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Hierarchy of Sustainable Design Factors within the Fast-Moving-Consumer-Goods sector

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Abstract *The alarming rate of today's environmental degradation shows that the business-as-usual is not sustainable. Thus sustainable design has emerged, as not only a thriving research area but also as a business imperative. However, few studies offer empirical evidence on the successful implementation of sustainable design to consumer products. This study identifies the influencing factors for successful implementation of sustainable design within the Fast-Moving-Consumer-Goods (FMCG) sector. The unit of the analysis is the front-end of the new product development (NPD) process. Two companies from Brazil and South Korea were selected for in-depth case studies representing different stages of the sustainability continuum respectively. A total of 14 interviews were conducted with different functions from management, design, marketing, and sustainability to R&D at high/ middle/ low level within the company hierarchy. The qualitative data analysis of the standardised questionnaire survey and simultaneous semi-structured interviews results are presented as a conceptual model of 'Hierarchy of Eleven Sustainable Design Implementation Factors'.*

1. Introduction

This research starts from the stance that we all are the part of causes and consequences of today's environmental crisis. Particularly it is explicit for the first author as she is an industrial designer by vocation, and a consumer by nature. Thus the scope of the research is sustainable design of consumer products and the purpose of this research is to gain a deeper understanding of the influencing factors for FMCG to implement sustainable design and enhance their sustainable practice level in their products.

1.1. Sustainable Design and the front-end of NPD

Sustainable design is defined as 'design that addresses all environmental, economic, and social impacts throughout the product's life cycle without compromising other criteria such as function, quality, cost, and appearance' [1,2]. Over the recent decades, it has become a thriving research area as well as an emerging business imperative, as one of the strong media to enhance the sustainability practice level. The purpose of this research is to gain a deeper understanding of the influencing factors for FMCG to implement sustainable design and enhance their sustainable practice level in their products. Arguably, sustainable design can play a key role in reifying sustainability into products as

product design decisions make a substantial difference in the product's overall impact from the material use, manufacturing methods, transportation capacity, distribution channels, energy consumption, longevity, and disposal methods besides the shape and style. Since the late 1980s, the pure importance of design for successful businesses has been stressed by numerous business management academics [3,4,5,6,7]. In short, when design embraces sustainability, it can maximise the influence of the products and services to the environment, stakeholders (e.g. product users, supply-chain communities, manufacturing labours) as well as company's profitability.
The earlier sustainable design is considered, the more impactful it can be. This means that introducing sustainable design at the front-end stages of the NPD process allows more to consider aspects of sustainable design products and thus more holistic results of the whole NPD process [8,9,10,11,12,13,14,15].

1.2. Sustainable Design and FMCG

FMCG are non-durable retail products (e.g. toiletries, soft drinks, groceries) that are generally replaced or fully used up over a short period of time: days, week or months. The characteristics of the FMCG industry entitle its significance in sustainability research. From consumer's perspective: a) frequent purchase, b) low involvement, and c) low price, whilst from the manufacturer's perspectives: d) high volume, e) low margins, and f) fast turnover. In short, FMCG products are cheap, accessible and short-lived products made to meet consumers' everyday needs. Unlike heavier areas such as automobile, housing, or electronics, FMCG products require lower investments of money and time both to manufacture and to consume, possibly leading a rather lighter-minded attitude towards their impacts. However, FMCG products have direct anthropogenic impacts on the environment and society throughout its entire lifecycle [16]. Consumers can be highly impactful by their constant purchase decision-making and usage, as well as manufacturers by the high manufacturing volume and the fast turnover. Natural resource depletion, energy consumption, greenhouse gas emission, and waste generation are some of the conspicuous examples during its manufacturing, transporting, using and discarding. However, sustainability within FMCG is surprisingly understudied and few industrial practices offer empirical evidences at a major scale.

2. Literature Review

An extensive literature review of influencing factors was conducted encompassing three different research areas: Eco design in the sustainable engineering research, NPD and front-end studies in the business management field, and sustainable design from the industrial design area. The cross-disciplinary nature of the literature review is beneficial not to dwell in one research realm but to complement disparate research areas with the similar focus.

2.1. Early adoption of sustainable design

One of the emerging themes is the constant emphasis on the early adoption of sustainable consideration in the NPD process. The most critical decisions are

made at the early stage of NPD regarding cost, appearance, material selection, manufacturing process, energy source, function, environmental impact, longevity, durability and repairability [14,17,18,19,20]. And those decisions dominate how to handle the specifics and usages of tools at rear-end stages [2,9,14,21].
Despite the abundant supporting arguments, there is still a tendency *not* to include sustainability consideration at the conceptual stage in practice. It is a fundamental flaw since the opportunities for environmental improvement are missed [22].

2.2. Front-end factors

The front-end is 'the activities that come before the formal and well structured NPD or Stage-Gate process.' [23] (**Fig.1**). The front-end activities are so crucial that the success or failure of the new product is determined even before the NPD project actually takes place [24,25, 26,27,28,29,30, 31].

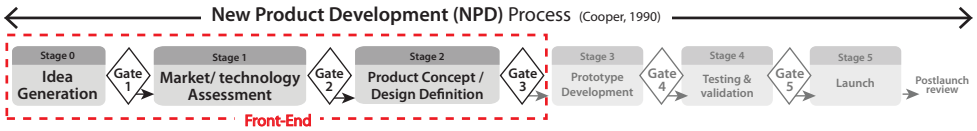

Fig. 1 Front –end of the NPD in Stage-Gate model ® (Sourced from [27, 32])

The case studies of 18 business units in 12 U.S. and Japanese firms from various sectors suggest the *success factors* of front-end activities such as a cross-functional team responsible for the key activities, project champion as a facilitator, communicator and motivator, executive review committee to provides checkpoints throughout NPD, etc [33, 34].
To date, few empirical studies combining sustainable design and the front-end stage of NPD have received enough attention as opposed to its importance to the success of the product. Two reasons for the lack of research are; a) the intrinsically non-routine, dynamic, uncertain and unstructured nature of the front-end is difficult to generalise, and b) the level of formalization is low [14,30,33,34]. This lack may act as a hindrance for industry's effective adoption of sustainability and diagnosis what factors influence the success. There has only been "too many normative suggestions with little practical relevance or testing" [35]. This research is expected to bridge the discrepancy between academic emphasis on the early adoption and the lack of the follow-up empirical research.

2.3. Sustainable design factors

2.3.1. Confused sustainability terminology

Unconsolidated usage of green design, eco design, design for environment (DfE), and sustainable design is common in sustainability research area. Following Mebratu [44]'s thorough summery of the vague concepts of sustainable developments, Glavic and Lukman [54] clarify the relevant terms under a hierarchical classification and relationship of 51 sustainability terms and definitions. They reveal that the established definitions are so non-specific that they cause

occasional misunderstanding; hence sustainable development should be supported by a common, unambiguous terminology. Brezet and van Hemel [46] share a similar view.
However, a large number of researchers take the fuzzy terminology issue rather lightly. Many others believe all the different terms can be used *synonymously* or *interchangeable* [9,13,19,47,48,49,50].
Ideally, these different terms embody distinguishing approaches on scale, scope, ease of implementation, potential benefits, and focus of design activity [51]. The transition form 'green' to 'eco' to 'sustainable' in the design field represents a steady broadening of scope and perspective; from 'tackling single issues', to 'the entire lifecycle of products', finally to ' social/financial impacts' respectively [47,49]. In this study, the most commonly used terminology, and typical design emphasis will be questioned separately in order to investigate the reflection of the academic definitions in the FMCG practices. Currently for the purpose of this paper, all the above terminologies are collectively called 'sustainable design'.

2.3.2. Enablers

One of the first in-depth studies of sustainable design success factors was by Lenox and Ehrenfeld [36]. They view the environmental *design capability* as the direct indicator of the environmental capabilities of companies. Another research at an organizational level by van Hemel and Cramer [37] is confined to SMEs sector in the Netherlands (albeit extensive to 77 firms) and the very difference of the context yields somewhat contradicting results. *Motivation* was the common finding while *internal communication* was less important. In addition, *innovative approach, a positive attitude to ecodesign,* and the *commercial opportunity of an ecodesign project* are unique aspects for SMEs. This study examines how many of the found factors apply to the FMCG sector.
From a managerial perspective, Ritzen and Beskow [38] claim that *managerial practices promoting the participation of individuals* enhance the chances of successful implementation of environmental aspects into product development. Built upon Lenox and Ehrenfeld [36], Simon, *et al.* [39] identify five critical factors to success in ecodesign from an operational perspective, based on the Design for Environment Decision Support (DEEDS) project [40].

a) *Initial and sustained motivation,*
b) *Communication,*
c) *Whole-life thinking,*
d) *Hands-on ecodesign*, and
e) *Position in a competitive market* to success in ecodesign.

Johansson [12] thoroughly collates relevant literature from 1990 to 2000 to classify 19 factors under six different areas. One of his noticeable observations is: 'to a great extent many of the important elements for NPD are generally claimed to be same for the integration of eco design'. Four out of six areas such as management, customer relationship, supplier relationship, and development process are common success factors, while *competence* and *motivation* are specifically unique to eco design. As he covers a number of important elements and issues, an empirical validation is necessary to follow as a next step.

Boks [35] empirically validates the success factors and obstacles in ecodesign. Notably, his study is the overturning of a number of literature findings through his interview analysis. Some of his low-ranking elements such as sustainability champions and eco design tools have been highly acclaimed by others. Rather, he argues the importance of the soft side; *emotional, sociologica*l and *psychological* aspects as well as *communication between horizontal teams*. Although his article carries a good number of shrewd analyses of the status quo of sustainable design research, his validation is inherently restricted to the cultural context of Far Eastern Asia's Electronic firms. His findings will be scrutinized within the FMCG context.

2.3.3. Barriers

Lee-Mortimer and Short [41] conduct an empirical research on adoption of design for sustainability (DfS) within SMEs in the UK. Simply put, they conclude the product development *'environment'* as the main roadblock overarching previously identified barriers: e.g. van Hemel and Cramer [37] 's a) not perceived as responsibility, b) no clear environmental benefit, and c) no alternative solution available; or Keijzers [42]'s a) relatively *short-time horizons* for major investment decisions, b) o*verestimated importance* of realised efforts on environmental improvement, c) *immature internal management structures* for the identification of sustainability opportunities, and d) *insufficient knowledge*. Aforementioned "soft" sides [35], or the "environment" [41], such subjects can be grouped as corporate culture: i.e. collectively held basic beliefs, determines the company's general orientation. The key dimensions of general corporate culture [43] will be confirmed within sustainability context in the FMCG context in this study.

2.4. Conclusion of literature review

The literature review demonstrates that the sustainable design factors rely on a noticeable numbers of common factors as those of the front-end, despite the independent paths taken by each research area. The identified common factors for sustainable design integration are *communication, senior management support, cross-functional team, sustainability (project) champion, motivation*, and *competence* while the controversial factors are *confused terminology, insufficient information*, and *lack of supporting corporate culture*. The found factors will be tested through case studies with a focus on the first 3 stages of NPD.

3. Methodology

3.1. Multiple case studies

This research employs comparative case study method, as the evidence from multiple cases is often considered more compelling and robust [52,53]. Also, variable-oriented strategies were adopted as it enables certain attributes between case studies rather than comparing the whole process within the respective companies [54] (**Fig. 2**).

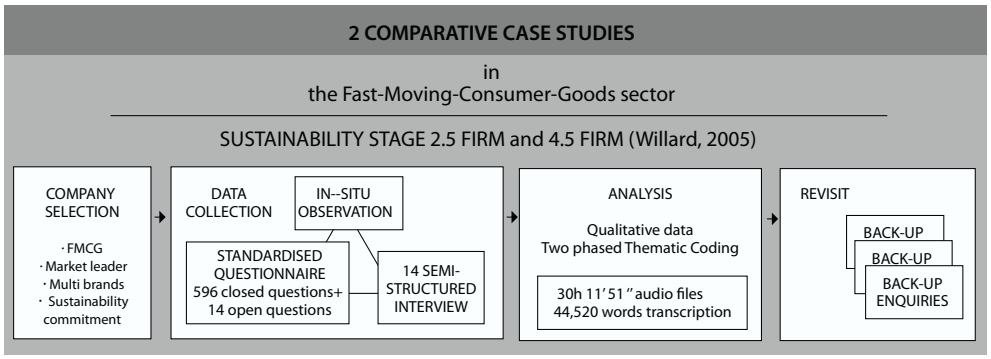

Fig. 2. Case study data flow

3.2. Selection criteria

Firstly, the selection criteria were established as follows:

a) FMCG manufacturers,
b) Market leaders in respective country or continent,
c) Multiple brands companies,
d) Companies with a certain level of sustainability commitment,
(e.g. publishing sustainability report, running a department solely dedicated to sustainability, acknowledged by global sustainability measuring institutions such as Dow Jones Sustainability Index, Corporate Knights' "Global 100" Most Sustainable Corporations), and
e) Representatives of stage three or four or five of the sustainability continuum by Willard [55].

Admittedly, in regards of the criteria d) there are eligible debates over the arbitrariness of its measurements [55], still it is a useful reference point of active commitment to sustainability practice.

3.3. Case companies

Two FMCG companies were selected in accordance with the above criteria. In order to protect the identity of the participating companies, they are referred as Company A and Company B. Company A is thriving Latin American cosmetic company, and according to Willard [55,56], they would rank as stage 4.5: between *Integrated Strategy* and *Purpose and Passion*. Company B is South Korea's no.1 market sharer in personal / beauty care sector and represent the Stage 2.5: between *Compliance* and *Beyond Compliance*.

3.4. Questionnaire survey and semi-structured interviews

This research is the fieldwork involving integrated collection of both quantitative and qualitative data. A standardised questionnaire was used as a basis of total 14 interviews and additional questions were asked to enable the participants to expand on their answers. Interviews took place at the company headquarters in Sao Paulo, Brazil and Seoul, South Korea for 5 days and 7 days respectively. In order to cater for their busy daily schedules, the first author was on stand-by mode

from 9 am to 5 pm everyday in which she gained many opportunities for in-situ observations and field note taking between interviews.
The 24-pages of in-depth questionnaire covers 11 subjects of success factors extracted from literature, consists of 596 questions including sub-questions. To begin with, a set of three fixed questions about each subject's 'importance, frequency and effectiveness' to the success of their NPD process was asked for the triangulation purpose:
"please indicate the *importance* of xxxx in achieving success within the following front-end NPD activities".
The majority of questions adopted the Likert scale from 1-5 to impose quantitative attributes to data: 1 as representing *not important at all*, 3 as *neutral*, and 5 as *very important*. Those questions were followed by the segmentalized value questions and additional customised questions in each section. All the interviews were digitally voice-recorded under verbal permissions and transcribed. Total 12h 3min 52 sec. of audio files were transcribed into 21,119 words for company A, and 18 hr 7 min 52 sec to 23,401 words for Company B.

3.5. Thematic analysis of the qualitative data

A two-phased thematic coding analysis was undertaken: the first phase went through the transcription in search of the recurring patterns and themes which produced 12 themes based on the pre-determined subjects in the questionnaire. The second phase of coding helped the author narrow down into 11 themes and entailing 25 sub-themes. The arbitration process of the themes was conducted by one of the co-authors.

4. Findings and discussion

4.1. Senior Management support

McAloone and Evans [57] demonstrated that top management understanding and commitment have to be gained primarily. And similar literature findings both from sustainable design and NPD studies are supported by the empirical results [41, 55, 56]. In this study, *senior management support* is confirmed to play the foremost role in both cases.

"Sustainability is very difficult to be bottom-up. Without CEO's strong intention, the reality kicks in so easily. So it's important." (Company B)

This includes verbal / non-verbal actions, and mindset through 1-1) *firm sustainability leadership*, 1-2) *rewarding the individuals with financial incentives* and 1-3) *understanding of sustainability principles*. In case of Company A, the requirement of the bonus in was based on the TBL achievement. However the employee level was not aware of such incentives as it applies only to managers.

4.2. Strong sustainability vision

Strong sustainability vision, provided by the senior management, should 2-1) *align with company's general vision, and* 2-2) *provide and disseminate a strong sustainability vision throughout the company philosophy and daily activities.*

"We always talk about it (sustainability). There is no way not to talk about it." (Company A)
"The founder is very strong reference. His personal life and professional life are the cause. Our founders are very strong leaders." (Company A)

In Company B, the sustainability vision was less clear, especially towards the low level of the position. Employee level tends to prioritise the financial growth.

"Is having sustainability vision important? No. It's getting bigger but we haven't set it up clearly." (Company B)

4.3. Internal communication

The empirical results agree with many academics on the importance of internal communication [12,33,35,36]. The vision should internally penetrate the company's daily NPD process through 3-2) *various communication channels*.

"I can see that highly profitable products are from a team with a good interrelationship." (Company B)

Also, 3-1) *hierarchical openness* encourages effective *internal communication* and promotes the success of the product development project in general.

"We are close to each other, and have lots of discussions and conversations. Rather than arranging formal meetings, we casually exchange ideas when we bump into each other and all. So the idea exchanges accumulate and make it easier when it comes to the development process." (Company B)

4.4. Corporate culture of sustainability and Individual attitude

In terms of the soft side of the factors [35], based on the strong senior management support and the vision as the ground, the *corporate culture of sustainability* can build up [43]. It is an overarching concept that embraces all the soft factors within the company from *sustainability transparency, legacy, behaviour, belief, structure and citizenship.* Also, committed *attitudes of individuals* are articulated as 4-1) *motivation based on the company's past sustainability practice, 4-2) satisfaction about company's present sustainability practice, and 4-3) ambition about the company's future sustainability practice*.

"We exist for sustainability." (Company A)
"It (sustainability) motivates people and make the employees proud." (Company A)

4.5. Focus on Growth

The level of the *focus on growth* can hinder or promote the successful sustainable design implementation. This is particularly conspicuous within the FMCG context especially with the consumer orientation. Without 10-1) *a careful balance of Triple*

Bottom Line, 10-3) over-reliance on consumer insight can stagger company's sustainability vision. Especially where the consumers are not aware of sustainability issues, there is a tendency to drift away from sustainability for the sake of consumer orientation.

"Consumer is the core success factor." (Company B)
"Korean consumers are very picky. The product development should consider their taste." (Company B)

This can result 10-2) *concentration of sustainability practice on certain sub-brands* rather than equal sustainability emphasis throughout company's brand portfolio, especially for the FMCGs that target a less-matured sustainability aware market.

"As a mother corporate brand, we are very strong in sustainability. But some of the sub-brands have much lower connection to sustainability." (Company A)

4.6. Sustainability champion, tools, and clear terminology

Regarding the hard side of sustainable design implementation at the operational level, the involvement of *sustainability champion* (7), frequent and detailed utilisation of customised *sustainability tools* (8) answer the previous literature findings [17, 56].

"Sustainability is as important as cost and performance… You don't have a champion for quality or performance. It's everyone's responsibility!" (Company A)

However, per se, deeper involvement of the sustainability champion at the project level is highly recommendable. In addition, *clarity of sustainable design terminology* (6) is another influencing factors at the operational level. Curiously enough, the most commonly used term and typical design emphasis did not align: reflecting the gap between the academic definitions and industrial understanding. Also the perceived importance of using an agreed sustainability terminology was rather controversial and inconsistent both in Company A and B. However it was observed that an interviewee emphasised the clarity of a specific terminology,

"We don't call them 'consumers' but 'customers'." (Company B)

Thus the undiscovered necessity of clear sustainability terminology can be argued.

4.7. External contexts: Maturity of market and infrastructure

The above hard factors still have to go through the potential barrier of *external context* under the categories of the *infrastructural maturity* and *consumer/ market maturity*. Both in Company A and B, it is repeatedly asserted that the success is inevitably limited, without enough infrastructural support.

"Even if we want to use recycled materials, we don't recycle in Brazil." (Company A)
"There are number of issues that our factory cannot handle even if we want." (Company B)

Companies suffer from a lack of supply-chain alliances. This could attribute to their regional location. In addition, the maturity of the target market and consumers is another critical matter. Companies are fundamentally economic organisations that pursue profitable activities by nature, should the target market or consumers are not mature enough to recognise the sustainability benefit and make purchase decision, further action into sustainable practice may be jeopardised.

4.8. Hierarchy of the factors

Interestingly, the analysis reveals that the individual factors do not stand-alone separately but co-influence one another. The dynamics and orders among them are presented in **Fig. 3**. The chronicle pattern in how industry integrates environmental decision into their product development has been introduced in a model of eco-design integration [57]. While this model comprised with only three steps from 1) initial/sustained motivation, 2) communication/information flow, and 3) whole-life thinking, this research elaborates their argument to the next level.

5. Conclusion

This study contributes to the knowledge by providing in-depth empirical data of sustainable design factors in the front-end of NPD within FMCG. The research attempts to bridge three identified research gaps: a) a limited number of empirical studies in sustainable design at the front-end of NPD process, b) little understanding of sustainable design implementation within FMCG, and c) rare

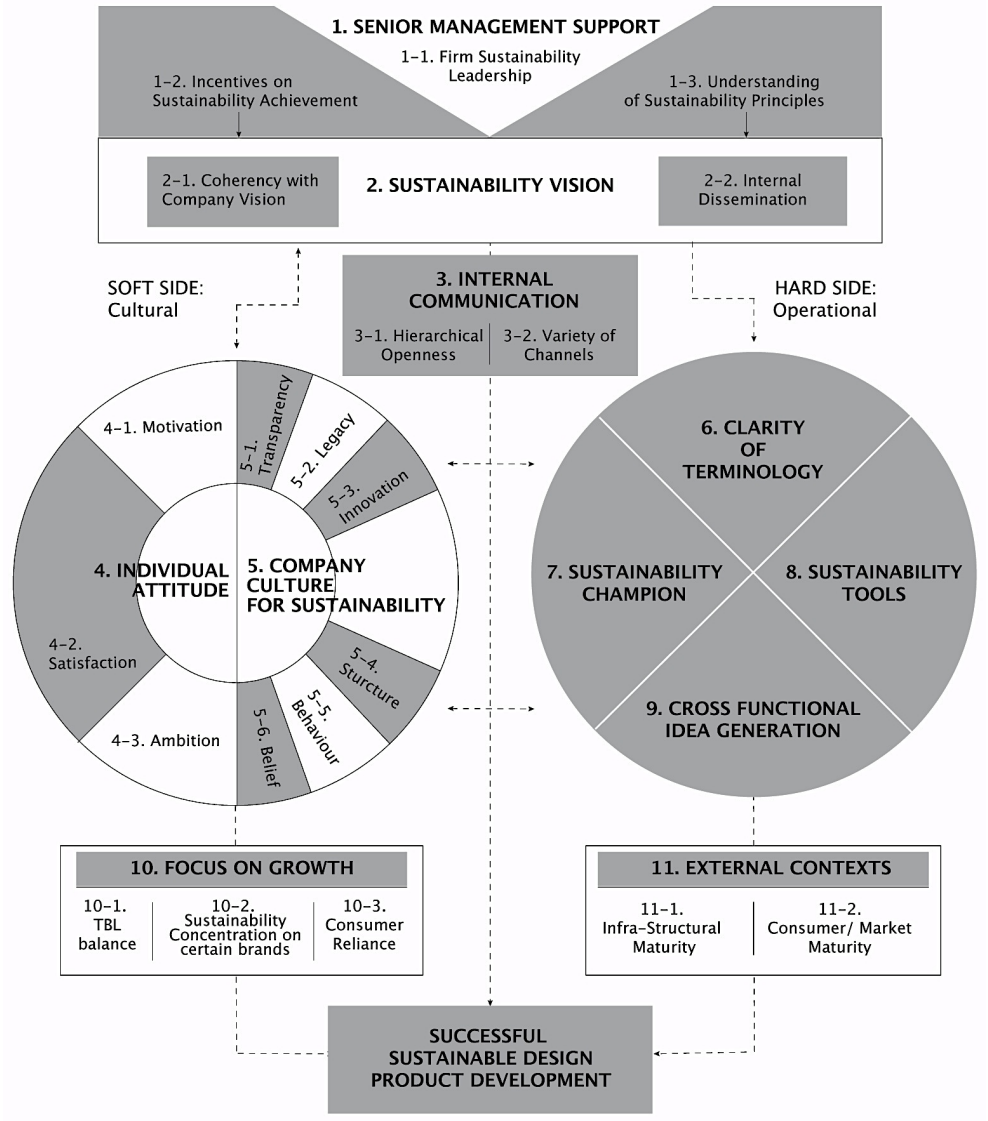

Fig. 3. Hierarchy of Eleven Sustainable Design Implementation Factors

evidence of industrial application of sustainable design implementation in conjunction with the front-end of NPD within the FMCG sector. The empirical insights from this research based on the supporting or debunking of the literature findings offer valuable understanding for practitioners on influencing factors, their characteristics, and their interrelationships. The academic contribution of this research lies in the inter-disciplinary nature of sustainable design. The cross-sectorial comparison adds to the existing body of knowledge by complementing the disparate epistemic research communities. Furthermore, FMCG companies that

aspire to improve their sustainability practice are expected to benefit from this research by knowing where to start and create the flow. An expanded verification of above suggested conceptual model is being carried out with additional FMCG firms from various sustainability stages and regional contexts.

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