trends.

In order to form the brand identity, each brand would emphasize its own characteristics in this trend, which accompanied by slight differences in its products, this is largely due to the **strong competitive situation in the consumer electronics market.** On the one hand, all brands need to introduce the advanced technological innovations in their high-end product lines, on the other hand, flagship products are designed to response any challenge from other brands, which also including visual appealing in design, thus a trend was strengthen by competitive strategies with a similar visual preference from various brands. While sharing the similar effects, different brands introduced various materials such as glass substrate to create more delicate visual perception and tactility.

1. Giacomo Balla (18 July 1871 – 1 March 1958) was an Italian painter, art teacher and poet best known as a key proponent of Futurism.

2. Dan Flavin (April 1, 1933 – November 29, 1996) was an American minimalist artist famous for creating sculptural objects and installations from commercially available fluorescent light fixtures.

3. This value shows how much of the ray is reflected off the surface versus how much is absorbed. Surfaces viewed at grazing angles reflect more of the incoming light compared to surfaces facing the camera.

Life span and innovation cycle

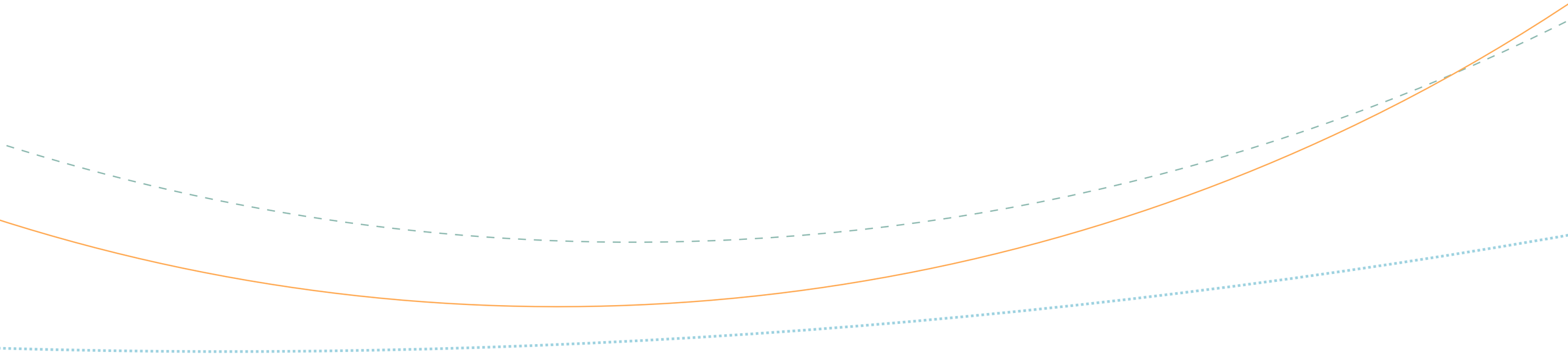
Since there is a strong relevance between the technological development and the innovation of consumer electronics industry, products are designed with an expected update cycle, which also leads to a **certain lifespan** of most products. This is why more bolder visual effects or designs can be introduced into consumer-electronics, and as the trend fades, these products will soon be replaced by newer ones. In interior space those designs are considered to just meet the trend, would later gradually lose its charm over time by its fading, **maybe in a longer cycle**. However, If such an effect could be simply replaced in the installation, or the space is **originally designed for temporary use**, thus, the strong elements like dichroic would be an excellent choice to create an uncommon visual experience or a state, this flexible design approach could enhance a certain visual experience instead permanently change the nature of interior space.

First read

Second read

CMF harmonies

A trend is often accompanied by a relative strong visual perception, or normally widely recognized in various fields. The colors and materials in the trend need to be readable, to create a more direct visual identity. If a trend is difficult to represent, or complicated to be recognized, then it would be difficult to get widespread. Therefore the “First read” should be extremely important in application for people to quickly identify the trend through visual perception. This will leading a **more direct expression in application**, for example, less detail would be applied to weaken the visual state of this “First read”, sometime additional elements would interference the perception towards this effect. And in interior design, a certain visual effect may dominate the atmosphere of the entire space. it is recommend that other neutral materials would be considered to **avoid over contrast**, especially when emphasizing the trend in design.



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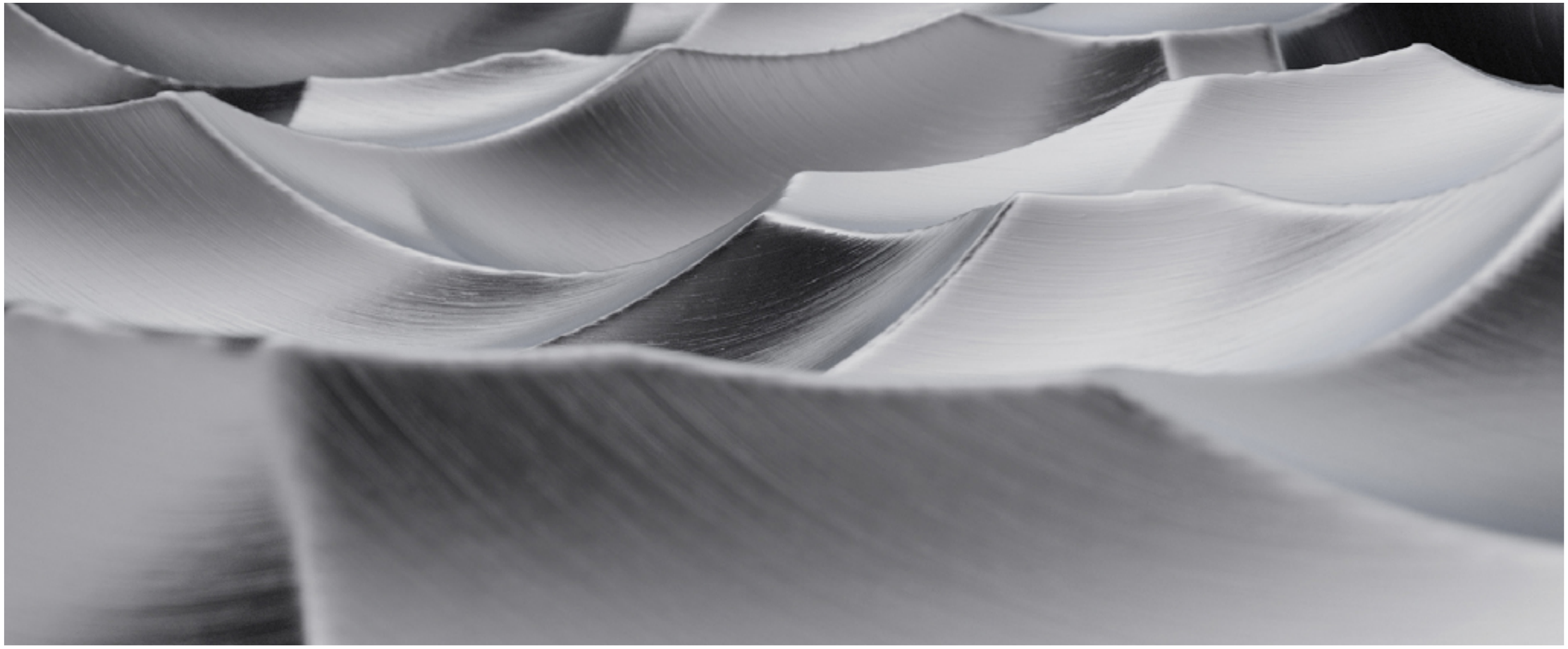


Fig.5.3.01 “Exist to Create” concept visual image, Bang & Olufsen, 2019.

5.3 Synesthesia in Materials

Since Bang & Olufsen was founded in Struer, Denmark in 1925, every product symbolizes the harmony and balance of technology and design, which is created to improve the quality of life and enjoyment of customers. "Different from others" is the spirit of biggest creativity. In the course of nearly 90 years of development, Bang & Olufsen is known around the world for high-quality materials, reliable performance, stylish appearance, user-friendly design and perfect after-sales service.

In their latest series 2019, the concept “Exist to Create” introduces the highly emotional creativity of color and material in products, rather challenging peoples’ imagination with a synesthesia perception of visual, hearing and even touch. The Bang & Olufsen describe this deign process of making a product is a magical transformation, an alchemy[1]. (Fig.5.3.01)

1. https://www.bang-olufsen.com/

5.3.1 The Magic of Bang & Olufsen

Bang and Olufsen, otherwise known as B&O, the Bang and Olufsen brand is a staple of Danish history, and a perfect example of what can be achieved in the branding world, with a strong purpose, a powerful dedication to long-standing values, great product design and aesthetics. As the most innovative, and revolutionary audio visual brands in the world. Their legendary story has already well known as its high-priced strategy of products.

Without the “competitive” priced, the thing that makes it special is the fact it knows how to innovate, evolve, and create with its customers in mind. Over the years, B&O has centered its growth around the idea that technology should be both beautiful, and functional at the same time[63]. This distinguished Danish company has delivered some of the most revolutionary products the electronics the world has ever seen, alongside some truly unforgettable marketing and branding strategies.

B&O considered itself the only brand that bridged the home electronics and lifestyle/luxury categories. Compared with bigger players, the company featured classic products with **long life cycles** sold in relatively small volumes, but at price points and margins that declined much more slowly than industry averages. Said Peter Eckhardt, head of B&O’s product development[64].

From the branding perspective, it’s easy to recognize the Bang & Olufsen identity in everything the company does. As B&O continues to build the brand, it consistently looks for new ways to showcase the brands purpose, and values. In such a competitive industry, B&O is surrounded by challenges , it manages to stand out in the marketplace by designing products for an almost cult-like following of people who put quality and design first[63].

The ever changing appeal of Bang & Olufsen just indicates how sustainable this company could be. This brand is building around customer experience, considering every aspect of design from the way the item looks, to how it feels, sounds, and works. It’s B&O’s devotion to impeccable customer experience that has made it so appealing throughout the years. By combining technology with visual appeal, B&O has found its differentiator, and continues to impress loyal customers, and attract new ones[63].

People who don’t have a B&O always think it’s just about design. But people who have a B&O often forget to talk about the design—they say it’s about the way the product works. B&O’s customers were an elite group, according to Torben Ballegaard, the company’s CEO, he also indicated their clients are business or liberal arts professionals over 20 years old, internationally oriented, appreciate the fine things in life and have a passion for perfection.[65] The brand offers them products that allow them to feel good at home, have a striking look, are easy to use, manufactured to the highest standards, and that last 15 to 20 years instead of the **industry typical 24 months**[64].

Another highlight is about innovations in using experience, Ballegaard described this as “a touch of magic”, some sublet consideration in design such as the glass doors of a CD player that open with a hand wave, or the TV screen that turns towards watchers when they switch it on. People who believe in their products then attract others. That idea of buying a product that lasts and represents something appeals to people of a certain culture[64]. He convinced the value in the connection of the emotional power by designers and the power of clients in the market. There is sustainability and growth[64].

With an introduction of the new range of smaller products with lower prices for younger customers from 2012[1]. Now in Bang & Olufsen, there are three main categories involve almost products. However, every unique design always has much stories to tell behind the product. (Fig.5.3.1.01)

Fig.5.3.1.01 Portable products in On-the-go category, Bang & Olufsen, 2018.

[63]. Stewart Hodgson. (2017), *A brand for sensational sound & vision: The Bang and Olufsen story,* https://medium.com/.
[64]. Robert D. Austin Daniela Beyersdorfer. (2007), *Bang & Olufsen: Design Driven Innovation.*
[65]. Factiva. (2005), *Bang on target,” Digital Life.*
1. https://www.bang-olufsen.com/

Known for design, Bang & Olufsen had never employed in-house designers. As design director Flemming Møller Pedersen explained, this was intentional:

We don't want "designers" to be "unduly" influenced by other parts of the organization . . . "which have" to worry about optimizing the daily business. "Designers" don't need to understand our industrial limitations . . . manufacturability, or what sound can come out of which form. Designers have to be free to look in an unconditioned way at what's happening in our society, how people live and furnish their homes, and then come up with proposals that could be good for B&O. It's up to our engineers to make it work[64].

One of B&O's most prominent designers, David Lewis, had been working with B&O since 1964 and had created some of its most famous designs. Formerly an apprentice of B&O's main designer Jacob Jensen, Lewis had remained with B&O when Jensen and the company split in the 1980s. However, this legendary designer, Jacob Jensen has been permanently written on the wall, in Bang & Olufsen official website, they introduces him:

For nearly three decades, pioneering designer Jacob Jensen gave form to Bang & Olufsen's vision. It became a defining collaboration that would consolidate the company's reputation as a world leader in sound and design[66].

Born in Copenhagen, Denmark in 1926, Jensen left school at thirteen and trained as an upholsterer. Bored by the humdrum tasks at his father's workshop, the young Jensen started tinkering around, making designs and models of everyday items. These eventually caught the eye of an architect who told Jensen's father that the unusual furniture designs clearly came from someone with great potential. Spurred on by this encounter, Jensen enrolled at the Danish School of Arts and Crafts in the late 1940s, where under Jørn Utzon's tutelage, Jensen was the first graduate in the new discipline of industrial design. He continued to ride the wave of this movement and in 1951 started working for Bernadotte & Bjørn – Denmark's first industrial design studio[66].

In 1958, Jensen prepared to set up his own company: Jacob Jensen Design, in Denmark. Soon thereafter, Jensen started to work with Bang & Olufsen.

Jacob Jensen become chief product designer for B&O in 1964 and is credited with developing the B&O design style, which is still used today. Through his time at Bang & Olufsen, Jensen developed over 200 products for the company. During this time he established a minimalistic, horizontal, and severe design style that became characteristic of his product designs[67].

Jensen's first complete product for Bang & Olufsen was the Beomaster 5000 tuner and amplifier, released in 1967. Jensen credited Bang & Olufsen's Roderik Madsen for the vision in taking on a revolutionary new design[66].

The spirit of innovation and experimentation only grew deeper as Jensen's partnership with his fellow Bang & Olufsen designers and engineers evolved. Together, they created landmark Bang & Olufsen designs that challenged the domination of the multinational corporations they found themselves competing with. With every new Jensen product came a story of collaboration and creativity: the Beogram 4000 turntable(Fig.5.3.1.02) with its revolutionary twin arms, designed in the home basement of aero engineer, Karl Gustav Zuethen[66]. In terms of concept, performance and technical design, this record player was much ahead of its time. All functions were governed by computer-like logic circuits and just pressing START, that was all. Through the unique detector arm (parallel to the pickup arm) these circuits could judge the size of the record, determine its normal playing speed and instruct the pick-up arm to lower the stylus into the lead-in groove[67].

Fig.5.3.1.02 *Beogram 4000*, Jacob Jensen, 1972-1975.

[66]. Bang & Olufsen. (2020), *A dialogue between past and present.*

[67]. Daniel Giebel. (2017), *function follows form: BANG & OLUFSEN design classics*, https://magazine.bulangandsons.com/

Another classic integrated home music system, the Beocenter 9000, which went through nearly 80 conceptual designs before its final incarnation[66]. The cool, clean design is carried out via microprocessors. The Beocenter 9000 is electronic through and through: the operating instructions for the relatively complicated apparatus with its many functions are built into the control equipment. Only the entirely everyday basic functions are visible in standby. When they are touched gently, the upper glass sheet - the 'magic mirror' - lights up. Several possible choices emerge only when they are needed[68].

The sheet of the Beocenter 9000 disappears into the side of the apparatus and makes the user feel like the actor in a science fiction film. The plus values of products cannot be created on the background of qualitative or quantitative marketing surveys. Jensen read the trends of the time and uses his intuition to fulfill consumers' unconscious wishes gives him a special state as an artist in product development[68].

5.3.2 Alchemical Aluminum

Mostly of these innovations in the pure aesthetics were designed with a representative material Aluminum, which with the cognition of its high performance and the association for future technology. Curiosity was the starting point for Bang&Olufsen's pioneering work with Aluminum[66]. In 1955, when the industry convention was to use heavy metals such as cadmium, chrome and nickel in audio products, engineers at Bang&Olufsen became intrigued by the possibilities of aluminum, for the functional attribute, the aluminum is a material that was strong, flexible, flat and resistant to corrosion. In today's products of Bang&Olufsen, the slick, mirror-like aluminum surfaces effect have become an integral and ubiquitous part of their design aesthetic.

"Aluminum has had an instrumental effect, not just on how our products perform," says Ib Kongstad, "but also on how they are designed[66]."

Since Ib Kongstad was joining Bang&Olufsen in 1984 as a chemical engineer he has worked as a technical specialist in anodizing, which is the electro mechanical surface treatment of aluminum. This process, taking place at the Bang&Olufsen factory headquarters in the northern Denmark town of Struer, (Fig.5.3.2.01/Fig.5.3.2.024) builds up a resistant oxide layer that gives aluminum surfaces their handsome glaze and make them so durable[66]. Ib Kongstad described the process in a poetic way

Fig.5.3.2.01 *Beosound 2* aluminum shell in process.

Fig.5.3.2.02 *Beosound 2* aluminum shell in process.

that cutters, grinders and steel transporters provide the soundtrack, which sheets and tubes of aluminum are transformed with an alchemist touch. First up is brushing and polishing. Ib pointed to the touch panel ear cup cap on the wireless BeoPlay H8i headphones to illustrate how the polishing create a spiral like-structure in the aluminum; its centered reflections swirl like a shiny wheel of fortune when you turn it around[66]. (Fig.5.3.2.03)

Fig.5.3.2.03 The conceptual rendering of *BeoPlay H9* in *Exist to Create,* 2019.

[66]. Bang & Olufsen. (2020), *A dialogue between past and present.*
[68]. Beoworld. (2006), *BeoCenter 9000*,https://www.beoworld.org/.

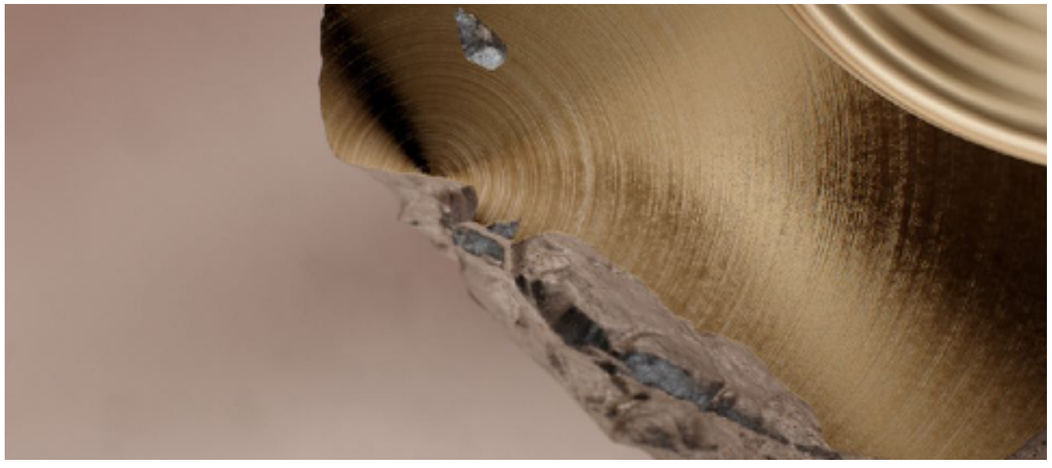


Fig.5.3.2.04 The conceptual rendering in *Exist to Create,* 2019.

This “alchemist” concept has been fully expressed by the ManvsMachine, which pays homage to the constancy of care in honest materials and conscientious design choices that are at the heart of the Bang & Olufsen brand[69]. As a loyal supporter and distributor of Bang & Olufsen, Pascal van Loo does not skimp on his appreciation of the honest design on materials. Once in an interview of him, he explained:

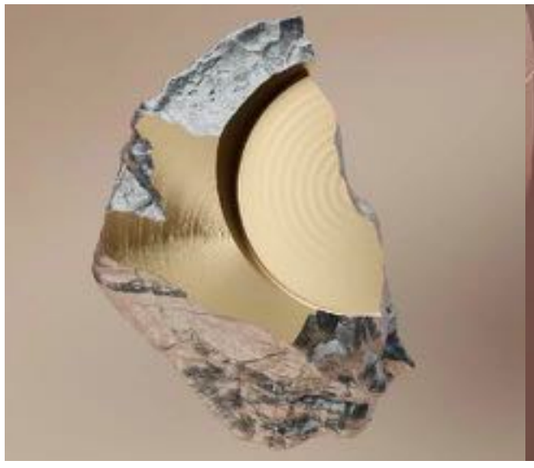


Fig.5.3.2.05 The conceptual rendering in *Exist to Create,* 2019.

Fig.5.3.2.06 The conceptual rendering of *BeoPlay H9* in *Exist to Create,* 2019.

“At Band & Olufsen, the aluminum is real aluminum, and the wood is real wood. That’s what has always separated them from other companies. People who recognize and value something like that will also treat other things differently.” But as far as Pascal van Loo can tell, there seem to be less and less of such people: “Average seems to be the new standard, doesn’t it?! But for me, Bang & Olufsen products have passion, a soul, a story – and the story of such classics today is worth more than the products themselves. If more people knew about the story of Bang & Olufsen, the brand would be much more present today[67].”

Such narrative of alchemist in the new “Exist to Create”, the aluminum has been depicted with highly emotional expression, that it does not give the functional induction and how excellent of this product could be, instead a double exposure has been introduced to show a transform from the bare aluminum ore to an extremely refined finish. (Fig.5.3.2.04)

The use of aluminum on this headphones is really impressive and carefully engineered. The surface of die-cast slider arms are sandblasted, and the outside hairline surface is brushed in the direction of the experience wear and tear. This also gives it a matte finish, which contrasts the glossy touch interface on the ear cap. The inner circle of the touch interface is only 0.2 millimeters thick and utilizes a technology whereby the touch sensor registers the forging of the aluminum[66].

From a functional point of view, this advanced processing technologies guarantee the high quality of the product from material properties and performance to a delicate surface touch, such as shaping it in one piece, the dissonance from joints and corners could be eliminated. And for the acoustic performance, aluminum is a “dead” material causing no distortion of the sound[66].

However, these attributes are expressed emotionally, and would be directly captured intuitively by users, this is a perfect example to describe how to achieve an impressive“user experience” through the material and finish processing. (Fig.5.3.2.05/Fig.5.3.2.06)

About this colored finished, an outstanding feature is the dyed aluminum in Bang&Olufsen products, normally, one single product involves various colors, this largely richen the options by different user preferences. Moreover, using aluminum as a substrate, more surface processes have been developed to meet different design approaches to fulfill the aesthetic and technical requirements.

[69].Bēhance. (2019), *Exist to Create : Campaign Bang & Olufsen.* https://www.behance.net/

[67]. Daniel Giebel. (2017), *function follows form: BANG & OLUFSEN design classics*, https://magazine.bulangandsons.com/

[66]. Bang & Olufsen. (2020), *A dialogue between past and present.*

Fig.5.3.2.07 The conceptual rendering in *Exist to Create,* 2019.

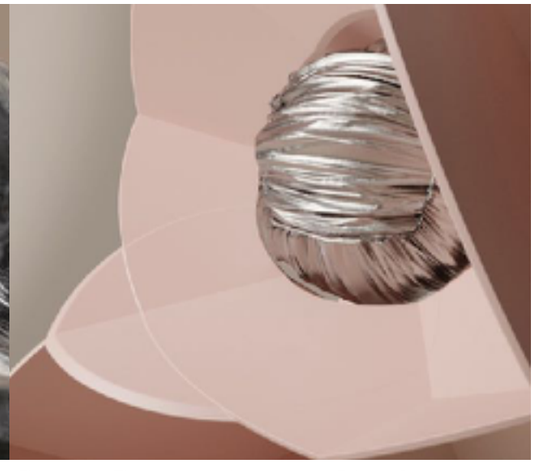


Fig.5.3.2.08 The conceptual rendering in *Exist to Create,* 2019.

Fig.5.3.2.09 The conceptual rendering of aluminum in *Exist to Create,* 2019.

Fig.5.3.2.10 The speakers panel of *Beovison Harmony*, 2019.

Beside the brushed effect of the aluminum, polished or matte surface are represented emotionally in this visual promotion. The aluminum foil with the brushed surface is rendered to flow like the silk, creating a tactile impulse, which is an excellent analogy through computer graphics technology. (Fig.5.3.2.07/Fig.5.3.2.08)

In another product, the latest smart television, “Beovision Harmony[1]”. The television is based on mid-century entertainment cabinets that hide the TV panel behind two delicate blinds to fully integrate with the living room. The main structure of the speakers are made by the combination with Oak strips in different thickness and aluminum components in constant size. The two materials installed at intervals produce a **gradual sensory effect as a whole**, and an excessive transition from metallic aluminum to wooden materials.

With this design, the materials are proposed into a fluid state with a dynamic rhythm. Following this concept, a harmonious fusion is represented as the the liquid aluminum passes between the oak slices. The inherent impression of a solid, high-performance metal material was transformed into a **surreal intent**, with a lighter, softer and smoother touch than oak. At this time, **people's perception was changed** of the material in this design. Although, materials are still formed into a simplicity with the minimalist aesthetic. (Fig.5.3.2.09/Fig.5.3.2.10)

Another material that is widely used in products and cannot be ignored is the brand's love of wood craftsmanship. While maintaining the original texture and natural properties of the wood, the Bang & Olufsen is constantly exploring its potential through the design and advanced technology. Various corporations with different designers in order to form a versatile nature of this material.

Fig.5.3.2.11 *Beovison Harmony*, 2019.

1. https://www.bang-olufsen.com/

5.3.3 Imagination of Wood

The existence of wood has played an integral part in B&O products. The use of wood is driven by an unwavering vision for the exacting standards of craftsmanship and engineering, and also this preference are normally seen in Scandinavian Design. On the one hand, it creates an association and the respect toward nature, on the other hand this concept was built on the strong connection between products and the interior space.

“Wood has always been an important aspect of Nordic architecture and furniture design because of its individual character, robustness and versatility, and we are proud to carry this forward in our Beovision Harmony[70]”, says John Mollanger, Bang & Olufsen’s Executive Vice President of Brand and Markets. (Fig.5.3.2.11)

This strong connection was originally carved at the beginning of the brand’s identity, B&O considered itself the only brand that bridged the home electronics and lifestyle/luxury categories. Compared with bigger players, the company featured classic products with long life cycles sold in relatively small volumes, but at price points and margins that declined much more slowly than industry averages. Said Peter Eckhardt, head of B&O’s product development[64].

“This problem of what to do with a screen when it’s turned off is something we’ve been thinking about for some time[70].” Jakob is Bang & Olufsen’s Mechanical Lead in the Vision department, which a moveable speakers in the wing-shaped are integrated in the front of the television. (Fig.5.3.3.01/Fig.5.3.3.02)

“People want to have large and immersive screens to enjoy movies on, but basically the larger the screens become, the less attractive it all is, with this big black monolith taking over the room. We’ve tried working with different technologies, LCD screens and more, trying to figure out how to solve this[70].” Jakob explained the design purpose. “When the Beovision Harmony idea emerged, the deal-breaker was the combination of having this transformation where we lift the screen and rotate the speaker fronts and have this graceful and dramatic shift between two states – all of a sudden it was a beautiful fluid motion[70].”

Fig.5.3.3.01 *Beovison Harmony*, 2019.

Fig.5.3.3.02 The poster of Bang&Olufsen in Salone del Mobile, 2019.

In their “design stories”[71], the technical development of this product has been briefly introduces form the very first prototypes made by cardboard to more detailed mechanical structures to pursuit this “unreachable” design proposal. And behind, it is their design-driven innovation[64]. (Fig.5.3.3.03/Fig.5.3.3.04)

Fig.5.3.3.03 footage in *Bang & Olufsen Design Stories: Our Creative Director of Design,* 2019

[70]. Bang & Olufsen. (2019), *Magic unfolds: Bang & Olufsen debuts Beovision Harmony at Milan Design Week*.
[64]. Robert D. Austin Daniela Beyersdorfer. (2007), *Bang & Olufsen: Design Driven Innovation.*
[71]. Bang & Olufsen. (2020), *Bang & Olufsen Design Stories: Our Creative Director of Design*.

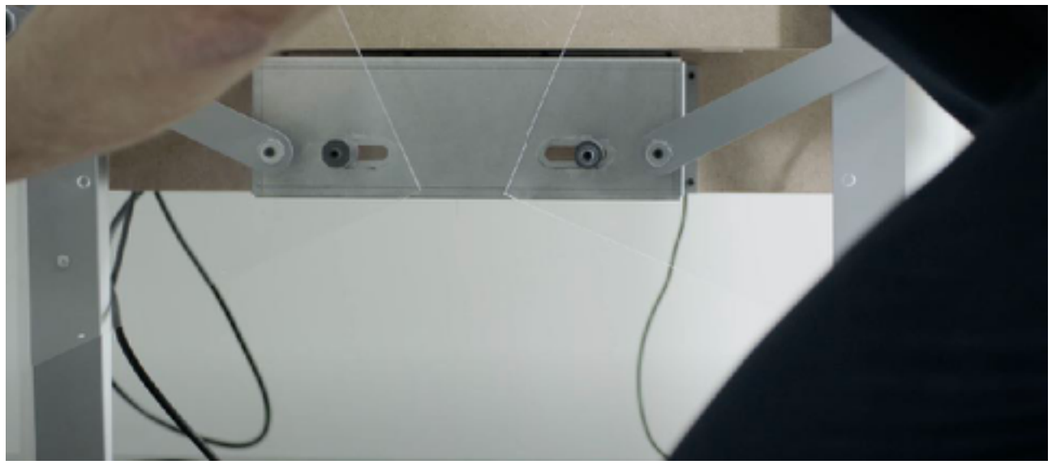


Fig.5.3.3.04 footage in *Bang & Olufsen Design Stories: Our Creative Director of Design,* 2019

Fig.5.3.3.05 The conceptual rendering of aluminum and wood oak in *Exist to Create,* 2019.

As design director Flemming Møller Pedersen explained to the design of B&O, this was intentional:

“We don’t want “designers” to be “unduly” influenced by other parts of the organization . . . “which have” to worry about optimizing the daily business. “Designers” don’t need to understand our industrial limitations . . . manufacturability, or what sound can come out of which form. Designers have to be free to look in an unconditioned way at what’s happening in our society, how people live and furnish their homes, and then come up with proposals that could be good for B&O. It’s up to our engineers to make it work[64].”

Based on the professional experience of creating the high-quality sound performance, the design team were emphasizing the excellent hearing experience in this surreal design. Such design highlights are also cleverly visualized in the way of people's imagination of sound.

Unlike the design of woven textiles commonly used as covering panels in audio system, solid materials such as wood and metal aluminum are depicted as extremely soft images in the conceptual video “Exist to Create”, which following the rhythm and vibration of the background track and showing the waveform curves similar to sound, that is a brilliant metaphor. (Fig.5.3.3.05)

Just several months ago in April 2020, there was an event that Bang & Olufsen Presented a minimalist showroom located in Tokyo, Japan, designed by Schemata Architects. Instead of sitting in one place for a long time and listening to music there, one constantly hops from one place to another and gets various types of information simultaneously as if surfing the internet[72]. (Fig.5.3.3.06)

This installation offers visitors such a contemporary sensory experience through B&O products. Sounds loop, and one can get different types of information depending on the time and place. In order to create such an experience, the designer built a sound grid system modeled after traditional Japanese wood joinery[72]. (Fig.5.3.3.07)

In the interview of Schemata, he indicates that the fundamental concern is to create an inspirational and joyful experience for clients. Those structure were made by the wooden sticks into a symbol of Japanese traditional architecture, which the aim of this structure was originally designed to support the roof of the house. Products of Bang & Olufsen were orderly placed at the junctions in cross structure. Those speakers have became important points in the framework that were supported by a Japanese narrative. The wood as the crucial material in the traditional Japanese architecture represented a state, which built a connection with the products of Bang & Olufsen.

[64]. Robert D. Austin Daniela Beyersdorfer. (2007), *Bang & Olufsen: Design Driven Innovation.*
[72]. Leo Lei. (2020), *Bang & Olufsen Presentation by Schemata Architects,* https://leibal.com/.

Fig.5.3.3.06 Bang & Olufsen Presentation by Schemata Architects, Tokyo, Japan, 2020.

Fig.5.3.3.07 Bang & Olufsen Presentation by Schemata Architects, Tokyo, Japan, 2020.

In this context, a strong emotional attribute of the wood would be perceived by clients and then turning into a cultural identity of the product. And this metaphor introduced the familiar building structure in the traditional culture supports a new concept and idea that provides people a brand new experience. This may delivery a concept that products have cultural support with a strong correlation. A slightly exotic impression of this changing panels has been expressed in the “Exist to Create”. The fan-shaped surface composed of wooden strips is gradually opened, a process that simulates the structure of the speaker opening from a vertical position to parallel. This is an intuitive representation of a product mechanical move. Another very creative expression is to render the wooden panel to be stacked like the cream with the surreal elasticity and extensibility. (Fig.5.3.3.08/Fig.5.3.3.09)

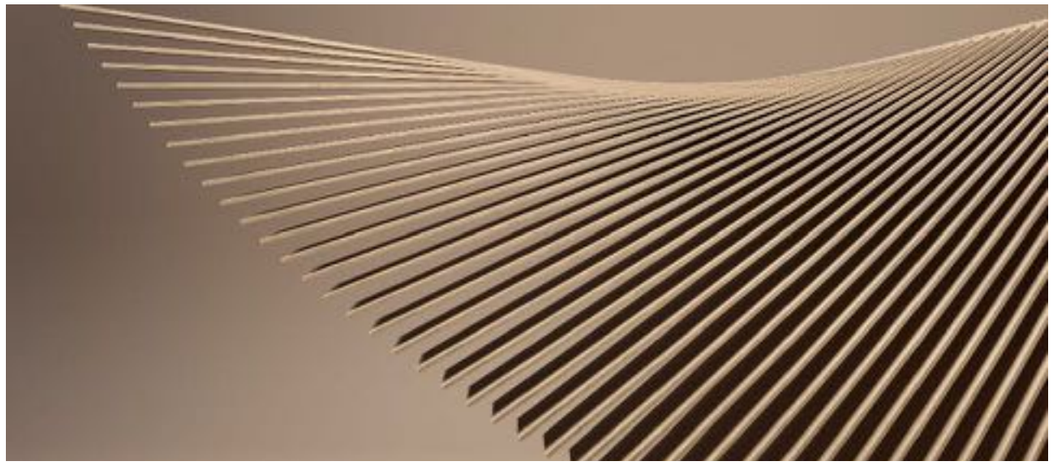


Fig.5.3.3.08 The conceptual rendering of wood oak in *Exist to Create,* 2019.

Fig.5.3.3.09 The conceptual rendering of wood oak in *Exist to Create,* 2019.

Through associations between forms, a poetic design of wood in B&O's product was inspired by the truly instrument, the strings of the cello, where beautiful melodies begin. Then designers Torsten Valeur, David Lewis turned this concept into a product with neatly arranged wood components. The BeoLab 18 is an update on B&O's iconic BeoLab 8000 – a tall, slender and striking speaker, and first released in 2013. (Fig.5.3.3.10/Fig.5.3.3.11)

Fig.5.3.3.10 Footage in *Immaculate Wireless Sound - Great sound deserves Bang & Olufsen,* 2013.

Fig.5.3.3.11 Footage in *Immaculate Wireless Sound - Great sound deserves Bang & Olufsen,* 2013.

This iteration artfully blends 21 thin wood panels with aluminum accents to create the sort of futuristic aesthetic that gets B&O's products placed in motion pictures so often. Technically, driver compliment involves two 4-inch mid-woofers and a 3/4-inch tweeter powered by the same duo of 160-watt internal amplifiers. The design here allows the speaker to radiate sound in 180 degrees, an approach that is mean to deliver a wide and realistic sound stage, delivering that "you are there" feeling when listening to music[73].

The application wood in such sized product has a certain consideration of how to meet the design in the interior space, the Bang & Olufsen emphasized the warm of feeling and the "furniture-feel[74]" attributes. The color strategy of the wood components offers totally five different options, they are separately Maple, Smoked oak, Walnut, Black and White. (Fig.5.3.3.12/Fig.5.3.3.13)

Fig.5.3.3.12 *Beolab 18,* Bang & Olufsen, 2013.

Fig.5.3.3.13 Footage in *Immaculate Wireless Sound - Great sound deserves Bang & Olufsen,* 2013.

In 2015, Bang & Olufsen released a produce with an incredible user experience through the wood. The "Moment" is an ambassador for both of the qualities in a new lifestyle and interaction between users and products. The removable controller was integrated to a solid base, which is actually double-sided. There's the sparse wooden panel, but flip it over, it's aluminum surrounding a large touchscreen[75]. (Fig.5.3.3.14/Fig.5.3.3.15)

Fig.5.3.3.14 *Beolab Moment,* Bang & Olufsen, 2015.

Fig.5.3.3.15 *Beolab Moment,* Bang & Olufsen, 2015.

[73]. Caleb Denison. (2013), *B&O's new Beolabs are adorably named, insanely designed, exceptionally wireless* , https://www.digitaltrends.com/.

[74]. Bang & Olufsen. (2020), *Adding the natural touch to technology.*

[75]. James Trew. (2015), *B&O wants you to touch wood to control your music at home.*

Fig.5.3.3.16 *Beolab Moment,* Bang & Olufsen*,* 2015.

Fig.5.3.3.17 *Beolab Moment,* Bang & Olufsen*,* 2015.

Each side represents a different way to interact with the music, and both of them look like something that wouldn't be out of place in an interior design magazine. Especially when nestled between two of the firm's equally manicured speakers and the function supports to connect B&O's wireless ones[75].

There is capacitive sensor just under the thin layer of laminate, thus when using the wooden side, the interaction was called habit-learning “PatternPlay." It could learn the users’ music-listening patterns and preferences. The Moment is taking note in every operation, and will start auto-playing the music that users want to hear with just a single touch of the wooden panel[75].

The wood side meets people's experience of this natural material and intuitive interactive logic, simple and with a slightly uncertainty, but generally meet your expectation. This expressed the sense of non-reproducibility and randomness produced by a natural material.

On another side, it's effectively a digital tablet. There's a conventional UI that lets users browse sound collection via the usual filters such as artist, album, etc. The Moment also aggregates all musics into one seamless catalog. While this interface is more conventional, there's still a little B&O magic on this side of the controller[75].

[75]. James Trew. (2015), *B&O wants you to touch wood to control your music at home.*

A color wheel with concentric circles provide intuitive options to choose and to discover musics based on the mood. Colors represent intensity and emotion, while the circles dictate how close the music is to user’s personal collection, the central more certain and further form would be something unknown. It's certainly an interesting take on discovery.

This product as a perfect example to describe double operations with a similar emotional connection. There is nothing complicated through a touch with a wooden furniture, or even a tree. And the laminate surface engages users to explore the product in the most natural way, bedside the logo of Bang & Olufsen, only shallow grooves are carved on the wooden side and waiting for users to draw a circle in a mild way. (Fig.5.3.3.16/Fig.5.3.3.17)

The logic of “color control” completely exceeds people's expectations for digital touch screens. This is based on a human’s general perception of color mood, people project their emotions in a certain color range, and this particular color range also responds to people's emotions through music playback. The color here becomes a visual connection between the user's emotions and music. Therefore, this product satisfies the user's emotions from multiple senses of visual, hearing and tactility. Thanks to the people’s inherent perception of color and material, the magic design simplify a series of complex logical operations into an intuitive transformation between the senses, a Synesthesia.

5.3.4 Hearing Textiles

Soft materials such as fabrics, textiles and leather are very important in professional sound products of Bang & Olufsen. In small-sized products, the choice of textiles or leather is not only for aesthetic considerations, but also as a medium for a direct contact with human skin. Such frequent contact places high demands on comfort and tactility. For example, the design of the headphone in Bang & Olufsen are extremely emphasizing the comfort, Soft synthetic textiles are rendered as the marshmallow and the white colored leather is depicted in a “milky” way. In this scenario, soft materials such as textiles create a high-quality user experience. It has the feature that hard materials cannot achieve, which belongs to its excellence in functional performance. In addition, the genuine leather creates the perceived value to the high-end products. (Fig.5.3.4.01/Fig.5.3.4.02)

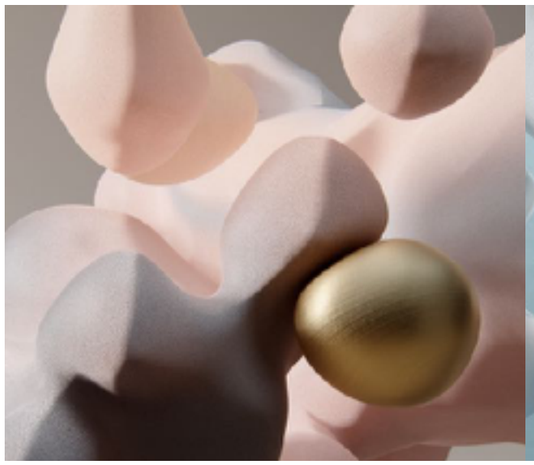


Fig.5.3.4.01 The conceptual rendering of synthetic textiles and aluminum in *Exist to Create,* 2019.

Fig.5.3.4.02 The conceptual rendering of leather and aluminum in *Exist to Create,* 2019.

Fig.5.3.4.03 *BeoSound Shape, 2017*

In larger sized products, the textiles has been given some different meaning in the design. An interesting perceptive by “BeoSound Shape” provides color and material solutions both in the product and the interior space.

Compare to emphasize the statement of design-orientated products, the “BeoSound Shape” in modular wall-mounted speaker system offers a different solution for “hiding” the product in interior space. The narrative of this product mainly concentrate in new possibilities for the senses, from sound performance to the visual experience of the interior space. The designer Øivind Alexander Slaato indicated the inspiration for the “Beosound Shape” speaker is a combination of the hexagonal-shaped structure in nature and the spectrum of the snowflake[76]. The mathematical feature allows a repetitive and expanding form for this and the designer created additional auditory sense in this form. (Fig.5.3.4.04)

Because of this modular tile concept, it allows customers to choose the size, shape, color and even the sound performance according to personal preference. Each tile functions as a speaker, amplifier or acoustic damper and can be pieced together in endless combinations and sizes to serve rooms big and small. This flexible system can be rearranged to form new patterns or tiles can be added to boost sound performance or acoustic dampening properties[76]. (Fig.5.3.4.03)

Through the collaboration of designers and engineers, basic modules with different functions have finally achieved a modular installation and his process completes the definition of the product. All technical challenges and engineering details are cleverly hidden behind the textiles panels, and users most consider how to choose their favorite colors and forms in their own interior space, thus designers left the most interesting to the users. (Fig.5.3.4.05)

Fig.5.3.4.04 The design concept of *BeoSound Shape,*2017

Fig.5.3.4.05 *BeoSound Shape,* 2017

[76]. Bang & Olufsen. (2020), *Beosound shape, The story of shape.*

Modularity is not the newest concept in design, however, the form of this product provides extremely high degrees of freedom and possibility through the visual and auditory characteristics of colors and materials. From the perspective of product functionality, the arrangement offers a variety of auditory settings based on personal preferences and the nature of the space. The arrangement is sometimes not fixed in a certain position in the space, these may be shaped as a group on the whole side on the wall, or scattered in all corners. (Fig.5.3.4.06)

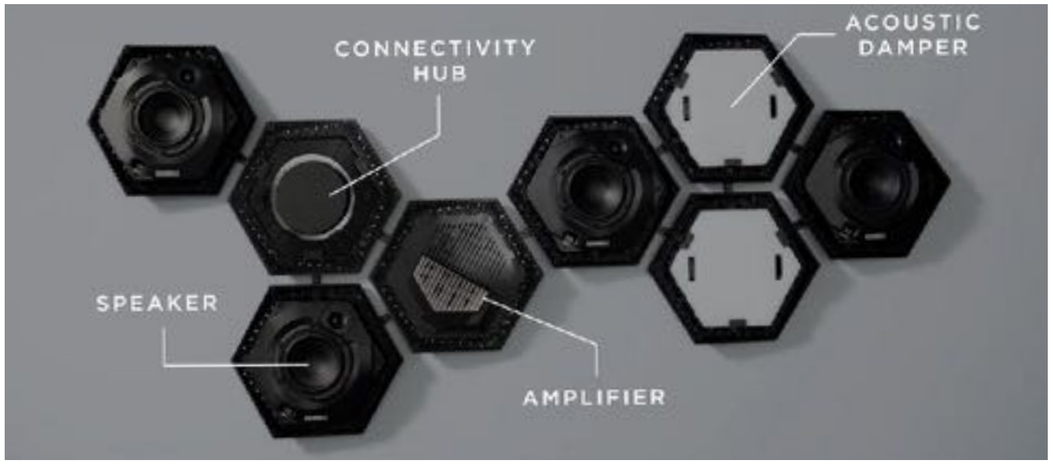


Fig.5.3.4.06 Technical structure of *BeoSound Shape, 2017*

Finally, all these functional approaches are hidden under a flexible color strategy, the variety of colors and surface materials redefine the perception of all modules in space. With this “separation” of functionality and emotional attribute, this modular system offers countless possibilities, in other words, it can adapt to different using scenarios to the greatest extent.

Generally speaking, the design of the product hopes to emphasize the uniqueness of its own aesthetics, so that the user can recognize it to the greatest extent, and feel its functionality and aesthetics. In contrast, the design philosophy of “Beosound Shape” transfers the priority to their consumers and using contexts. The appearance of products are determined by the actual settings, a dynamic and ever-changing visual perception rather than a static communication which a preset dialogue provided by the designer.

B&O suggests a patented technology called "band on the wall", a unique up-mixing algorithm that distributes the signals across the speakers making the correlated signal appear in the center from every listening position instead of sitting in the center of a stereo perspective. It is described as a “sound carpet” or architectural sound[76]. (Fig.5.3.4.07)

Fig.5.3.4.07 Kvadrat’s wool textiles on *BeoSound Shape,* London, UK, 2018.

[76]. Bang & Olufsen. (2020), *Beosound shape, The story of shape.*

In this design approach, each module is covered with soft textiles without excessive ornaments, thus, when these modules are combined in a large area and placed in an interior space, the perception of colors and materials will be amplified, just as the smallest flaws in the sound will be amplified.

At Salone del Mobile Milano 2017, Bang & Olufsen launched an experimental event (Fig.5.3.4.08) to introduce closer relationship between products and interiors. The modular “Beosound Shape” has been the main actor to create in a highly artistic visual impression to enhance people’s perception of a new interior soundscape. Besides a detailed introduction of the “Beosound Shape” in technical aspects, the colored textiles have been applied as an eye-catching elements in interior space, such as divides or screens.

Base on the official indiction, the design manifesto of this large-scaled dome structure (Fig.5.3.4.09) was aim to create an inspiration which to engage people live with the sound[77]. Even without a consideration of the acoustic attribute in this installation or any other settings, the design may inspire a perspective of colors and tactile materials in this interior space. A simple instance, the module was form like a palette, according to the user’s preference, it provides a color tone and got rid of the aesthetic contradiction and competition between different products in the interior space.

Fig.5.3.4.08 Bang & Olufsen Exhibition in Salone del Mobile Milano 2017.

Such the palette engages designers like Johanna Grawunder and Sophie Ashby[78], to develop some relevant installation in interior space, and this product was involved in their mood board.

Bang & Olufsen's design philosophy encourages designers to consider the product based on the user's actual experience and scene, and for most audio equipment, their use scene is the interior environment, thus, it can partially explain that images in product catalog tend to show the real product in a more specific scene, sometime surrounding with appealing details.

Fig.5.3.4.09 Bang & Olufsen Exhibition in Salone del Mobile Milano 2017.

[77]. Bang & Olufsen. (2020), *BeoSound Shape - Technology or Art?*

[78]. Wallpaper*. (2020), *Creative talents explore the possibilities of Bang & Olufsen’s BeoSound Shape system.*

On Bang & Olufsen's website, they are sharing stories about their designers, products and lifestyle, etc. This could be recognized as the storytelling that introducing their products in some ideal using scenarios, in order to emphasize the life style. Moreover, they offer the customized color and materials service to better coordinate the atmosphere of home or any other place (Fig.5.3.4.10). Such the method is actually quite different from the marketing methods presented by conventional consumer electronics. About this strategy, Jakob Kristoffersen, the brand's Concept and Design Manager pointed out:

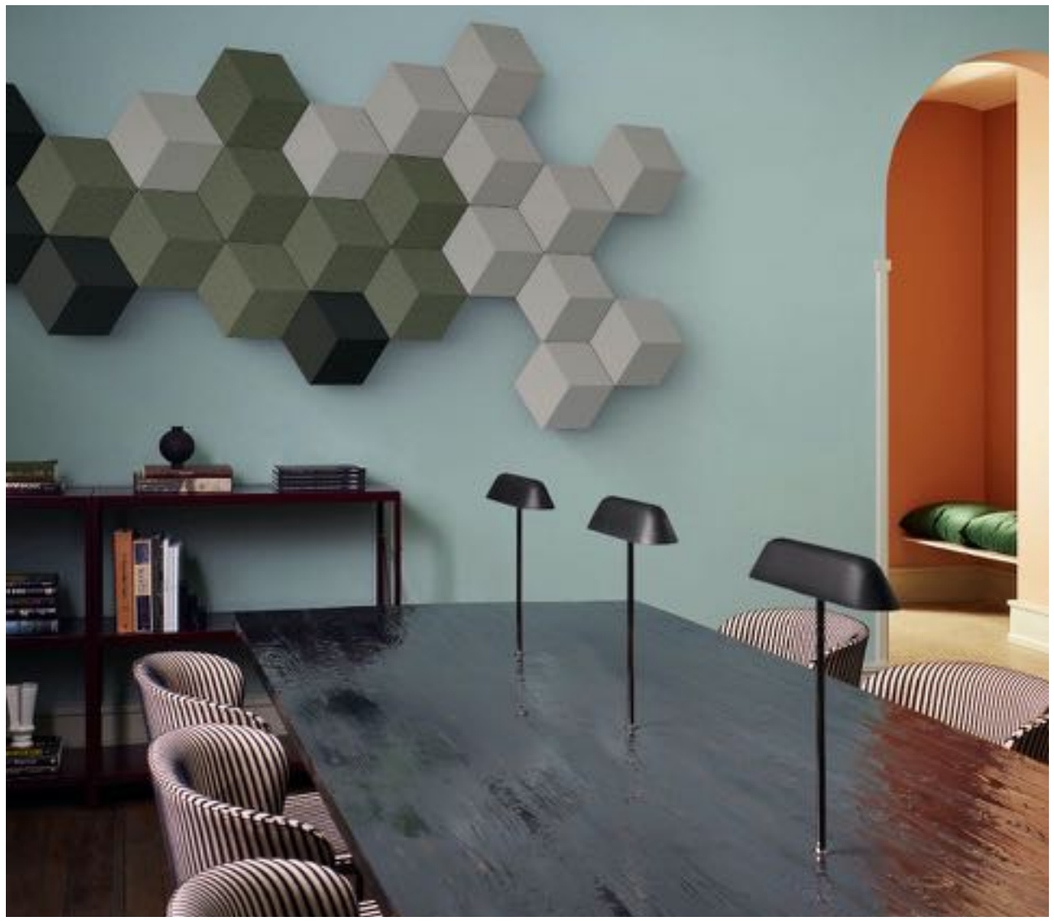


Fig.5.3.4.10 *BeoSound Shape, 2017*

"B&O Play exists in a corner of consumer electronics world defined by design. And that's merely the beginning. The brand and its designers view sound as furniture for the home and conceptual design thinking drives invention." He identified their design process: "We have framed our whole process on being a lifestyle brand, rather than a tech one[79]."

It is not difficult to imagine that the product in Bang & Olufsen's are partly defined as the sculptures or furniture rather than household appliances and this makes the design in products have more interior design considerations. (Fig.5.3.4.11)

Fig.5.3.4.11 Bang & Olufsen products catalog, 2020.

[79].David Graver. (2018), *Concept + design manger for B&O play, Jakob Kristoffersen,* https://coolhunting.com/.

5.3.5 CMF in Bang & Olufsen

Bang & Olufsen defines its brand as a global **luxury lifestyle brand** in official annual report, and their deign mainly focus on products of audio innovation, in addition, the aesthetics and high quality in their product design are emphasized in its statement, with other characteristics such as the unrivaled craftsmanship[80] in terms of digital sound devices.

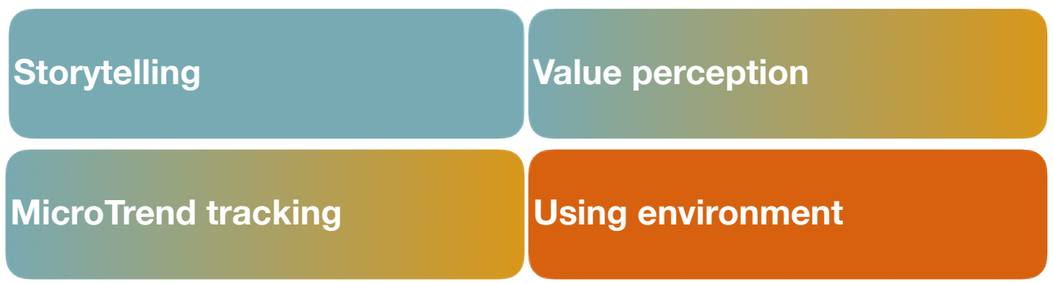
Bang & Olufsen's aspiration is to become the most desired audio brand in the world[80]. To achieve this, the company will strengthen the luxury-lifestyle positioning and continue to create innovative and progressive products based on its core **capabilities of sound**, design, and **craftsmanship**. Its luxury-lifestyle positioning ensures the CMF have a certain consideration in its design, especially it is more willing to draw more inspiration from cooperation with external teams or independent designers instead establishing an internal design team to complete all works.

After clarifying its positioning, user research is more targeted to achieve the product design purpose. The brand regards its sound performance as the core of product functionality, and product design is the **physical implement** of achieving this **sound quality or innovation**, which could be perceived by its **unique using experience**. In terms of CMF functional context, this aspiration has been materialized to **respond the the appealing of its consumer segment**. In its design language, natural wood and metal aluminum are widely engaged as the most representative materials in the products, various **processing techniques** based on these two materials give more expression on different products. Another common material in its product with higher flexibility is textiles, which enhance the tactile experience and comfort in closer contact with users, moreover, theses materials sometimes have the certain acoustic consideration in the product design.

For the emotional context, the value perception through these materials are normally represented by a **delicate manufacturing and fine processing**, which would convey the luxury and high-end approach of the product. Generally the oak wood and metal aluminum could not be recognized as rare materials in products, however, the CMF design of the product largely takes into account of its use environment, that partly determines the user experience and corresponding space. The interior or domestic space is considered as the most important scenario of its products' storytelling, especially in the categories of "Flexible Living" and "Staged"[80].

The products in category "Staged" are defined as used in stationary settings for immersive listening or viewing experiences, these products normally with a permanent state, which makes the it collectible rather than common electronics. The complex operation and multi-functions normally in digital electronics have been replaced by a simpler and intuitive user experience, the CMF in such product creates **a closer association with the furniture and interior design**. For example, the design of the good seat is to provide a comfortable experience to a large extent, in this logic, the seat would not be endowed with multiple functions or any complicated using interactions, but only to satisfy one functional approach with the **simplicity and harmonious aesthetics in interiors**. And the simplicity in CMF design could be represented as the exquisite craftsmanship and authentic expression of material to rich the aesthetics in the category of "Staged".

The colors in Bang & Olufsen's CMF could be seen form a perspective of the flexibility in trend, the category "On-the-go" introduces some smaller and potable products in lower price, and the CMF in these products is intent to **evoke certain dynamic states**, which brighter and trendy colors design are purposed to engage younger people in a larger market place. The changing using environments vary the CMF approaches in portable products.



[80]. Bang & Olufsen. (2018), *Annual report 2017/18*.

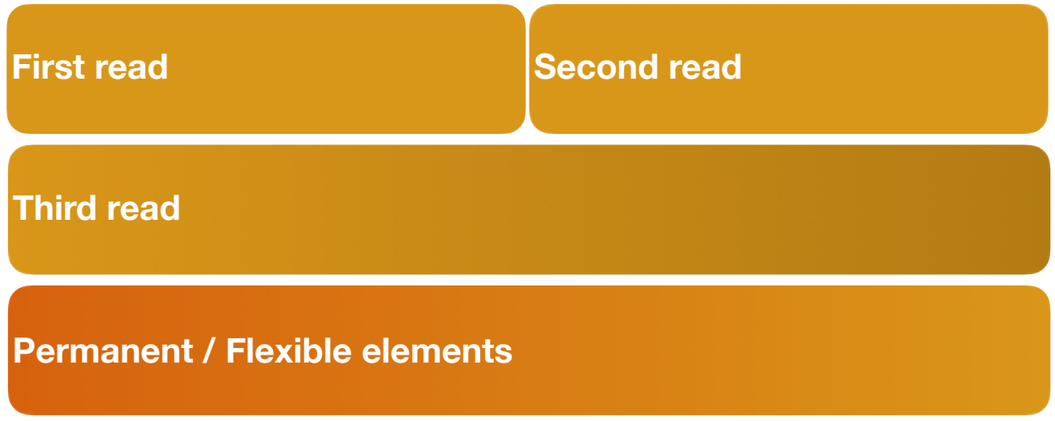
The conceptual CG rendering “Exist to create” would be an example to introduced the color and material design in Bang & Olufsen’s product with an extreme innovation, which the materials are **rendered with a realistic effect but in a surreal state**, such as the ductile wooden sticks or liquid metal aluminum. The materials in this visual Mood board are represented with genuine details, the wooden grain with matte surface and the aluminum has its metallic reflection, this familiar perceptions of real materials have been completely changed into a **highly emotional state through the CG tech**. This visual expression indicates that its CMF design is faithful to real materials with the innovative formation, to create an exceptional using experience.

Mood board

In this way, the ““Exist to create” could be also recognized as the metaphor to the design philosophy in Bang & Olufsen, the pursuit of the sound and audio technology relies on technical supports, that is the core of this brand, however, all these highly rational details related to technology are cleverly hidden in pure and natural materials, that makes all products seem to have nothing to do with those complicated structure, ugly wires and integrated circuits.

The product is designed as an artwork or some kind of interior decoration similar to furniture. Visually, it has the beauty of craftsmanship, but there is no technical rigidity and alienation. It visually established a connection with people's familiar things, like a fine processed chair or any contemporary furniture, while retaining its uniqueness, without any sense of abrupt or strange. And more worth mentioning is that a simultaneous perceptions are happening at the same time in using, the visual perception, the interaction with touch, and the main function of the product, the hearing experience, all these senses are closely connected through an intuitive operation. Therefore, the association of the hearing is based on a certain color and tactile experience, the sound creates a visual state, or to make an analogy, synesthesia.

For example, usually advanced LED TV will increase the size of the panel as much as possible, which is usually called a “borderless design”. When the “Beovision Harmony” in turned off state, the product is only a stereo. The wooden and aluminum panels are emphasized in front of the black scream, which reduces the abrupt of the LED display in the space. With the switch, the TV screen will slowly rise, and the wooden panel rotates from vertical to horizontal, and finally people would focus on the screen. It transformed a technical operation such as turn on turn off, into a series of perceivable moving actions. and this magic transform with the material creates an exceptional using experience.



The **“First read”** in Bang & Olufsen’s design would be recognized as pure and complete to emphasize its professional by introducing the tightness and accuracy in material processing. The **“Second read”** in some products are seen as precision finish effects on metal aluminum shell, parting structures are usually avoided, making the visually single molding. The **“Third read”** could be normally seen in Bang & Olufsen’s products, especially in the high-end series. Such as the wooden components in “Beovision Harmony” are processed with handicraft and carefully polished, or the delicate logo on any surface. For the permanent elements in the products, the design are usually inviting rigid structures with higher performance, and for the flexible elements, like the decorative panels, this replaceable structure enable optional colors and materials for further upgrading.

LANDING TO INTERIOR

6.0 CMF in Apple Stores

If the discussion is to clarify the CMF approach in interior design, then more considerations and analysis of the interior should be introduced. Of course, the CMF design approaches in this research mainly stem from the representation and a collation of “The Fundamental Principles of CMF Design: Colour Material Finish”, and the author pointed out that the CMF approaches discussed in this book focus on the topic of consumer-products and the corresponding design process, and the starting point is mostly from CMF at the product level, from the perspective of brand, market and user experience. (Becerra, 2016.)

The author indicates the category of colors and materials in interior design, that it is another professional discipline, which differentiates from consumer products **in terms of scale and duration**, etc. Therefore, the part of the interior space mentioned in the previous case studies in this research are limited to the specific aspect in discussions, such as analyzing the colors and materials of the brand identity, or looking at the state of the specific finish effect in the interior and its application from the perspective of the trend ,or other more. (Becerra, 2016.)

Therefore, when introducing the interior cases for further discussions, the colors and materials related to the brand identity, market or trend and user experience would also be considered to a certain extent, however most would focus on **how CMF approaches may provide a perspective to analysis of the colors, materials and finishes in interior consideration.**

Based on these premise, the Apple Store could be regarded as suitable case studies and analysis of CMF in interior design. From the perspective of the brand, **Apple Store in its global layout** is designed as the experience center of their products, and are often recognized as the landmark any surroundings in the center of the city. It is an "icon", so **a consistent brand identity** has been formed in people's impressions, which contains some very **representative colors and materials**, such as bright shades of white or light gray, or large areas of glass curtains as the building facade.

In addition, according to the different venues, the design of Apple Store in different regions could ensure its uniqueness, which makes the Apple Store not only stand out from the many buildings surrounding, but also allow each store to have a **distinguished characteristic**.

A not-so-appropriate analogy, like the unique aesthetic and industrial design of Apple’s products among various brands, the Apple Store could be easily identified from a certain distance even in the center of the city, besides to the impressive architectural form, it can also inspire the thinking about the contribution of colors and materials. Some **current projects by Foster + Partners**[1] **would be the representative case studies accompanied with CMF approaches**, the “Key Nodes” for further discussions. (Fig.5.3.4.11)

Fig.6.0.01 Interior of Apple Store Piazza del Liberty by Foster + Partners, Milano, 2018.

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[1]. Lilliana Becerra. (2016), *The Fundamental Principles of CMF Design: Colour Material Finish*.

1. Sir Norman Robert Foster, Baron Foster of Thames Bank, OM, RA, is an English architect whose company, Foster + Partners, maintains an international design practice.

6.1 The Background “Noise”

From the perspective of color and material to form a general identity of the Apple Store, it creates a **simple and neutral idealized color impression** in the space. In interior applications, colors with higher lightness and lower saturation are often seen, with a completely retained interface to form a relatively pure sense in visual experience.

Except for the introduction of some green plants, usually, the interior space presents a relatively low complexity, and the color contrast in the hue is very little, the overall appearance shows a **neutral color preference.** For example, the Apple Stores Regent Street in London, natural stones (Italian Castagna stone) are proceeds in the warm gray[81], which is widely used as the main interface on the wall. The surface is carefully polished to form a matte texture, and excess reflection will be avoided (Fig.6.1.01). The strip-like patterns of natural materials normally remains to be arranged neatly in parallel. The same application of this natural stone has also been applied in the Apple Orchard Road, the first Apple flagship in the Singapore[82].

This material are considered as a complete visual perception in design and processing, the walls and staircases are made from sandblasted stone, while the balustrade – seemingly carved in to the wall – has a smooth, curved, and honed finish that is pleasant to touch. The stone walls and balustrade

Fig.6.1.01 Apple Stores Regent Street by Foster + Partners, London, 2017.

Fig.6.1.02 Stairs of Apple Store Dubai by Foster + Partners, Dubai, 2017.

were created by a combination of handicraftsman-ship and CNC robotics, and were dry assembled at the manufacturing site to make sure each piece fit perfectly before installation[81]. And in Apple Orchard Road, an higher spiral stairs (Fig.6.1.02) has been built for a dynamic expression through this solid material, an unusual definition of stone in shaping. This harmonious tone was achieved by introducing less kinds of material with various processing instead chromatic material categories, such as the subtle difference was emphasized by a darker polishing of the stone in handing groove.

[81]. Archdaily. (2016), *Apple Regent Street / Foster + Partners*.

[82]. Amy Frearson. (2017), *Foster + Partners opens "one of our greenest Apple spaces yet" in Singapore,*https://www.dezeen.com/.

Fig.6.1.03 Handrail of Apple Stores Regent Street by Foster + Partners, London, 2017.

Fig.6.1.04 Handrail of Apple Store Dubai by Foster + Partners, Dubai, 2017.

In a certain distance, this handing groove area is visually as a different material, or shadow casting on the surface, in closer, this part would be perceived as a continuous surface with the same material[82], a metaphor of the stone carving art. (Fig.6.1.03/Fig.6.1.04)

Part break-ups in CMF

From the technical analysis, in this way, the same material is distinguished by colors and processed finishes to indicate the structure in perception and **visual guidance**. The handrail is an important interactive part of the entire surface, and its functional properties have been expressed through this **visual "part break-ups"** instead of introducing two physical materials to form this difference.

Similar to this natural design, in Apple Store Piazza del Liberty in Milano, a massive application of another stone (the Gray **Beola stone**)[83] with local characteristics has been emphasized in this project. The cool-gray surface retains the graininess of the original stone without fine polishing. The stone itself does not have obvious patterns, instead resulting in a stillness and unified tone.

It is widely applied in the interior space(Fig.6.1.05) of the project and extends to the building and surrounding environment (Fig.6.1.06). This is a typical building material in the Lombardia region[83] , which people are familiar with this in **local city context**. Although this Apple Store has a very different architectural manifesto from the surrounding buildings, a closer perception of this building could be acquired by introducing this material.

Fig.6.1.05 Interior of Apple Store Piazza del Liberty by Foster + Partners, Milano, 2018.

Fig.6.1.06 Exterior of Apple Store Piazza del Liberty by Foster + Partners, Milano, 2018.

[83]. Niall Patrick Walsh. (2018), *Foster + Partners' Milan Apple Store Opens to the Public With Dramatic Waterfall Entrance*.

The introduction of local materials is often seen as a response to **local culture and context** in architecture and interior design. A sense of familiarity could be connected with people, and a soundless communication could be built among architecture, interior space with the surrounding environment and people through materials.

Design localization

The localization strategy in consumer-products is widely regarded as the **catering of colors and materials** to the target market and corresponding consumers, it also draws inspiration from local culture, in consumer products, local elements tend to be expressed in a more direct and strong way, so that consumers could accurately capture the cultural symbols and corresponding visual elements in design. The expression of this design element in the interior space would be considered more carefully, especially in a larger scale, to reach **a state of harmony** with the general spatial ambience. As the application of the Beola stone in this space, it occupies **almost the vast majority** of the wall and the ground. People would realize its existence, but they may not be distracted by it, as if the sound of rain is actually loud, but it will be ignored. The **stone works in a massive but talks in whisper**. (Fig.6.1.06)

In addition to natural stones, a neutral gray tone can also be achieved through other materials. Such as another common feature in some Apple Stores, the aluminum panels[84]. Compared with natural stones, metal aluminum is one of the main interfaces in the space and is usually processed into a unique smooth, that such finished effect is in line with people's impression of the aluminum. This metal effect creates more detailed reflection and more precise technology in processing than natural materials. It creates an ideal surface that is more complete than natural materials, which without any flaw and random textures. (Fig.6.1.07)

In closer touch, these materials represent very different feelings, but generally form an overall sense, a light-colored neutral visual experience as the background of the Apple Store in people's mind. As the counterpoint, “this Background” constitutes the **“First read”** of the space. It dominates the overall atmosphere of the space as a whole in vertical walls and even on the ground. However,

Fig.6.1.07 Apple Stores Hangzhou by Foster + Partners, Hangzhou, 2015.

compared to the nature of the “First read” that is aim to be **“Visible” in the product**, such materials are no longer noticeable by **weakening the color in Apple Store’s interior**. In contrast, as a part of the urban landscape, this monochrome blocks can be well recognized in the complex urban landscape in a certain distance. When observing these materials more closely, their surface effects and patterns retain the **details of the “second read”**. However, those details are considered as a delicate expression of inherent characteristics to keep a real state of the material. For example, the patterns of natural stone are carefully stitched into continuous lines, or neatly arranged aluminum panels that are precisely cut and installed.

First read | **Second read**

Moreover, another factor to form the **“First read”** in interior is the lighting, that is certainly more obvious with even subtle changes than products. In visual perception, the “first read” in products engage the most attention of users, however in interior, the strategy may differ from states to form an enclosed space, which lead considerable influence on the senses and emotional perception. **If there would be a context for products, thus the interior space is the context surrounded.**

[84]. Amy Frearson. (2015), *Foster + Partners completes Apple store in Hangzhou, China,* https://www.dezeen.com/.

6.2 The Invisible State

Another iconic design element that is almost considered to be a must in the Apple Store. The **huge glass structure or curtain in facade**. This functionally can be regarded as an indoor and outdoor medium, becoming an important part of shaping the space. Visually, the huge transparent glass introduces the natural light into the interior space, and from an exterior perspective, it invites the city landscape and surrounding environment to a closer state.

From the outer perspective, the huge transparent facade makes it possible that the pure visual background in the store with a special aesthetic and visual perception could be perceived without any reservation. In some Apple Stores, huge glass is even formed as a monumental and poetic urban sculpture in design, which emphasizes an **exclusive identity of the brand** with its Logo.

The application of glass may be considered as an “engaging material”, which is always connected with **a large “Apple” icon**. When used as an architectural facade of the Apple Store, it allows the indoor environment and activities to be directly perceived by people are passing by, and when it exists as a "sculpture", it creates the engagement that internal things are physically isolated by this transparent material, but they are visually presented, which arouse people's curiosity and desire to explore.

This may explain why it can be used as an important material in the main channel. For example, the Apple Store Piazza del Liberty has a huge fountain entrance in the that square.

The site was originally the historical Apollo cinema. The fountain catches the attention of the curious people, or the Portal, as it is called, a form of a parallelepiped eight-meter high from which 56 jets of water flow, and the imposing staircase that recalls a Roman amphitheater (Fig.6.2.01). The Milanese store has a similar concept as the one in 5th Avenue in New York: **a geometric glass architecture** that expands to the underground. Actually, the store where you can get the Apple products and accessories is reached by going down a couple of floors[83].

Almost every Apple store, its highly recognizable icons ( ) will be visually connected tightly wit the glass. This is largely related to first Apple Store in Manhattan, New York. The well known “Apple Cube”. Apple then remains this symbolic material and geometric minimalist design as a **distinctive**

Fig.6.2.01 Stairs of Apple Store Piazza del Liberty by Foster + Partners, Milano, 2018.

brand identity in stores. Or the glass can be regarded as a **metaphor for the “screen”**, which is normally applied in Apple’s electronic products, providing the exclusive visual experience of virtual space. In interiors, the application of glass often introduces light, which is the same as the screen, the **light and visual perception,** and every Apple device will display its logo on the boot interface.

Visual identity

[83]. Niall Patrick Walsh. (2018), *Foster + Partners' Milan Apple Store Opens to the Public With Dramatic Waterfall Entrance*.

Unlike products, visual identity in space could sometimes overlap each other or appear in a dynamic manner. Apple Store Piazza del Liberty introduced the fountain as a design element, to represent an Italian city culture behind the glass, which generates an overlap with Apple's design aesthetics, to from a dynamic visual experience. This makes this store keeps its uniqueness with the general brand image.

Similar design language could be seen in the Apple Store in Macau[85]. The Macau scheme takes the form of a "luminescent cube" with a pure geometry and warm "paper lantern" (Fig.6.2.02) glow seeking to draw pedestrians through its bamboo grove and external event plaza. Upon entering, visitors are surrounded by glowing stone panels, shimmering by day in reaction to the sun, and softly radiating a warm glow at night to contrast with the bright lights of Macau[85]. Like the water behind the glass, here the natural stone pattern provides a doubles surface for both exterior and interior.

An innovative glass-stone composite facade is comprised of five glazed layers integrated with thin layers of stone, creating a definable translucent stone materiality not dissimilar from stained glass. This glass facade here have two states, a clear transparent and fuzzy translucent. (Fig.6.2.03) Obviously, this is a visual experience directly related to the changing light, the **"First read"** here builds a certain connection with a dynamic visual identity, instead of being the stationary background.

Fig.6.2.02 Facade of Apple Stores Macau by Foster + Partners, Macau, 2018.

Nevertheless, the color preference still follows a bright and neutral tone with lower saturation, It also can exist as a background or can be perceived with more details at a closer distance. In this design, emotional attributes such as cultural consideration and local elements are perfectly organized with the innovation of technology. At the same time, this design also introduces another thinking of the material in the interior application, the distance between the person and the material directly affects the visual experience, in other words, the **layering of the material** at different **observation distances**.

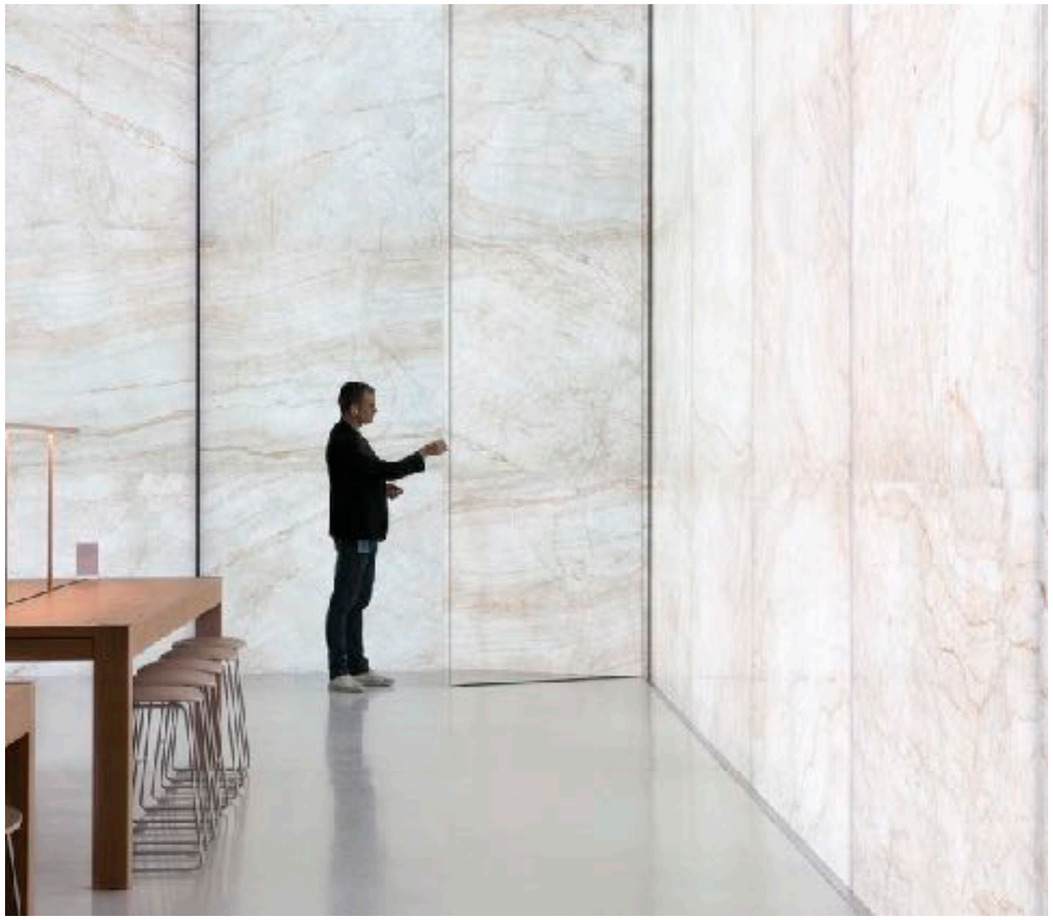

Fig.6.2.03 Facade of Apple Stores Macau by Foster + Partners, Macau, 2018.

[85]. Niall Patrick Walsh. (2018),*Stone, Glass, and Bamboo Meet in Foster + Partners' Recently-Opened Apple Store in Macau*.

Another eye-catching glass application in Apple Store is sometimes associated with stairs, which creates the perceptional conflict of glass as a fragile material. The anti-slip treatment of the surface not only guarantees safety in functional attributes, but also enriches the visual layerings aesthetically. There may be a sense of fear by pedestrians without this polishing process, and various transparency of surface makes the whole stairs lighter in visual (Fig.6.2.04). The matte surface was processed in line with detailed edges, this finish effect could be considered as the **“Second read”** or even **“Third read”** in small-scale details. (Fig.6.2.05)

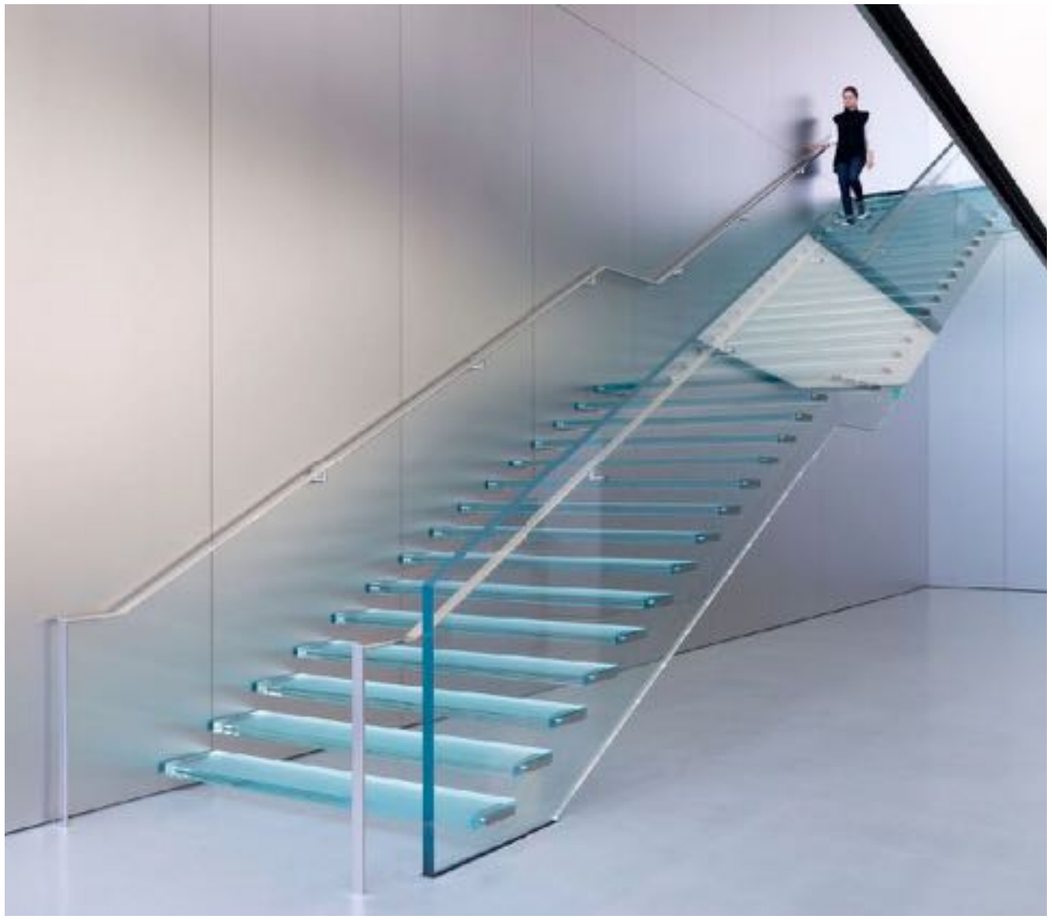

Fig.6.2.04 Stairs of Apple Stores Hangzhou by Foster + Partners, Hangzhou, 2015.

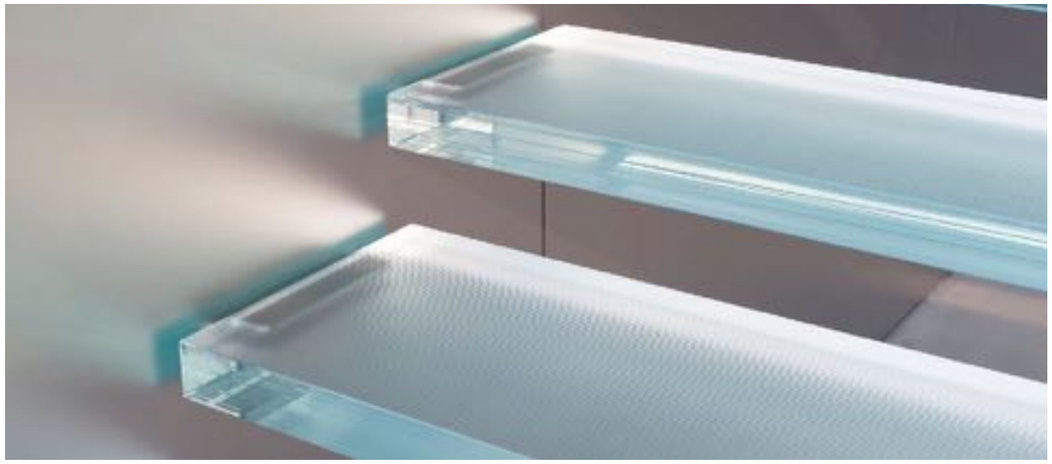

Fig.6.2.05 Stairs of Apple Stores Hangzhou by Foster + Partners, Hangzhou, 2015.

Third read

Mirror stainless steel is used as a material with a very strong visual perception in the recent Apple Stores, the extremely polished surface gives it an unparalleled reflection effect. It reflects all the colors and light from the surrounding environment without inherent color or tone, which makes it like a chameleon, disappearing in the space but in a noticeable way. Its reflection of light comes from its morphological changes, and colors and materials in the space are formed in a special effect on its surface. Like a sound as a metaphor, an Echo with distortion effects. Such characteristics may cause uncertainty in the perception of its volume. Regular application of this materials would emphasize the quality of accuracy in products. The effect of this mirror surface is carefully polished to form an aesthetic of advanced processing technology. In the application of interior design, a small amount of mirror stainless steel can also evoke such perception, and compared with the neutral expression of metal aluminum, stainless steel in people's perception is more in line with the cold and technical sense conveyed by its metallic nature.

Another noteworthy point is **“scale proportion”** of this material in the space could form different visual experience. For example, stainless steel is applied to blade-shaped staircases arranged in a neat manner. The specular reflection forms a sharp contrast with the diffuse natural stone surface in the background, and the introduction of light render this contrast more intense. The unique surface properties of stainless steel make it a strong visual impact even if it occupies a certain small proportion in the space area. (Fig.6.2.06) When it is given on a complete curved surface, it becomes less sharp in visual perception, even with a larger proportion in interior space. This implies that for

Scale proportion

such materials with strong finish effects, the application in space is not only related to the scale and proportion in space, but also to a large extent affected by the shape and form applied. (Fig.6.2.07)

Fig.6.2.06 Stairs of Apple Store Piazza del Liberty by Foster + Partners, Milano, 2018.

Fig.6.2.07 Stairs of Apple Stores Fifth Avenue by Foster + Partners, NYC, 2019.

6.3 White and Light

In addition to introducing natural light into the indoor environment through glass on the facade, the materials and colors of store's ceiling take into account the interior light environment and the setting of artificial lighting.

In Apple Stores Fifth Avenue, the main interior space is located underground, an innovative tunable white-light ceiling to match the exact wavelengths of sunlight at different times of day, blurring the boundary between inside and outside, Most recent Apple Stores use a plank ceiling or narrow lengths of fabric stretched over light boxes. (Fig.6.3.01)

Fig.6.3.01 Ceilings of Apple Stores Fifth Avenue by Foster + Partners, NYC, 2019.

Apple Fifth Avenue's ceiling is divided into a grid with circular cutouts trumpeting upward to reveal the sky. The store's artificial lights respond to natural rhythm of the sunlight by **gradually shifting color temperature** throughout the day[86]. (Fig.6.3.02)

Fig.6.3.02 Ceilings of Apple Stores Fifth Avenue by Foster + Partners, NYC, 2019.

And another lighting solution for the underground space is the backlit ceiling panel in Apple Store Milano, the light inside a single subterranean space (Fig.6.3.03) from above through skylights and the artificial lighting arrays[83]. This way of combining **natural light and artificial light sources** on the roof ceiling is not uncommon, however, the stable and uniform light provided by backlighting allows the interior of the space to not only feel the comfort brought by natural light but also form a **stable indoor lighting environment** in dynamic natural light (Fig.6.3.04).

Since the backlight distributes the lighting components over a large area and provides illumination with a soft light-emitting panel, the dazzling light generated by a large number of point lights is avoided. The uniformly illuminated panel visually creates **a slightly luminous a pure white perception**.

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[86]. Chris Welch. (2019), *Apple's iconic fifth avenue store is Bach and bigger than ever, The cube looks the same, but everything around it is new,* The Verge. https://www.theverge.com/

Fig.6.3.03 Section figure of Apple Store Piazza del Liberty by Foster + Partners, Milano, 2018.

Fig.6.3.05 Ceilings of Apple Stores Hangzhou by Foster + Partners, Hangzhou, 2015.

Fig.6.3.04 Ceiling structure of Apple Store Piazza del Liberty by Foster + Partners, Milano, 2018.

This “white” is also applied in a larger area to create a purist spatial sense in Apple Stores Hangzhou. The whole ceiling was designed with a custom-made lighting panels that creates a dynamic artificial solution to balance the impact of outdoor light on the interior (Fig.6.3.05), and it allows the monolithic aluminum plate in the space to maintain a constant neutral tone, such as the grey card[1] in photography. Generally, the **application of colors and materials on products is static**, and is largely affected by the use environment, especially some surface effects are easily changed by the surrounding environment, and it is difficult to **accurately identify colors** in the absence of lighting. The expression of CMF in the interior space can be optimized through lighting settings to obtain better perception. The external natural light will change drastically due to the weather, so it will directly determine the product display in the space. The lighting integrated by the ceiling system in the interior ensures that the colors and materials can be **clearly identified in a stable state**. In some environments, people need "standard white" as a reference to feel other colors.

The definition in photography is called white balance. For cameras, white balance is the process of removing unrealistic color casts. Proper camera white balance has to take into account the "color temperature" of a light source, which refers to the relative warmth or coolness of white light, digital cameras often have great difficulty with auto white balance (AWB) — and can create unsightly blue, orange, or even green color casts. The human eyes could judging what is white under different light sources, however, in the indoor environment, artificial light sources cannot fully simulate the characteristics of natural light in the perspective of the spectrum. Specific wavelengths will seriously affect the rendering of colors, this makes the application of most **colors and materials in interior** should be **considered with an accurate lighting solution**, so that “white” could be perceived as the real white.

1. A gray card is a middle gray reference, typically used together with a reflective light meter, as a way to produce consistent image exposure and/or color in film and photography.

6.4 Standardized Woods

The Apple Store can form a unified impression visually and sensory, even if there are differences in materials such as localized design thinking, besides the preference for specific colors in the interior space, another important factor is the standard display furnishing of every store in the world.

These Maple wood standardized furnishings including movable tables and chairs, which are provide the convenience for customers to experience products quickly, moreover the same material in fixed wall-mounted showcases are also introduced in every Apple Store to display product accessories. In addition, some electronic display, advertising pictures and even facade Greenery would be integrated into this wall display system. There is no doubt that this kind of wood furnishing is the most direct medium with products and consumers in the interior space. (Fig.6.4.01)

All wooden furniture retains the open inherent wood texture, and usually has no defects on the surface, such as wood knots or uneven color. And all the furniture has a concise shape and is cut with sharp edges, like an industrial product that has been delicately processed. The introduction of natural materials gives these industrial products a furniture-like feel to imitate a daily use scenario with an extremely concise form. This setting provides a **standardized guide** for its display and all products will be organized to experience in this unified small **“Using environment”**, thus consumers

Standardized guidelines

can get a **consistent background** on the senses when experiencing products in any Apple Store. By abstracting common materials of furnishings in the interior environment, a symbolic perfect wooden surface with neutral colors could provide **a similarity in sensory experience**. About the **“Neutral attribute”** of this material, the wood can provide a warm and natural tactility that is so different from conventional building materials such as setons, metal aluminum, etc. From the perspective of material perception, wood evokes the **softest perception among the general materials** in interior, which providing a **certain contrast** for its industrialized products. (Fig.6.4.02)

Using environment

Neutral attribute

Fig.6.4.01 Wall system of Apple Store Union Square by Foster + Partners, San Fransisco, 2016.

Fig.6.4.02 Wall system of Apple Store, unknown.

And the smooth and open wooden surface also has a certain degree of stain resistance and scratch resistance. Due to its standardized production and design, the replacement of furniture will be also very convenient. In order to better support their product display and experience, these wooden furniture have also been carefully designed to meet functional requirements such as providing wireless power for products[87].

Compared with the CMF considerations in products, the colors and materials in interior design not only need to meet the functional and aesthetic requirements, but also the **social factors in**

Fig..6.4.03 Apple Stores Regent Street by Foster + Partners, London, 2017.

Fig..6.4.04 Wall system of Apple Stores Fifth Avenue by Foster + Partners, NYC, 2019.

Consumers analysis

Storytelling

communication venues provided by public buildings, which include **group psychology and Behavioral analysis**. That is so different from the relationship between individuals and products. For example, the Apple Store's introduction of real plants into the interior space may lie in simulating the scene of people's social behavior in outdoor squares or streets. These green vegetations are planted in ring-shaped benches, arranged in a very neat manner, to visually form **an impassion of urban streets**, which is not only to introduce the natural perception into the interior space, but to evoke the **language of urban lifestyle** territory. (Fig.6.4.01)

This setting provides an excellent narrative for products and corresponding communication, as if people will sit on a bench under the tree to intuitively talk with each other. The experience of daily life is connected with the product and it also a **natural storytelling to the context** of user experience. (Fig.6.4.01)

[87]. Blair MacGregor. (2016), *Apple details 'magic' gesture-controlled store tables in new filing*.

CONCLUSION

In processing of this research, the information about CMF is very limited. As a design concept based on the Meta-design, there is few existing conclusion with a clear framework and systematic definition in various fields. However, **specific methodologies** and design approaches involved in CMF are relatively clear, which as the practical solutions have been taken into practice. That means design approaches with the **certain flexibility in the CMF design process**, which relies on the interdisciplinary analysis from different perspectives, and makes it possible to introduce CMF in a wider range through the coordination of different design approaches.

The research mainly from the consumer-product industry where the CMF concept has been widely approved, by inducting the approach of colors, materials and finish effects in product design to a **representation of CMF framework**, which consists of CMF consideration and corresponding solutions in brand, market and user experience.

Existing color and material relevance has been normally considered in interior design approaches, and the value of CMF in this context is by introducing sophisticated solutions from another field to interior consideration. This may provide some inspiration, especially in some **interiors preferred some scenario with products**. Therefore the interior design could form a closer relationship with the product in terms of color and materials.

In this thesis, through interpretation of design approaches of functional and emotional attributes in CMF, there would be **a certain value to interior design, but also with limitations**.

The research and classification of materials in the CMF could effectively provide a wide range of references for interior design. For example, the application of emerging materials in consumer products can be quickly transplanted to interior spaces with the specific design purpose. Some design approaches such as CMF indicator can be introduced to clarify colors and materials in interior design. Persona and Mood board have been widely approved as design approaches for user analysis and conceptual materialization in interior design, while CMF 's functional and emotional analysis of colors and materials in the user experience may provide additional valuable information, to create an ideal interior space that is more in line with product using scenarios. Also, the idea similar to CMF palette could improve the efficiency for a systematic design evaluation based on specific interior design appeals by establishing keywords, defining material partitions and visualization. Design considerations of CMF about brand identity would be interesting topics as reference in interior design.

The application in different fields vary design approaches from CMF in products to the interior space, especially the contrast in size and scale, even consideration of lifespan, which determines the perception of colors and materials in interior design. For example, the visual classification of CMF as the "First read" and "Second read" could not be directly applied as an inherent methodology in interiors. Or even the definition and application of “Permanent and Flexible elements” in CMF needs to be optimized according to the long-term using in interior design. Besides, the market aspects in product design could not be represented as the sam way in interiors. Such as an analysis of the trend indicates its particular expression in each field.

Finally, this thesis invites the **comparative analysis of CMF in product design and interior design**, which partly shows the possibility of CMF being used as the meta-design concept in interior design, form **particular perspective of brand, market and users experience** to consider the inspirations and limitations.

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