3R Evokes Ecodesign Identity in Ecological System of Green Manufacturing

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***Abstract*— For the past few decades to the era of industry 4.0, young practising designers have been enduring environmental communication challenges in the green manufacturing context. The problems stem from their failure to comprehend the pattern of environment communication phenomenally. The objective of this study is to address the environmentally-driven elements of recycling methodology along with the product's form development via "re-think waste" of the environmental communications concept; screened by the bubbling model of intangible ecological form theory. In the realm of industrial design, it is implicitly visualised by the common Mobius loop cycle method of the green manufacturing paradigm. Under the Descriptive Study I of design research methodology framework, the goal-setting participation from Malaysian manufacturers sample using two methodologies concurrently; (1) the cluster sampling that measured the designs perception as the quantitative structure by statistic values and (2) the purposive sampling interpreted the design behaviors of the subject as the qualitative structure by first cycle coding. Consequently, the heuristic evaluation is used to triangulate the two methodologies. For the finding, an intangible ecological form model formulated the change for environmental communication to digitise and screen an intangible ecological form according to extrapolative strategy morphing.**

***Keywords*—** *Design methodology, ecodesign, industrial design, industry 4.0, innovation*

1. Introduction

The earth's climate, as presented in the environmental indicators of the 21st century, reveals a host of international challenges [1]. After two decades, sustainable design is growing increasingly crucial. Global warming, pollution, and the instability of our ecological systems occur due to human imprudent environmental activities [1],[2].

In industrial design (ID), experts have succeeded in formulating and elaborating Sustainable Product
Design (SPD) from the theory's founders. Their contributions include the 4R's model approach: Rethink, Redesign, Refine and Repair [3],[4],[7]. They coined the capability of presenting the three innovation ecodesign points (Concept Design, Core Design, and Continuous Improvement), which explain the complexity of transforming a design process into the right translation and interpretation [4],[7]. The study is able to extract the specific domain of design knowledge based on the literature map chart, which is the relevance and/or judgment of justification.

1.1 Research Objective

At the end of the literature map, this study tested one hypothesis statement in developing the research objective; "*If the transitional processes do not work, then the ineffectiveness of ecodesign products will be implicated into the resource recovery and waste management*". The null hypothesis statement result used the word "*transitional*" to indicate the change in environmental communication.
The objective of the research topic is to address the existence of Möbius loop symbol that can be approached by the intangible ecological form of ecodesign. Therefore, the study has developed two research questions (RQ) in order to seek the answer to the research objective:
RQ 1: What kind of design knowledge of 3R's element processes that would enable the practicing designers to develop and create an intangible ecological form of ecodesign?
RQ 2: How to purposely create the 3R's element within an intangible ecological form of ecodesign?

2. Literature Review

Owing to the new ecodesign era, green technology is allowing the expansion of internal and external national economic growth [1],[2]. Designers that have been newly-exposed to sustainable development and started to evaluate the form of ecodesign products identity. This study presents two ecodesign product pinpoints following the synthesised literature of paradigm study in the context of SPD phenomena, namely, (1) formgiving design [5],[6] and (2) the recycling methodology of 3R's element [7].

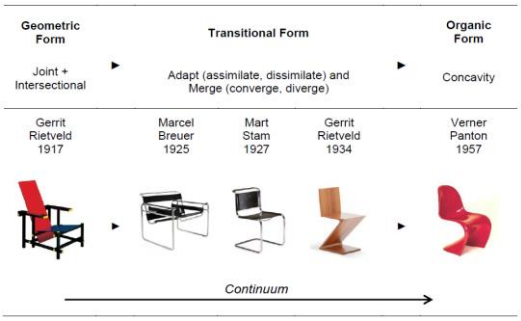

Figure 1. The morphing of cantilever principle design (extrapolative strategy) [6]

Firstly, the cantilever chair, designed by Mart Stam which was created in 1927, presents the ecological relevance with implicit data based on the form characteristic [7],[8]. In the simple object's case study, after architect-designer Mart Stam introduced the cantilever design concept, he revealed and delivered the assumption of ecodesign manufacturing paradigm [8]. The historical development of ecodesign influences the intangible ecological form characteristic in the ecodesign identity background [4],[9]. Figure 1 presents the modern classic furniture to project the sequence of an ecological form movement. It can be traced from the observation study (using the quality review in mind) within the morphing concept approach. Through the evolution of design history, the wooden geometric chair is transmitted into the organic resin form of the cantilever principle design concept entirely. It is morphed by the extrapolative strategy via the cantilever principle design morphing to screen an intangible ecological form characteristic. Ref [9] refers to that the design's historical development exposes a chronology of design narratives where it presents the previous evolution of design.

Secondly, in the context of product ecodesign, the study seeks to explain the 3R's element that can deliver an intangible ecological form of ecodesign in producing recycled products (design artefact) [7]. This is considerably useful to the designers in screening the environmental elements following the foundation of recycling methodology. It will be beneficial to apply their understanding in the designs of consumer products and the practice of reduce, reuse and recycle (3R's) method as the descriptivism of a person's behavioural response and it ecodesign thought in the environmental communication [5]. Regarding the recycling methodology, the study prefers the designers to use the life cycle framework during the design process thinking [7] as shown in Figure 2.

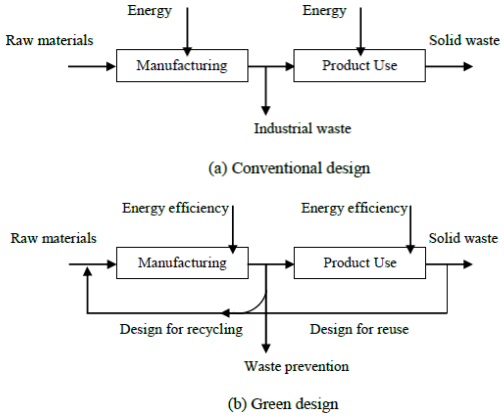

Figure 2. Life cycle framework for clean manufacturing technology [7]

Hence, two roles of ecological form system underpinned the intangible ecological form identity concurrently:

2.1 Technology System of 3R

It is to separate and standardise the source of material waste before proceeding into the disposal stage. The graded system will sort the types of materials where the disposed material will be segregated into five categories: (1) reduce; (2) reuse; (3) recycle; (4) appropriate disposal technologies; and (5) common disposal technologies [5],[10].

2.2 Functional Unit System

For example, the sitting components of a chair design may be reduced to the occasional support of four legs to support a single and/or dual legs (functional units – product components). Here, a chronology of design narratives identified the 3R's method validation that revealed the green design characteristic to simplify the product shape criteria in which these components reduction can be minimised during the production process and explicitly reduced the energy consumption during the product assembly operation [7],[11]. The functional unit system refers to the number of materials used and their selection for the design implication. In the context of the environmental design concept, the single material selection could easily manage the kind of molding designs within it systematically functional design; the use of resin plastic material allowed the indication of resin identification codes (3R's Möbius loop cycle) to be reused [5],[10],[12].

3. Problem Tree Analysis

The definition of the industrial cycle or ecological cycle methodology towards beauty forming design identity is difficult. In relation to the issues, the enquiries sent the design research study to identify the setting of a local subject sample as Malaysian practising designers in Research and Development (R&D) groups. Using the problem tree analysis, it will extract an exact content analysis that there could be addressed the problem statements – causal and consequences phenomenally.

3.1 Problem Identification

Aesthetics Product Design - Ref [11] refers to that the Managing Director and Chief Designer, Ben Teo (a company of Benithem Sdn. Bhd.) coined a statement during the Malaysian International Furniture Fair (MIFF) 2012, "…the local market is still into elaborate designs that draw attention at first glance. But, Westerners prefer designs that are clean, streamlined, functional, ergonomics that used sustainable materials. Those designs have a lasting kind of beauty. But they are actually harder to make." (p.03) [7],[11],[13].

3.2 Causal

Design Knowledge Gap - Since the going-green phenomenon has transpired in the Malaysian furniture manufacturing sector [13], both the complex qualitative and quantitative data are involved in the ecodesign communication creation. This engagement has developed a space between industrial designers (ecodesign concept – qualitative approach) and manufacturers (green design principle – quantitative approach). Therefore, the 3R's method closed-loop/cycle (space) as a recycling approach symbol is used to bridge both disciplines of knowledge within the triangulation method and/or approach needs [5],[7].

3.3 Consequences

Design Process Thinking – The ID expert described the design outlook meaning which simplifies the complexity of the design process thinking in producing the objects [9]. The expert emphasizes, "Design is to design a design to produce a design" (p.03). Owing to the difference in ID profession background, his description stressed on a wider design process thinking. As such, two environmental issues were elaborated and coined with [2]: (1) many young designers misunderstood the environmental and social impacts, thinking that the use and disposal of waste at the end of a product's life cycle is somebody else's responsibility, and (2) the designer's role is to select and manage the raw materials that caused the least damage to the environment, which influence the manufacturer and distribution system.

4. Methodology

This study used the design research methodology (DRM), which is the empirical study of design sciences related to design artefact orientation [14]. DRM aims to systematically explore and solve the complexity of design research activities from the assumption of phenomenology. According to the DRM experts, as shown in Figure 3, the DRM framework consisted of four stages: (1) research clarification – RC; (2) descriptive study I – DS I; (3) prescriptive study – PS; and (4) descriptive study II – DS II. The current study applied descriptive study I (DS-I) stage under the DRM framework due to the nature of enquiries.

4.1 Methodological Triangulation

The DRM framework employed two research methods, and they were implemented under one DRM program in DS-I stage, concurrently. For instance, the cross-sectional research commonly describes positivism and the longitudinal research refers to constructionism [14],[15],[16]. From the scenarios mentioned, two strategies of phases in the methodological triangulation had occurred, and the study was executed by (1) combining the appropriate dual sample sizes; the sampling population study between macro data[1] [17],[18] (non-probability sampling) and microdata[2] (probability sampling) can be overviewed, simultanously. It can be easily triangulated by using the homogenous characteristic (first strategy) itself, even with different type of sampling, and (2) the similarity of dual data collection; to use the heuristic evaluation (second strategy) to shape and define an exact meeting point of similar characteristics (from each quantitative and qualitative data collection, respectively) for the trustworthiness finding's interpretation [17],[18].

[1] A total of 10 municipalities such as DB Kuala Lumpur (DBKL), Perbadanan Putrajaya, MB Shah Alam (MBSA), MB Petaling Jaya (MBPJ), MP Klang (MPK), MP Kajang, MP Subang Jaya (MPSJ), MP Selayang, MP Ampang Jaya (MPAJ) and MD Sepang had covered the Greater Kuala Lumpur/Klang Valley (KL/KV) area defined with "*an engine of the nation's economic growth and hence designated as a NKEA*" (ETP; Pemandu, 2010).

[2] The *statistic data* manufacturing project by states in year 2013 and 2012 shown the famous capital states Selangor (2013: 228 and 2012: 252 projects), Penang (2013: 119 and 2012: 115 projects) and Johor (2013: 197 and 2012: 184 projects) were still leading at top rank in the country even the number of projects approved has slightly decreased after a year (MIDA, 2013).

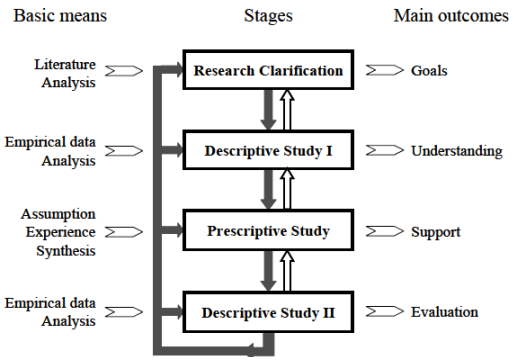

Figure 3. The flow of the design research methodology framework [14]

4.2 Instrument Design

The DRM framework in the questionnaire forms, the instrument's design content regarding the design objects or artefacts benchmarked following the formgiving object theory [6]. It developed the formgiving theory in which ID expert coined the design object and/or artefact through an evolution of form (EoF) that the geometric shape morphing onto the organics shape, sequentially [6]. The reason is to define and seek the designer's perception of the intangible ecological form of ecodesign in the EoF context. Ref [11] explicitly clarifies to that the evolution of morphing concept is under the extrapolative strategy – having certain characteristics of semantics design thinking scales. Therefore, the study used two types of scale measurement, namely the nominal and ordinal scales. Four types of questions were used: (1) fixed alternative questions; (2) simple-dichotomy (dichotomous) questions type; (3) multiple or determinant-choice questions type; and (4) five points of Likert scale; numerical scale [17],[18].

4.3 Data Collection and Fieldwork

Initially, the fieldwork started with a pilot study in which a questionnaire with 27 items was (N of items) provided. The purpose of the pilot study is to test the questionnaire reliability before it is used in the real survey. For this reason, the study has decided to employ 10% of the main sample size (43 people[3]). The minimum percentage was chosen because of the reasonable amount of justification in the actual small sample size [19]. Four subjects were involved in the small scale pilot study, and the participants were the industry players from the Klang Valley with a senior level classification (8 – 9 years of design experience). However, the subjects were intentionally increased to five people (in the pilot study) instead of four people to fulfil the participant work designation criterion within the R&D group. The five identified position of work designation for the small scale pilot study in the Klang Valley district were: (1) designer, (2) engineer, (3) project manager, (4) product developer, and (5) production manager. Subject identification was chosen to avoid bias distribution. Thus, all of the subjects' designation mentioned were classified under the practising designers of an R&D workgroup. For the Cronbach's Alpha result, N of items = .75 as a higher CA value in the scale of reliability analysis. A "Good Reliability" was levelled under Coefficient Alpha (α) – CA rule of thumb refers to the internal consistency, which was computed using Statistical Package for Social Sciences (SPSS) software [20],[21].

The questionnaires were distributed to 38 respondents with the questionnaire's items increased to 54 for the actual survey. For the administrative design of the instrument distribution, the questionnaires were distributed via in-person drop-off and paper questionnaires [17],[18]. For instance, one of the respondents would lead a group of respondents as the leading representative of the R&D manufacturer. The leader would conduct a short briefing to another respondent face to face regarding the instruction of the questionnaire to achieve the aim and the survey distribution objective of the authorship. The manufacturer's R&D policy strictly prohibited public connection, especially regarding their product development and its design's information, which is the limitation of this study. Therefore, it is not advisable for the study survey to use electronic or/and digital questionnaires. This step is advantageous to prevent miscommunication, bias issues, sampling error and incorrect respondent's channel. Therefore, the fieldwork will be described as the exact design building perception of the research topic as follows:

- *Quantitative Approach*: A quantitative survey was conducted among 38 practising designers from the actual 43 correspondents required (small group of sample size), which represented seven categories of office furniture manufacturers (by geographic cluster) from 426 population in the state of Selangor. Then, it was randomly clustered (cluster-stage sampling) from three districts within four cities, and the area sampled was validated as a representative of the rest of Malaysia.[4]

[3] The population (*N*) refers to entire 426 practicing designers from the 71 office furniture manufacturers in Selangor state - Sample Size Rules of Thumb.

[4] 153 office furniture manufacturers - Not applicable for Labuan and Putrajaya (Sources: MFPC - EFE and MIFF Directory List 2014)

Meanwhile, the interview session was conducted with an open-ended response (transcript: first cycle coding) following the memoing classification [22],[23]. The purpose of using the qualitative approach is to interpret the exact abstraction of the value finding's perception (correspondents answered) that emerged from the descriptive study phase. Using the intangible ecological form data, the study found the design belief paradigm phenomenally in the fieldwork activities through:

- *Qualitative Approach*: The qualitative data analysis is the preferred trustworthiness interpretation of the 3R's method phenomenology by manual open coding structured. Open-ended response concept generated purely from the primary data collection based on the interview protocol (purposive sampling) from which this study drew the significant statement and generated the essence for validation purpose. However, due to the limitation of the study, only three practicing designers (senior and expert levels) out of the total five participants (the sample setting representatives of the NKEA's subject population; first strategy of methodological triangulation[5] were interviewed using the qualitative approach [19]. Also, the manual coding analysis was intentionally used because of the fundamental of first cycle coding [24],[25].

With regard to the participants, the study used the same proficiency of subjects' classification for both method approaches, concurrently. The proficiency of the subjects' classification of design experience was divided into four designer categories according to their length of experience, namely (1) novice: student, educator or practitioner – less than five years, (2) intermediate: educator or practitioner – five to 10 years, (3) senior: educator or practitioner – 8/10 to 15/18 years, and (4) expert: educator or practitioner – 18 years and above [6].

- *The Population Sampling*: The quantitative survey was developed using a sampling frame strategy. It focused on the sampling frame process to achieve the objective, which is highly significant for the element population addressing the geographic sample size, accordingly [17],[18]. All these represented the micro data source of Selangor, a representative of the whole of Malaysia. On the other hand, the macro data source refers to the trustworthiness design belief from the level of the subject's classification through designs experience. Hence, designing to build trust will be increased in the designer's community [19].

[5] The interviewing sample size was located from the Greater Kuala Lumpur/Klang Valley – NKEA; Klang, Petaling and Gombak districts positioned under the similar or homogenous characteristics in Selangor state (ETP; Pemandu, 2010).

4.4 Testing Methods

Firstly, the study was observed to 5 points (95%) statistical significance: Sig. $P < 0.05$ point equalled to 0.05 significance level to measure the alpha value findings, namely (1) frequency distribution test, and (2) Chi-Square test. For the Spearman Rho correlation, the testing method used the 1 point (99 %) statistically significant, which means it is a 0.01 significance level. Therefore, if the finding's value of the significance levels exceeded the values, it means no significance answered from the survey population as well [20],[21].

Secondly, the repetition of the codes created the frequency of significant values. It is categorised by "open coding analysis method" using the qualitative data analysis processing. The number of frequency validated the transcription approach where the recorded voice was transcribed into a text manuscript. For the open coding analysis, this method transcribed the manuscript interpretation of the actual phenomenon (particular) to abstract (general), which allow it to frame the streamlined Code-to-Theory Model. Lastly, the essence stage is required to reach a significant statement following the exact interpretation according to human behaviours and/or human activities. However, the essence of a significant statement supported and used for the statistical findings only, which were thoroughly coined under the first cycle coding method, specifically [22],[25].

5. Result

5.1 Frequency Distributions

A histogram bar chart is required to visualise and observe the frequency of bell curved pattern and its' value distribution. Ordinal data scale: In the study of this bell-curved characteristics, the analysis practice is defined as a "Design Method" data set as a single significant finding. According to Figure 4 and Figure 5 outputs it would be measured with both the mean = μ is 3.5 and standard deviation = s.d. or σ is 0.952 to fulfil the fifth outlined bell-curved characteristics – clarifying the numerical interval values in the histogram bar chart known as "The Empirical Rule". The interval values equations are as follow:

$$\mu \pm (2 \text{ x s.d.}) \text{ or } \mu \pm (2\sigma) \quad (1)$$

μ - (2 x s.d.) = 3.5 – (2 x 0.952) = 1.596 = 1.6, and

μ + (2 x s.d.) = 3.5 + (2 x 0.952) = 5.404 = 5.4, and

3.5 – 1.6 = 1.9 and 3.5 – 5.4 = 1.9

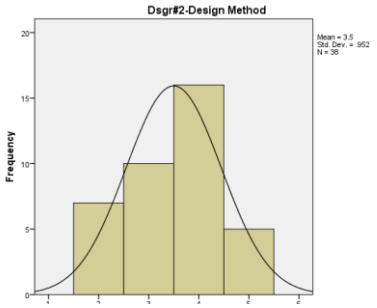

Figure 4. Histogram bar chart

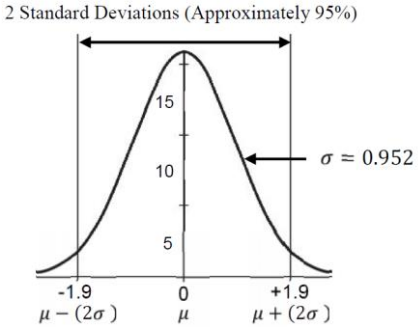

Figure 5. Bell curved distribution

5.2 Spearman's Rho Correlation Coefficient

To test the relationships between categorical variables. Ordinal data scale: One "high relationship" within positive monotonic curve distribution pattern tied both variables between Dsgr#2 Ecological Form and Dsgr#2 Cantilever Judge (0.733). The *p*-value = .000 result was under 0.01= sig. (two-tailed) value. Thus, the formal conclusion is Rs = 0.733, n = 38, *p*< 0.000. Item in Dsgr#2 represents the artefact's design namely the cantilever chair–Mart Stam (1927).

5.3 Chi-Square Statistic

This non-parametric test is used to measure the strength of the association between two variables. Nominal data scale: The association of paired variables is Gender by 3R's Element – The chi-square statistic counted value was 4.187. The 1 degree of freedom (df) was calculated using the following equation:

$$df = (r - 1)\,(c - 1) \quad (2)$$

(2-1) (2-1) = (1) (1) = 1

Then, the Sig. two-tailed *p*-value that was calculated with 0.041 described the alpha value followed the SPSS output note below with "2 cells (50.0%) expected a count of less than 5" (below the .05 alpha value). Therefore, the formal conclusion of the chi-square result is "independent". For the ordinal data scale – a significant test result: A 40.233 of chi-square statistical value resulted in the equation for the association of variables of Dsgr#3 – Material Used by Cantilever Judge:

$$df = (r - 1)\,(c - 1) \quad (3)$$

(5-1) (5-1) = (4) (4) = 16

Next, a 0.001 of Sig. two-tailed *p*-value achieved the "25 cells (100.0%) expected count of less than 5". Hence, the .001 amount of *p*-value is under the .05 alpha value. The Sig. *p*-value rejected the H1 alternative hypothesis (dependent). Thus, it allowed the H0 null hypothesis to be positioned under "independent" as a formal conclusion of the chi-square.

5.4 First Coding Cycle

The manual coding analysis - using two keywords, namely "what" and "how". The study recognised the essence decisions with:

"What" essence decision formed 'the subject's intuitive behaviour' from Section 1-Q1.3 answered the statements with:

- Interviewee 1 (company B) – Expert (>18 years): "*… I believe in this 3R's characteristic practised*"; and Interviewee 4 (company F) – Senior (10 to18 years): "*…attempts to minimise the material used…and it explained the 3R's element in a design*".

"How" essence decision expressed 'the subject's intuitive activities' from Section 2-Q2.1 answered statements with:

- Interviewee 1 (company B) – Expert (>18 years): "*…the basic idea actually must be based on recycle ideology*"; and Interviewee 4 (company F) – Senior (10 to 18 years): "*…almost total satisfaction an internal 3R's phase*".

6. Discussion

6.1 The Heuristic Evaluation of Triangulation Design Concept

This phase strategy of methodological triangulation used the heuristic evaluation of dual quantitative and qualitative approaches concurrently [6],[14],[15],[16]. The quality review of visual element (VE) patterns is required to develop and establish the similarity assessment such as criteria, capability, and characteristics (3C's). Detailing the VE data sources may derive the intangible ecological form to simulate the artefacts ecodesign identity. Hence, the 3C's description [7],[19] with (1) Criteria: product form (aesthetics) and ergonomics; (2) Capability: ecodesign process and green design (reduce, reuse, recycle element – 3R's); and (3) Characteristics: ecodesign concept and engineering principle.

6.2 Nature-inspired Design Delivers the Semantics of Formgiving Product System

In this study, the most consistently answered by many Malaysian practising designers are that they accepted (relationship) and agreed (association) with the cantilever principle design because of the roles of the object and/or artefact's perspectives on the extrapolative morphing concept.

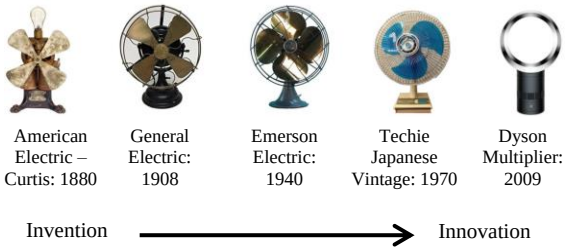

Figure 6. Beyond continuum of extrapolative strategy morphing (Non-linear/non-uniform) [6]

With design experience and belief, the Möbius loop cycle in 3R's method was a green design symbol (the context of cradle-to-cradle design) for Design for Recycling (DfR) in producing the ecodesign concept. For instance, Figure 1 and Figure 6 demonstrated and extracted the 3R's elements via extrapolative strategy within an intangible ecological form intentionally that enabled the environmental elements (design communication) through the ecodesign concept [6],[19],[26].

Hence, the understanding of essence respondents formally known as semantic design thinking associated with semiotic perspectives [6]. Ref [7] refers to that the practitioner pointed out the role of Möbius loop cycle, which offered the iteration process found along with the industrial cycle activities (closed loop cycle) that were explained under the elements and properties of the ecological design in the Literature Review section [6],[7],[26].

6.3 Design for the Base of the Pyramid (DfBoP) in Product Innovation

The findings described the medium and/or an artefact of product innovation, which is suitable and approaching the role of Pyramid Base Design (DfBoP) [26]. There had demonstrated that the product innovation is an important quality in the basic design of consumer needs [9]. By using the consumer needs of product innovation, the DfBoP will systematically emphasise on the four interrelated components, namely (1) desirability, (2) feasibility, (3) viability, and (4) sustainability. Realistically, the DfBoP function is to minimise the lack of market information that designers could creatively innovate the medium using the environmental issue design platform, and perform the concept of form, which follows the function in the Product-Service System (PSS) design sequentially. Due to the fundamental of the BoP that refers to the poorest portion of the global population context, the basic needs of a business to consumers (B2C) will generate a smart product system and/or services towards an environmental design solution conceptually. Figure 6 shows an example of a case study, an interpretation regarding an ecodesign identity that the DfBoP concept successfully visualised beyond the continuum of a Dyson product design. It started from the earlier artefact invention (formgiving perception) until the end design of the product innovation [4],[19]. Therefore, the historical development by the ecodesign model validated the innovative evolution of the product [4]. It derives a diversity of design that screen the extrapolative strategy [6] as the psychologically DfBoP concept itself in the bottom hierarchy of pyramid ways [9],[11],[26].

7. Conclusion

In the study, an ecological system of green manufacturing has developed a design method via the Möbius loop cycle – a recycling methodology through extrapolative strategy in the heuristics interpretation hermeneutically.

The operation of supply chain management was encoded so that it visualized the product form of

rethink waste within the characteristics of an intangible ecological form called environment communication. Second, to evoke the ecodesign identity, the cantilever principle design symbiotically screened the roles of design artefact. It is based on design experience, which means the designers represent the form and follows the function by their insight through the semantic patterns of photographic base images in design cognition. Thus, both synthesised components motivate Malaysian practitioners in enabling DfR morphologically; this impact has recognised the imagery digitisation as elaborated in the discussion section.

In addition, this study addresses a future green manufacturing network with the system thinking in imagery digitisation of semantics design context, which is the imagery of photographic (product form) that fulfil the challenges of Industrial Revolution 4.0 in design information approaches. This means that adapting and adopting green supply chain management challenges are needed in furthering the movement of designing the cyber-physical system (CPS). According to the latest clean manufacturing era, the previous model is irrelevant because it falls under the IT and automation method of Industry 3.0 practices [27],[28],[29],[30], especially from an old master Heskett iteration model previously mentioned. Therefore, the change in environmental communication with "form is to form a formgiving to form an ecological form of ecodesign" as the ecodesign information is grammatically recognised as a noun – verb – noun – transitive verb. This was inspired by rethinking waste the innovative design thinking.

However, the finding of this study unfolds the proper bubbling model of intangible ecological form theory to creating ecodesign identity in the ecological system. Because of the nature of the DRM comprehensive completion, which means the philosophical theory claims the research sources and its principles identification needs, a fundamental research study is required. Therefore, the researcher found to coincide this philosophical inquiry with QUAN: Qual (conception) throughout the methodological assumption that clearly revealed the DS-I stage by the data articulation [14],[22],[29],[30]. Explicitly, the "extrapolative design thinking" may occur due to the articulated new research paradigm. The extrapolative design thinking demonstrates a new insight into the element of the styling of deoxyribonucleic acid (DNA) in design sciences [6],[29],[31]. For future studies, a comprehensive DRM framework is a vital research design strategy to address and deliver the basic research building within the bubbling model of intangible ecodesign theory. It

emphasises a rigorous conception of change for environmental communication, systematically.

Acknowledgments

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