TALLINNA TEHNIKAÜLIKOOL
TALLINN UNIVERSITY OF TECHNOLOGY

Eesti Kunstiakadeemia

Department of Mechanical Engineering
Chair of ……..

Jibing Wu

INTERACTIVE LANDSCAPE ENCOURAGING SUSTAINABLE CONSUMPTION

Author applies for degree of Master of Technical Sciences (M.Sc.)

Tallinn 2015

Author's Declaration

I have written the Master's thesis independently.
All works and major viewpoints of the other authors, data from other sources of literature and elsewhere used for writing this paper have been referenced.

Master's thesis is completed under Ruth-Helene Melioranski supervision

"....."..... 201..... Author Jibing Wu signature

Master's thesis is in accordance with terms and requirements "....."..... 201....

Supervisor ..... signature.

Accepted for defence

..... chairman of defence commission

"....."..... 201... .

..... signature

Master's Thesis
Objective & Task

201... /201… academic year …… semester

Student: Jibing Wu 130351

Field of study: Design and Engineering

Supervisor: ……Ruth-Helene Melioranski (position, name)

Consultant(s): ……....(name, position, phone)

Master's thesis topic (estonian and english languages):

Encouraging sustainable consumption by interactive landscape

Interaktiivse maastikuga tarbimisharjumuste kestlikumaks muutmine

Tasks and timeframe for their completion:

Nr	Task description	Completion date
1		
2		
3		
4		
5		

Engineering and economic problems to be solved:

……...

Defence application submitted to deanery not later than ...……..... deadline .....…....

Student Jibing Wu /signature/……..……..……..…….. date …..…..…

Supervisor Ruth-Helene Melioranski /signature/ ……..…….…… date …..…..…

Phone …… E-mail: ……

INTERACTIVE LANDSCAPE ENCOURAGING GREEN CONSUMPTION

Interaktiivse maastikuga tarbimisharjumuste kestlikumaks muutmine

Abstract:

Increasing concerns about environmental issues led our attention to the environmental stress made on earth by overconsumption. In the present paper, I explore the hypothesis that an environmentally active urban landscape can encourage green consumption behavior. Interactive landscapes in the shopping center have the potential to raise consumer environmental awareness and offer them a new shopping experience though physical and emotional interactions. This paper analyzed twelve (12) existing interactive urban landscape designs or artworks, which aim at finding a theoretical background for designing an interactive urban landscape in the shopping center that can influence consumer behavior. The finding consists of a set of design practices that have been identified as four steps of rules for making an interactive landscape encouraging green consumption. These rules of practice can be considered as a toolkit for the contemporary interactive landscape designers.

CONTENT

ABBREVIATION

ECO - Ecology

DIY - Do It Yourself

ICT - Information and Communication technology

LED - Light-emitting Diode

L.S. - Landscape

METAR - Meteorological Terminal Aviation Routine Weather Report

PV - Photovoltaics

REEEP - Renewable Energy and Energy Efficiency Partnership

TSG - Tactic Sound Garden

UVA - United Visual Artist

LIST OF FIGURES

INTRODUCTION

Contextualizing the Research

The urban landscape is the primary component of people's daily life. The relationship between man and environmental landscape is a process of mutual interaction. Man's behavior can change the environment. On the contrary, the landscape may have a positive or negative influence on people, alter the way they act. The Un-self-evident mutual interaction can be brought to light by new technologies to enhance the positive effect that the environment may have on human, making it easier and more rewarding for people to change their behavior and protect the socio-physical resources of this planet.

The Aim of the Research

The study is an exploratory design research intended to explore the potentials of an interactive landscape to influence human behavior in today's overconsumption context. The aim of the study is to answer the following two questions: How to influence people consumption towards more responsible and green by interactive landscape? What is the process of making an interactive urban landscape that encourages green consumption? This paper had also discussed following two questions: How did the twelve (12) existing interactive landscape designs or artworks succeed in influencing people's behavior? How could the influences be put in the current overconsumption context and make a difference?

Research Method

The design research followed the Double Diamond model & Divergence-Convergence model in its first feasibility loop. This study contains both primary and secondary data. The primary data was collected from thirty (30) qualitative interviews conducted with different types of consumers in the Netherlands, to obtain different views of consumers towards sustainable consumption. Secondary data were obtained from relevant journals, reviews, books and other published materials. Including theory review on environmental influences on consumer behavior, and a case study of twelve (12) existing interactive landscape designs or artworks. Selection of the cases mostly relied on computer research on the keyword of "Interactive Landscape" and filter the highlighted results afterward by definition. Some cases also referred to prior case studies in relating research field. The case

study aims at finding a theoretical background for the positive influences of an interactive landscape can have on human behavior, and this paper had categorized them into series of steps and rules for making an interactive urban landscape that can influence people's consumption behavior. Information on the twelve (12) case studies were gathered from descriptions on official websites, online source of designer interview records, video documentation of user interaction, published reviews of design works.

Research Structure

The paper firstly provides a context of the design research by introducing an overview of the environmental problems caused by overconsumption and forwarded a hypothesis on the relationship between people, environment, and consumption stress, which set the groundwork for generating the idea of encouraging sustainable consumption by interactive landscapes. Secondly, the research had moved into the feasibility loop and mainly discussed the definition of two large terms-interactive landscape and green consumption, and reviewed theories under subjects of the environmental psychology in a shopping center. Thirdly, Twelve (12) relevant designs cases were analyzed and categorized from different angles. A discussion presented the four steps of rules in making an interactive landscape encouraging green consumption as the primary values of this research paper.

Significance of the Research

Past interactive landscapes designs concentrate on developing experiences and interactive features between people and physical environment for aesthetics and entertainment. This research has novelty in making a proposal, which presents that interactive landscapes have potential influences on consumer behavior, such as to enhance environmental awareness of the residents and to reduce consumption stress. The result of the research can hopefully contribute to the theoretical discussion on the significance of design intervention in sustainable development. The proposed outcome of the study can also be useful on the practical level by shopping center who wish to build new interactive environment or by designers who wants to develop interactive landscape designs. It also provides several directions for the application of multi-sensory technology for solving everyday problems.

The results of the work could be further discussed on the relationship between environmental influence on sustainable human performance.

METHODOLOGY

This master thesis is an exploratory research in the first loop of a standard design process showed by the Double Diamond model & Divergence-Convergence model (see Figure 1). Research methodology is qualitative, including methods of literature review, qualitative interview, and case studies.

Double diamond model

British Design Council introduced the Double Diamond model & Divergence-Convergence model in 2005, which illustrates the general process and thinking mode in varies types of creative works (Council 2007). The first diamond includes two distinctive phases: Discover and Define. The research process of this paper is switching between the Discover and Define quarter repeatedly.

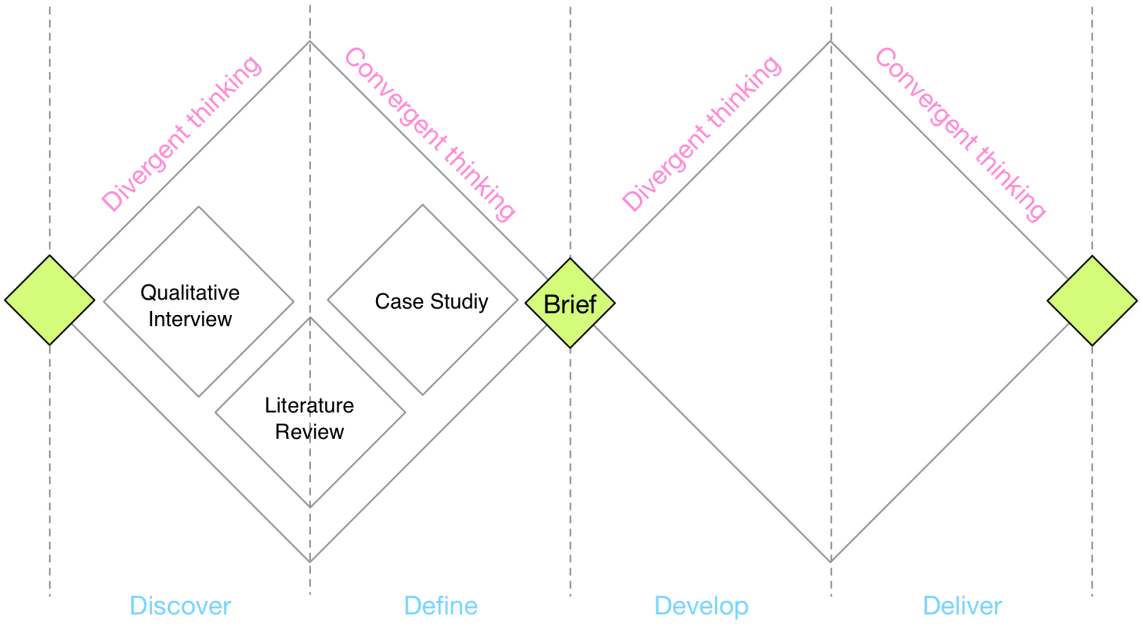


Figure 1: Double Diamond model & Divergence-Convergence model. (Council 2007)

The thesis starts at the left point of the diagram with an initial inspiration got from the relationship between people, consumption stress, and the environment. As collected data piles up, the design process moves divergently from Discover phase to Define phase, aim at keeping thoughts wide open to a broad range of ideas and influences. In this stage, the research analyzed market strategies and trends and posed as many hypotheses as possible. Consumer research is carried out to identify problems for consumers to change their

behavior towards more sustainable and green. When the Define phase starts, the design process convergently moves towards a point of design brief which clearly states the problems and plans for solutions. In this stage, two important terms-“interactive landscapes" and “green consumption” are redefined only for this research. The problems and hypotheses collected from Discover phase are combined and synthesized. Because the second diamond gets input from the design brief, as shown in the diagram model, a better design brief means a better outcome from the Development and Deliver phase. Sometimes the findings from the Define phase still lack distinction, and it should be then put back into Discover phase to restart in the first diamond loop once again.

Case studies

The study discussed twelve (12) existing interactive urban landscape designs and artworks. The case studies aim at finding a theoretical background for designing an interactive urban landscape that can influence people’s consumption behavior towards more green and responsible. The selection of the cases mostly involved a computer research on the keyword of “Interactive Landscape” and similar keywords such as “interactive environment” or “Interactive Plant”, and I afterward filtered the search results by media coverage and pre-set definition of interactive landscape in this research. The selection also referred to previous case studies in relating field (Lefffer 2011; Rahaman & Tan 2009; Wiley 2007). The twelve (12) design or artworks were categorized from different aspects. They form various groups according to similar design features that had successfully influenced people’s behavior. From the categorization, I identified a series of rules which can work as a design platform for making new interactive landscapes and analyzed these shared characteristics in the context of encouraging green consumption behavior. The twelve (12) works includes the Dune series, Boo and Sensory Valley from Roosgaarde Studio, Helix Tree by Bruce Ramus, Volume by the United Visual Artists, Sonumbra de Vincy by Loop.pH, Tactical Sound Garden by Mark Shepard, Botanicus Interactus from Disney Research, Botanicalls project, Hello Stranger by unknown artist, Fibre Tower by Makoto Sei Watanabe, and the Future Field by L.G.Leffers.

Qualitative interview

Thirty (30) qualitative interviews have been carried out to understand the significance of green consumption in consumer mind, and to locate the reasons for people to support or act against green consumption. Most interviewees are master students from the University of Twente. Other participants include randomly selected shopping customers in Enschede, the Netherlands, mainly in the age between twenty (20) to forty-five (45), including housewives or office workers, who are mentioned in Gilg's research (2005) that these people are most likely to participate in green behavior. Interview documentation includes critical opinions from the discussion and a record of informants' age range, gender, nationality, marital status, education background, and occupation. In-depth interview and focus group discussion are utilized to find out the definition of green consumption given by consumers, and to learn consumer behavior and collect ideas for encouraging sustainable consumption. I compared the data obtained from qualitative interviews with early research findings. Some results from the interview sessions are in agreement with previous conclusions and have gained credibility of recent results. Other outcomes that are different with previous findings have led to a general understanding of the distinct changes in current green consumption environment.

Quantitative research methods are not proper for this research because they measure the objective reality that existing "out there" in the world, and intent to reduce the ideas into a small discrete set of ideas to test existing theory (Creswell 2003). However, there are few earlier studies refer to the research problem conducted in this research. Qualitative research methods are thus more suitable for this exploratory design research. The purpose of exploratory research is to gain insights and familiarity for later investigation or undertaken when problems are in a preliminary stage of inquiry (Lynn n.d.). Qualitative interview technique is proper for this research based on the assumption that individuals try to understand the world in which they live and consume, and they develop the subjective meaning of their consumption experience. These meanings are diverse and multiple, leading the researcher to look into the general and complexed views rather than narrow down the meanings into a few categories. The goal of the research is to rely as much as possible on the participants' views of the situation under this research topic. The questions

become broad and general so that the participants can construct the meaning of a situation, a meaning typically forged in discussion or interaction with other persons. (Creswell)

Qualitative interview questions are semi-structured so as to get the maximum information and insights out of the informants. The questions are factual and open-ended so that the research can learn consumer opinion and behavior in their life setting (Boyce & Neale 2006). An individual interview takes about fifteen (15) to thirty (30) minutes. The in-depth interview lasts longer than thirty (30) minutes. The samples chosen for the in-depth interviewees are within thirty informants who are willing to participate in a further discussion.

In-depth interviewing is a qualitative research technique that involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation (Boyce & Neale 2006). In-depth interviews are carried out via friendly conversation during pre-arranged appointments and dinners. It is suitable to use this method here because it allows the informants' emotions and thoughts emerge naturally in a relaxed atmosphere, and the discussions will not be interrupted. The information collected through in-depth interviews are more detailed than those through other data collection methods. Focus group discussion often accompanies in-depth interviews. The technique of focus group session is used to gather information on a range of ideas and feelings that individuals have in common about particular issues, as well as illuminating the different perspectives between groups of individuals (Rabiee 2004). I identified three (3) focus groups with the decreasing degrees of participation in green initiatives. The three levels vary from green consumers who are 'Highly involved,' or 'Involved' in the green purchasing activities, to 'Never involved' non-green consumers. Each focus group is made up of three (3) participants excluding the researcher. The selection of the members of in-depth interviews and focus groups is on the criteria that they would have something to say on the topic, and are within the age range of the target audiences, having similar socio-characteristics as a representative sampling of a particular population. In-depth interview and focus group are used proper here to get detailed

information about consumer experiences, motivations, views and behavior relating to green consumption to explore new design values.

In this study, the ‘Highly involved’ green consumer is defined as a customer who put green products on top choice in making most of the purchase decisions. ‘Ever Involved’ consumer is defined as a regular buyer who had experience in green consumption, but not very often. ‘Never involved’ non-green consumer is a term for the one who do not have experience in green consumption in general.

DESIGN CONTEXT

The opportunity for the next paradigm shifting of the ICT age lies in innovation and sustainability. Design and Innovations could become necessary tools in shaping the desire of the majority and guiding them towards healthy lifestyles and environmentally friendly consumption habits (Perez 2014).

Increasing concerns about environmental issues led our attention to the environmental stress made on earth by overconsumption. Consumption is the reason for anything gets produced. Consumption and production together are the source of all man-made stress on the natural environment. In a market economy, the primary responsibility for environmental degradation thus lies with the consumer (Heiskanen & Pantzar 1997). In everyday life, however, traditional buyers don't have much knowledge about the consequences of their habitual consumption behavior, neither do they believe in having the power to affect the marketplace. Consumers do not value their relationship with the environment in a way to let them act in a sustainable manner. The environmental concerns are not strong enough to influence their decision making during shopping. These hypotheses can be claimed to be true from qualitative interview results in the early discovery stage of the research progress.

Building and enhancing a friendly relationship between man and environment is essential to all kinds of environmental protections. Experiences and emotions are important factors that start a relationship. Since we are young, we are exposed to understand our ecosystems through interacting with the world around us (Anderson et al. 2014). The relationship between man and environmental landscape is a process of mutual interaction. Human behavior can change the environment. On the contrary, the landscape may have a positive or negative influence on people, alter the way they act. Our conceptual understanding of the environmental resources and ecosystems may develop from the direct and detailed exploration of our urban environment with the use of our senses, such as touch and smell. Plants and trees in our urban environment were often being regarded as non-living objects due to its immobility and non-threaten presence, especially for children (Hwang et al. 2010). However, interactivity can make our physical urban environment 'alive'. The Un-

self-evident mutual interaction can be brought to light by new technologies to enhance the positive effect that the environment may have on human, making it easier and more rewarding for people to change their behaviors and conserve the socio-physical resources of this planet (Nagy, J. & Fawcett, S.B. n.d.). While most of the interactive landscapes stand in the museum today as a piece of artwork and keep a long distance between interaction and life, there are opportunities for the technology to reach out to its audiences in everyday situations. Users may be surprised and attracted at first by an artwork and soon lose interest. Integrating interaction into the daily occurrences of the residents can maintain a long-term relationship with the audiences.

This research forwarded a hypothetical correlation between people, environment, and consumption stress, which set the groundwork for generating the idea of encouraging sustainable consumption by interactive landscapes (see Figure 2). The study also assumed that by making our living environment responsive, interactive landscapes in or near the shopping center have the potential power to raise consumer empathy for the condition of the natural environment, as well as increasing concerns about environmental resources. It can communicate with people in a new type of dialogue and build a closer relationship between people and environment to reduce overconsumption.

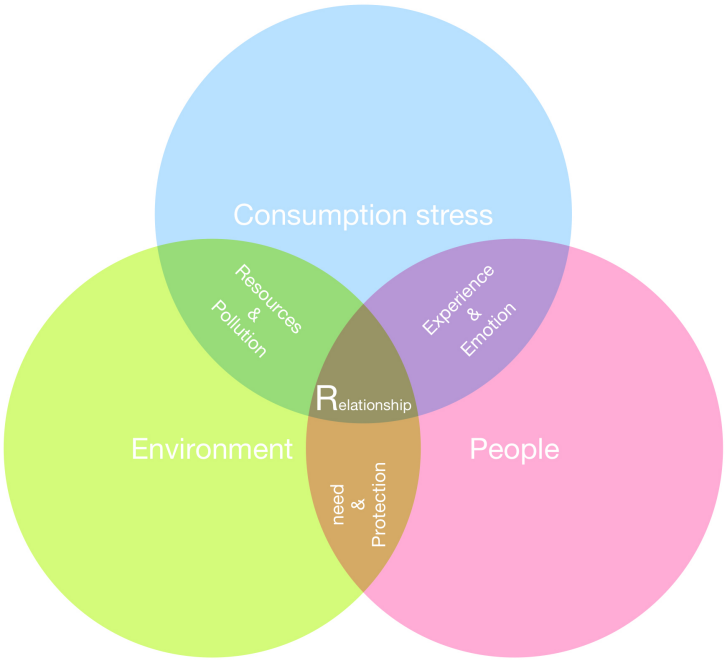


Figure 2: Correlation of crucial elements in design context

FEASIBILITY LOOP

Define Interactive landscape and green consumption

Definition of the interactive landscape:

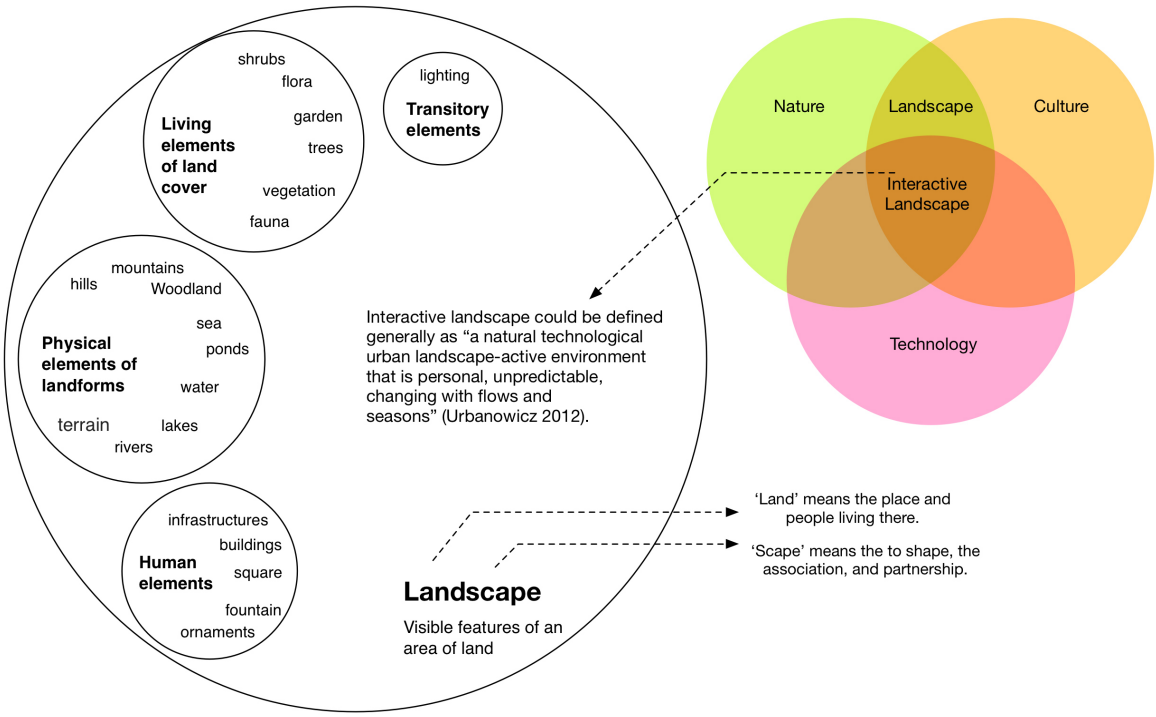


Figure 3: Definition of the interactive landscape. (Wiberg 2010)

The interactive landscape is a hybrid of natural landscape and modern technology (Roosegaarde n.d.). Its definition can be traced back to the overlapping between different research disciplines and has evolved through several stages (see Figure 3).

The disparity of the forms and functions of interactive landscapes makes it difficult to give a precise definition but invariably it starts with the subject of Landscape. The landscape is a discipline where nature overlays with culture. It was broadly defined as visible features of an area of land (Wiberg 2010), In which the word 'Land' means the place and people living there, and 'Scape' means to shape and associate (Sheng et al. 2014). The visible features belong to four groups: Transitory elements such as lighting. Living elements of land cover, includes shrubs, trees vegetation, flora, etc. Physical elements of landforms, such as hills and lakes and human factors like infrastructures, fountain, and square. The result of the landscape is people interacts with nature or natural elements. Therefore, it

could be presumed that the interactive landscape emerges when such visible features and interactions are equipped with modern technologies to become more intelligent and futuristic.

A proper definition of an interactive landscape was“A natural-technological urban landscape-active environment that is personal, unpredictable changing with flows and seasons”(Urbanowicz & Nyka 2012). Based on the definition obtained from prior research, the interactive landscape in this study refers to the environment or natural elements activated by sustainable technology or sensory technology, can physically or emotionally interacts with the user, performing a real-time response to human behavior.

Definition of green consumption:

A general understanding of the term green consumption is a form of consumption that is compatible with the safeguard of the environment for the present and the next generations. It is a concept that ascribes to consumers responsibility or co-responsibility for addressing environmental issues through the adoption of environmentally friendly behaviors. (Wikipedia 2015)

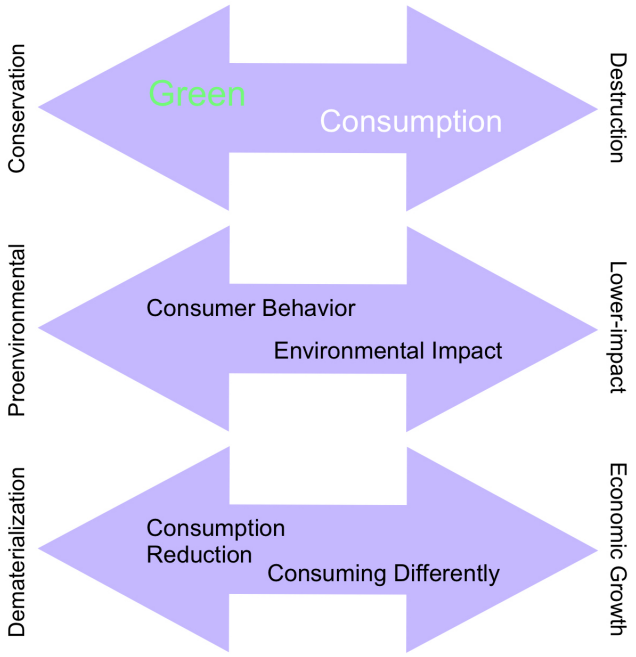


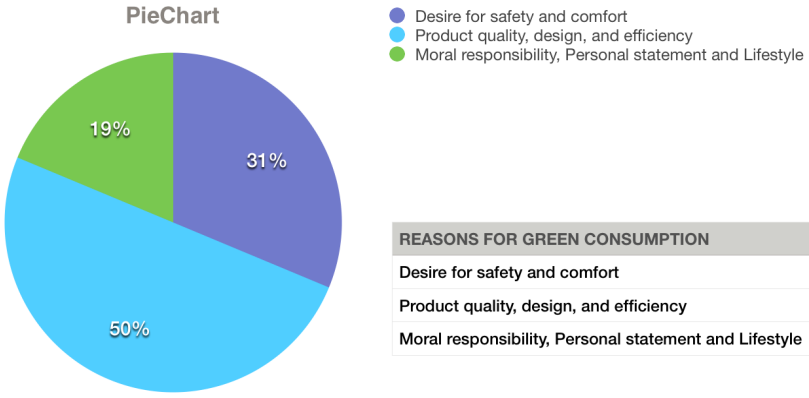
Figure 4: Paradoxes and incompatibility of green consumption. (Peattie 2010)

Green consumption activities began with such features as organic goods, simplicity, and frugality. In contrast, more recently, green consumption has come to be perceived as a symbol of both luxury and prestige. While everyday household items such as detergents were the focus of green consumption in the past, nowadays this has shifted to expensive and emotionally driven product purchases such as computers, cosmetics, and apparel. (Lee & Park 2013)

The occurrence of the concept of green consumption is a highly complex but incompatible process (see Figure 4). The term evolved from varies definitions throughout history and commonly overlaps with other concepts such as ethical, sustainable or responsible consumption, leading to a lack of clarity and consistency in notions of green consumption within the research literature. Instead of wrestling with such distinctions this study uses green more broadly as shorthand for "oriented toward sustainable development" and focus mostly on environmental aspects of sustainability (Peattie 2010), and the term 'green consumption', 'ethical consumption' and 'sustainable consumption' are used interchangeably describing an everyday consumption practice of purchasing product, or service does the least damage to the environment as well as those who support forms of social justice (Young et al. 2010).

Interview results from consumer research

Purchasers are currently buying green products for the desire of safety and comfort, product quality, design and efficiency, moral responsibility, personal statement and green lifestyle (see Figure 5). The structure of the interview referred to another study on consumer environmental orientation and had further proved its finding on security desire, consumer self-monitoring and self-satisfaction behaviors (Lee & Park 2013).



REASONS FOR GREEN CONSUMPTION	NUMBER OF PARTICIPANTS
Desire for safety and comfort	10
Product quality, design, and efficiency	16
Moral responsibility, Personal statement and Lifestyle	6

Figure 5: Interview Chart I

A desire for safety and comfort.

During interviews, ten (10) informants expressed consuming green products in pursue of their safety and comfortable environment. They are aware of the pollution and are paying considerable attention to the heath condition of themselves and their families. Especially a housewife performs environmental conduct in consideration of children health and future living situation. People tend to pay attention to short-term pleasure when they are young. However, when they become parents, they start to care about the long-term health of the environment for their kids. They consume as a parent and make buying decisions in the logic of their new identities, which indicates that people may act to fit their social roles and act in the expectation of both themselves and others.

Product quality, designs, and efficiency.

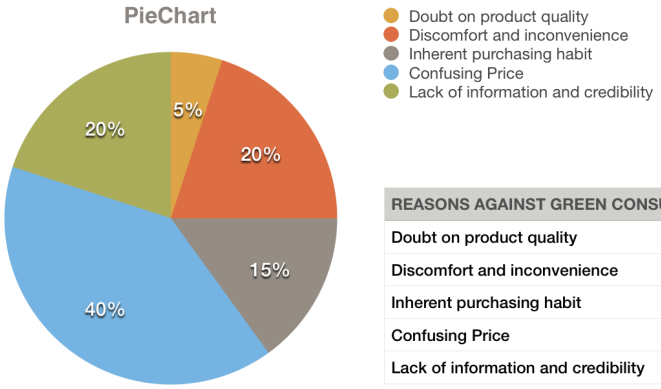
From the interviews, eleven (11) informants mentioned buying green products for durability. Five (5) sources value the atheistic or the design of a product. With life increasingly filled up with groceries, consumers start to rethink the essence of life, and

pursuit simplicity in product designs and aesthetics, especially among garments and household items. In general, green products have a reputation for the stylish appearance, friendly design, proper functionality and durability among consumers. Some green consumer also showed confidence in the efficiency of the products they are buying. Such as LED lighting, energy-saving washing machines, and other electric appliances with energy efficiency labels. These reasons apparently showed that the starting point of shopping behavior for many people are favorable functional needs to improve their life quality.

Moral responsibility, Personal statement and Lifestyle

Voices are stressing the social responsibility of environment protection. Interviewees express a strong sense of justice and moral accomplishment which pushed them to consume in green initiative. Green becomes a new trend. Even though green products are more expensive than their non-green counterparts, many consumers nevertheless purchase such products, because it allows them to make the statement to others that they are green consumers. The case indicates that customer seeks for satisfaction from the process of buying rather than the result. Interesting quote from an informant,“ I often buy environmental-friendly products. I always feel proud when I shop in Eco-brand stores. I think it shows I have sufficient income and a better taste.” I16 Beyond showing others a personal image or a statement. Most highly active green consumers believe it is the perception of lifestyle that matters. There is a consensus between life pursuit and product philosophy. Another citation goes,“I bought all my clothes and home decoration from Eco brands. My husband does that too. We think it is a lifestyle. We pursue to live a high quality but simple life.”I2

On the other hand, consumers avoid green products due to their doubts about product quality, discomfort and inconvenience, ingrained purchasing habit, confusing price, and lack of information and credibility (see Figure 6). There is a distinction between the results compared with similar research conducted before, which indicates an environmental change in consumption context.



REASONS AGAINST GREEN CONSUMPTION	NUMBER OF PARTICIPANTS
Doubt on product quality	1
Discomfort and inconvenience	4
Inherent purchasing habit	3
Confusing Price	8
Lack of information and credibility	4

Figure 6: Interview Chart II

Doubt on product quality.

Green goods were originally stamped with a bad reputation for quality in the past, and previous research showed that 42% of people think that green products don't work as well as conventional ones (Vernekar & Wadhwa 2011). Contrary to the past research result, only one (1) out of thirteen (30) informant expressed doubt on the quality of recycled material and products during the interview.

Inherent consumption habit.

From the interview, I found that the ingrained purchasing practice is deeply rooted in consumer's mind. Traditional consumers may initially resist the upcoming new trend to maintain their current aesthetic tastes, living conditions, and intrinsic consumer right. Typically, half of the non-green informants expressed a strong sense of exclusion against the topic or especially an emphasis on own self-being.

"Eco-products are too monotonous and boring; they are just not my type." I7

"I just like to buy cheaper products. Using the same amount of money I can buy a lot more kinds of stuff. Those green ones are made for the wealthy." I8

Confusing Price

Past research had stressed the negative role of high prices in the green promotion. High price creates tension between the desire for great family value and supporting sustainable products. It forces people to choose between emotional desires and fiscal budget decisions (Vernekar). However, during the interview, contradictory views on the price tags were

conveyed. Most of the “Highly involved” green consumers expressed an understanding and acceptance of the “slightly higher” costs while non-green consumers think green consumption brings emotional and economic burden.

“I may have to pay a bit more at first, for example, an energy-efficient refrigerator, but it will help me reduce the energy bill, later on, I can enjoy the pleasure brought by most advanced technology, and I feel socially responsible .” I29

Lack of information and credibility

All informants expressed confusion, doubt or uncertainty in green products and its credibility. The result is in agreement with prior research finding that states that apathy takes place when consumers believe individual action cannot affect the macro environment, their contribution is small and useless (Vernekar). It is also noticeable that consumers are less resist to products with clear and immediate benefit, further proving that the lack of knowledge on green technology, inadequate product information, lack of credibility of the product are a common contributor to the consumer giving up on green consumption. Many question leads to the difficulty of recognizing green product from the rest. Half of the informants met difficulty in recalling the green products they had bought at once or giving examples of familiar green products. Lots of doubts on the standards of environmental evaluation continued to pull back the potential green consumers. Consumers need to be enlightened and guided through the purchasing process. Under the help of organic labels supported by the government, most of them can figure out what to buy in a shorter decision-making time, with limited economic and mental effort (Young et al. 2010).

Another interesting finding from the interview sessions is that everyone believes green consumption is important while no one considers the majority would like to engage in green consumption (see Figure 7).

In this research The twenty-four (24) ‘Highly Involved’ and ‘Involved’ consumers had all expressed in an individual situation they will be willing to support and join green consumption. When they faced the question whether they think other people would also like to join in the same situation, seven people showed uncertainty and the rests answered no. All the six (6) non-green consumers expressed willingness to buy green products if the

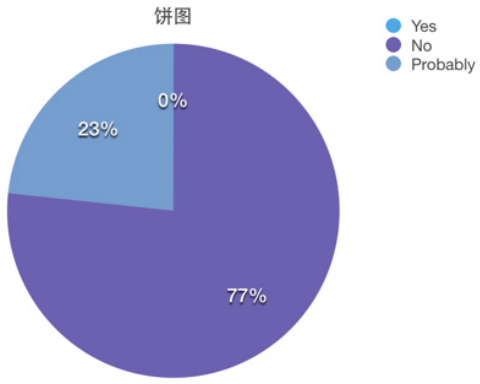
majority does so, which seems to point to consumer conformity in green consumption. They also claimed for sure that the majority will not like to join green consumption. In general, the thirty (30) interviewees all believed that green products are currently more expensive, and most people would like to buy cheaper products. There were also some people stating that shops like to sell short-lifecycle products for continuous revenues. However, everyone mentioned it is paramount to promote green consumption. This verbal agreement could indicate that consumers were aware of their moral responsibility and expressed high attitude in supporting green consumption. The non-green consumers said protecting the environment is crucial, the term 'green' is new. They are looking forward to the green technology to become matured and wait for the price going down. It is obvious that a gap between consumer attitude and behavior exists. Past research reported that 30% of consumers claimed they are very concerned about environmental issues but are struggling to translate the value into actions (Young). Due to the difficulty of attaining a sustainable conduct in consumption process, people may be less optimistic about the behavior of others.

Believing others will engage in green consumption

ANSWER	PARTICIPANTS
Yes	0
No	23
Probably	7

Believing green consumption is important

ANSWER	PARTICIPANTS
Yes	30
No	0
Probably	0



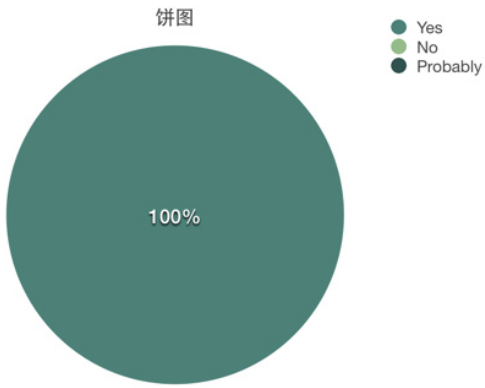


Figure 7: Interview Chart III

More interview quotes from informants see Appendix I.

Conclusion:

The reasons for consumers either to vote for or against green consumption behaviors could be considered as the main factors that will influence their decision-making process in a shopping environment. These influencing factors can further divide into two sides. Some consumers enjoy sustainable shopping experience because they have high empathy and concerns for the environment. On the contrary, others shop for the sake of personal benefits. They shop seriously for the goods or services that can improve their quality of life, or they seek for fun from the process of buying rather than the goods they have bought. Besides, Consumers intend to fit their social roles and consume logically according to their identity, while social rule will, in turn, affect individual behavior through consumer conformity. Moreover, due to the difficulty of attaining a sustainable conduct in consumption process, people may be less optimistic about the responsible conduct of others. And they are more satisfied and confident for living a more personalized lifestyle. Thus, to transform people's consumption behavior towards green and sustainable can start from either enhancing their environmental awareness or to design more personalized social values for improving their quality of life. Creating an interactive landscape should be put into the two contexts above to fit in the consumption environment.

Literature review on environmental phycology and intervention

Consumer sentiments towards the shopping environment are hard to detect. They experience the shopping environment through basic five senses, including sight, touch, sound, smell and taste (Reyhle 2012). The intrinsic character of the shopping experience is to convey our current existence through a series of actions, emotions and value orientations (Leffers 2011). Thus, a stimulating environment has five ways to determine whether a customer is engaged or disenchanted, with apparent influences on consumer activities, consumption mood, and cognitive acknowledgment on environmental values. Meanwhile, Interactive landscapes are exploring new roles in shaping the opinions and behaviors of inhabitants in an urban environment. Sensory interactivity together with environmental resources in a responsive environment seems to be properly used in a consumption context to implant environmental consciousness and encourage new consumption behavior. By interacting with surroundings, the once neutral space is filled with memories, reflections and emotions, based on different cultural interpretation from each person, and then the shopping center transform into a personal and social space with diverse infrastructures and functionality (Urbanowicz & Nyka 2012).

Interactive landscape influences consumer activities:

Peter H. Bloch brought the concept of habitat into analyzing consumer behaviors and states in his work: “Consumers, like wildlife, are likely to gravitate to a setting offering a favorable climate, a high potential for social interaction, perceived freedom from safety concerns, and an extensive selection of consumable goods and experiences". Nowadays the shopping center offers a relaxed atmosphere, good services, entertainment activities, etc. Inhabitants engage in a broad range of behaviors and interacting with a variety of environmental elements (Bloch et al. 1994). An interactive environment can provide a sense of secureness and comfort through varies means. Experiences and services offered by interactive landscapes are also with values and are consumable.

Interactive landscape influences consumer emotions:

The environmental psychology literature positions consumer emotion as a mediating factor between environmental cues and behavior (Michon et al. 2005). Emotion constitutes a

primary source of human motivations and exerts substantial influence on memory and thought processes correlated to consumer preference together with satisfaction judgment (Westbrook & Oliver 1991). Therefore, in correspondence to the basic five senses, commercial renovation in visual aesthetics, sound background, scents or odors, tactile displays and probably tastes of some food samples will mostly affect consumer mood and later proceed to the perception of merchandise. Interactive landscapes are favorable environments synthesized with plenty of distinct sensor possibilities that can contribute to the green initiatives.

Landscape preference associated with environmental value orientations:

People's affective or aesthetic evaluation of landscapes is not an isolated mental process; it must instead necessarily correlate with additional and related affective and cognitive constructions that we have regarding our relationship with both society and our physical surroundings. According to social adaptation theory, our universal values are one type of cognition that facilitate adaptation to the environment. Values have been defined as general life goals and standards that serve as guiding principles in our lives, and they are thought to determine attitudes and behavior toward particular aspects of our environment. Some people may want to protect a landscape because it serves utilitarian human needs, such as environmental issue may harm people. Meanwhile, others may emphasize that nature deserves consideration in its right beyond human interests. (Keltenborn & Bierke 2002)

Motivations of environmental concerns typically include anthropocentric attitude and ecocentric attitude. Significant and positive correlations exist between ecocentrism and a preference for natural and cultural landscapes while the latter one often associated with environmental apathy (Kaltenborn). The motivation theory partially explained the interview result that people intends to consume sustainably either for improving their life quality or an empathy for the environment. Hence, Interactivity and technology of the interactive landscapes can be designed in the two realms: to develop from environmental resources perspective or behavior and interaction perspective.

Furthermore, research showed that people with either type of environmental orientation prefer naturalness. Human influence may be appreciated, however, on the prerequisite for designing in balance with natural elements (Kaltenborn). Thus leads to a question of balancing between natural ingredients and artificial components in creating an interactive landscape.

Motivating experiences and attractive factors

Motivating experience for many consumers would mean the progress of self-actualization. In other words, experiences that can enhance how they feel about themselves or to get themselves closer to their ideal selves (Tanner & Raymond 2012). In turn, a better version of self-image contributes to the satisfaction of life improvement. People who have a tendency in overconsumption seek for motivating experiences from a vicarious acquisition of resources and social interaction (Gondor 2009). While inner anxiety usually drives those impulsive buyers to shop to improve their mood (Zimmerman 2012). A motivating experience may appear quite differently to consumers who consumes rationally, where they look for communication and cognitive interactions.

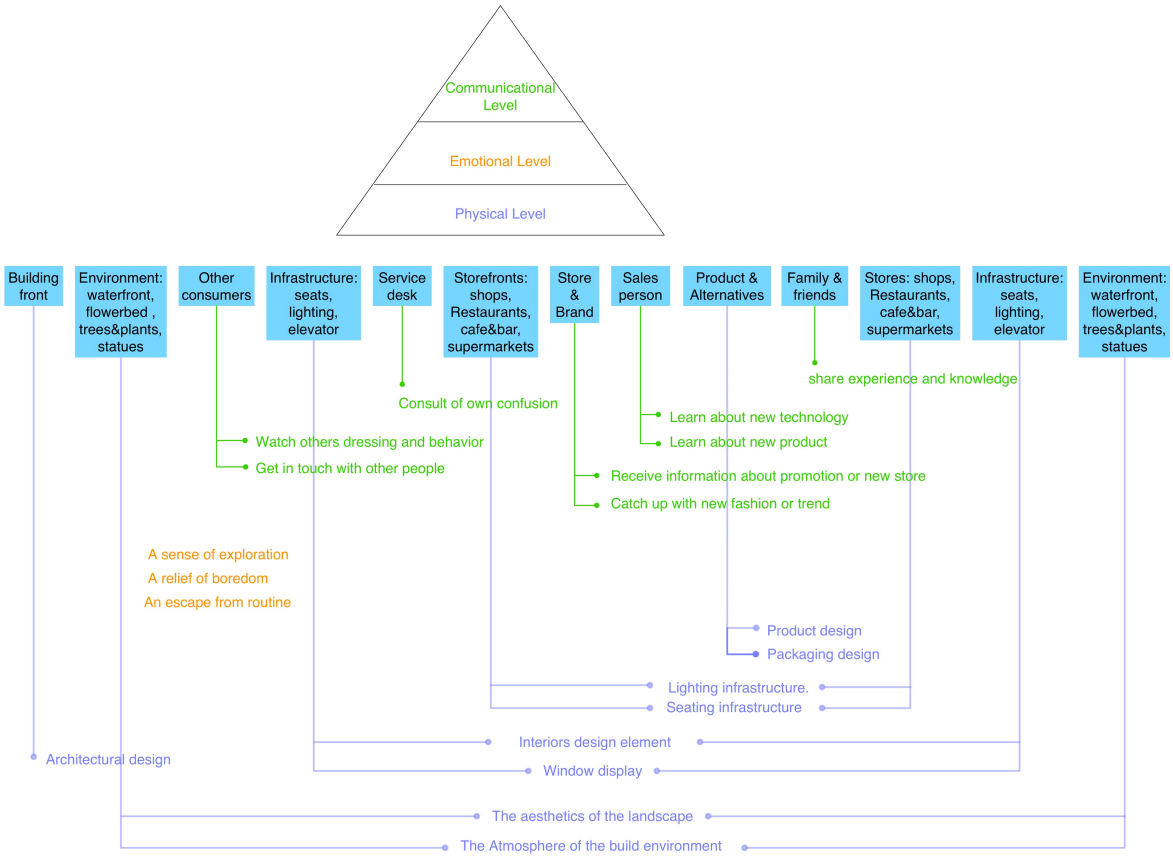


Figure 8: Paradoxes and incompatibility of green consumption.

Insights on attractive factors from Bloch (1994) helps to gain a deeper understanding of the attractiveness of a motivating experience. This research re-organized the elements and grouped them into three levels to correlate with the three types of influences from environmental psychology intervention. The three levels are physical level, emotional level, and communication level (see Figure 8).

The physical level means the customers are happy with the design relating factors and the activities. It is an individual and personal experience and rely on the personal view and cultural background. Architectural design, the aesthetics of the landscape, the atmosphere of the built environment, window display, interiors design element, product design, packaging design, seating infrastructure, and lighting support could all attract a customer's attention within a second.

The emotional level means the customer benefit from going through a series of emotional experience. They are also individual and personal experience, but much more rely on the interpretation of physical level attractive factors. Their emotion climbs a ladder from an escape from routines, a relief of boredom, up to a sense of exploration.

The communication level means the customer are happy with the social benefit and knowledge learning from the shopping experience. It is interpersonal and community experience, an exchange of information through words of mouth or the description on the product package and advertising. The attractive factors in communication level consist more interaction than the other two. Consumer cognitive learning and social satisfaction would raise by consulting of own confusion, receiving information about the new product or new store, learning about new fashion or trend, hearing about new technology, getting in touch with other people, watching others dressing and behavior, exchanging knowledge and experience. Consumers' views towards an Eco-friendly product largely depends on the opinions of other primary referents who live in the same community. Human beings are rational and proceed a variety of information when making a decision. Perception and ideas of others may have a high predictive power towards a particular behavior (Kim et al. 2013). Which indicates that social interactions can affect consumer consumption behavior towards green and responsible.

An environmental media to influence the masses

Culture more or less affects individual conduct and people regard it as an entirely natural experience. Individual behavior transforms to social practice when cultural influence come into play. In modern cultures, urban residents are bombed by a massive amount of stimulus from the Mass media. Consumers need to face and passively accepts an explosive number of figures and data from packaging or advertisement. These people who live in the whirling, from one side, are afraid of a slower perception caused by the reduction of stimulus. On the other hand, people are expecting something natural, rural and original to slow the pace of the growing amount of information. These people who live in the city have learned many ways to shield the problems, and keep the essential aspects of their lives, which involves social interaction and living environment. So they start to ban the advertisements while subconsciously spend much more time in a shop decorated with green plants. (Inglis 2005)

Social consumption practices will, in turn, transform individual purchase behavior by consumer conformity. One intends to become part of the masses by keeping a close contact with the majority. People may act to fit their social roles and act in the expectation of both themselves and others. They consume in the logic of their personal preferences as well as considering their social identities. Consumers look for support from the crowd and try to make correct buying decisions when there were not sufficient information available, especially in a green market where lots of puzzles still exist on different standards and the confusing prices. An individual consumer also follows the consumption pattern of the crowd with a desire to be liked by the public when they are put into an unfamiliar environment or in an ambiguous situation, particularly when their behavior is reflecting the moral traits or personal characteristics. (McLeod 2007)

Interactive landscape plays the role of environmental media when put into a consumption context. One person is reasonable to be part of the masses when individual interaction transforms into social interaction. It also involves competing or sharing of informational and environmental resources, as well as the emerging sign of familiar territory during social interaction.

CASE STUDIES

The study is based on twelve (12) existing interactive urban landscape designs and artworks, aiming to find a theoretical background for designing an interactive urban landscape that can influence people's consumption behavior towards more green and responsible.

(a) Dune Series (2006-2012): Dune is a series of interactive public landscapes by Daan Roosegaarde. The initial version Dune 4.0 locates in a lined corridor of the Netherlands Media Art Institute in Amsterdam. The work met its success and traveled around the world for exhibitions. In Dune, large amounts of fibers compose a digital field of light, which can detect and respond to the sound and motion of passersby (see Figure 9). The later versions are Dune 4.1, Dune 4.2, and Dune X. The work fitted itself to different contexts and evolved gradually through technology advancement. (Roosegaarde n.d.)

Figure 9: Dune by Daan Roosegaard
(Source: https://www.studioroosegaarde.net/project/dune/photo/#dune Jan 2015)

(b) Boo (2012): An interactive pillar field that looks like an eastern garden of bamboos. The work locates at Amsterdam University and regularly interact with hotel school students by its mysterious light and sound.

(c) Sensory Valley (2012): Another interactive light forest created by Roosegaarde Studio. It was the largest interactive sensor artwork of Europe and had been placed permanently in Assen. The artwork consists color LEDs and sound speakers, which allow appealing reactions to the movement of audiences.

(d) Volume (2010): The artwork is a grid of forty-eight columns (see Figure 10). Visitors weave a path through the light, and musical streams, the notes, and visual effect combines for a real-time effect to the walking route of the audiences. (UVA 2010)

Figure 10: Volume by UVA
(Source: https://uva.co.uk/work/volume Jan 2015)

(e) Hello Stranger (2007): An interactive pillar field with preset light scenes and react to the presence and proximity of the visitor. (zodzwingli 2007)

(f) Botanicus Interacticus (2012): A technology realized interaction between human and living plants through a non-invasive sensing circuit that transform human gestures and proximity into a unique expression of the living plant. The visual and sound characters vary between plant species. (Poupyrev et al. 2012)

(g) Botanicalls (2006): A DIY kit for gardeners to receive phone calls and text messages from their plants about its health condition and assistance request. Based on networked open source hardware and software, the plants are also able to post gratitude for the care on social websites such as Twitter. (Botanicalls n.d.)

(h) TSG (2006b): The Tactical Sound Garden Toolkit, an open source software platform for the community to collaboratively shape the public environment. Everyone with a mobile audio device can cultivate sounds in the participatory urban garden. (Shepard 2006a)

(i) Helix Tree (2013): The interactive tree is a central creation for a winter lighting program in Melbourne. The steel branches of the sculpture light up when they heard the human voice. The appealing interaction gathers people in the community to the harmony while playful social space. (Ramus Illumination n.d.)

(j) Sonumbra (2008): Sonumbra de Vincy is three interactive tree sculptures made from light-emitting handcrafted fibers (see FIgure 11). The responsive environment interprets online weather date of three European cities into patterns of light animation. (Loop.ph n.d)

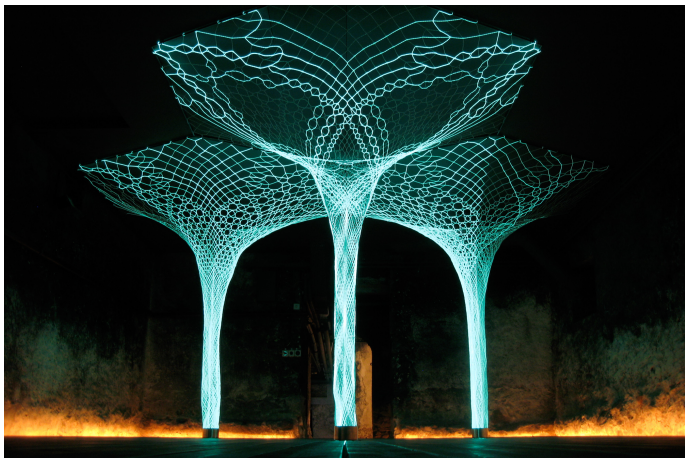


Figure 11: Sonumbra de Vincy by Loop.pH
(Source: https://uva.co.uk/work/volume Jan 2015)

(k) Future Field (2011): A technological roof landscape exists of a field of flexible strands that can collect wind power. Daylight is captured through optic fibers and act as a medium to provide people a visual experience of motion. (Leffer 2011)

(l) Fiber Tower (2004): An interactive cityscape with a non-static fiber structure bends in the wind (see Figure 12). The floating interior bubble spaces change according to internal activities, and it also communicates to outside world as a real-time visual screen. (Watanabe 2004)

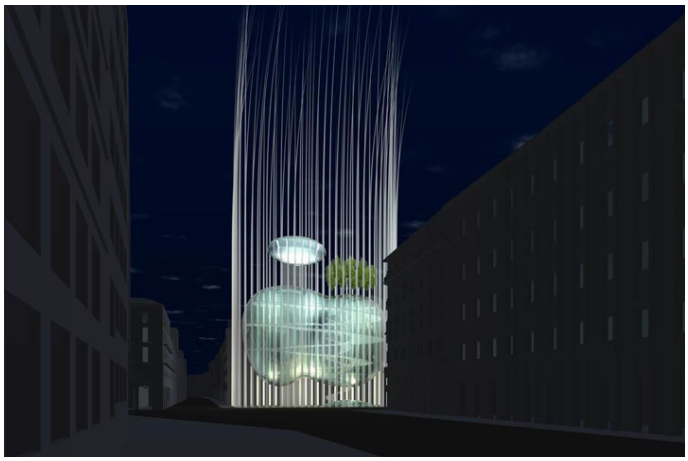


Figure 12: Fiber Tower by Makoto Sei Watanabe
(Source: https://uva.co.uk/work/volume Jan 2015)

DISCUSSION: FOUR STEPS OF RULES

Although the twelve (12) interactive landscape designs or artworks vary in forms, on a higher level of abstraction, they could be very alike in the design process and the ideas behind them. After analyzing the twelve interactive landscapes design cases, lots of similarities are found in methods that the designers used to make a model successful. These similarities are categorized from different perspectives and showed significant potential in influencing consumer behavior in the future as well.

From a comparison of twelve cases, I summarized four (4) steps to make an interactive landscape design, and eleven (11) evenly divided rules accordingly. These rules of design practice showed the process of making an interactive landscape with the potentials to encourage green consumption. Depending on different design goals some steps could be skipped. The rules within each step can be selective and mixed with each other for a better outcome.

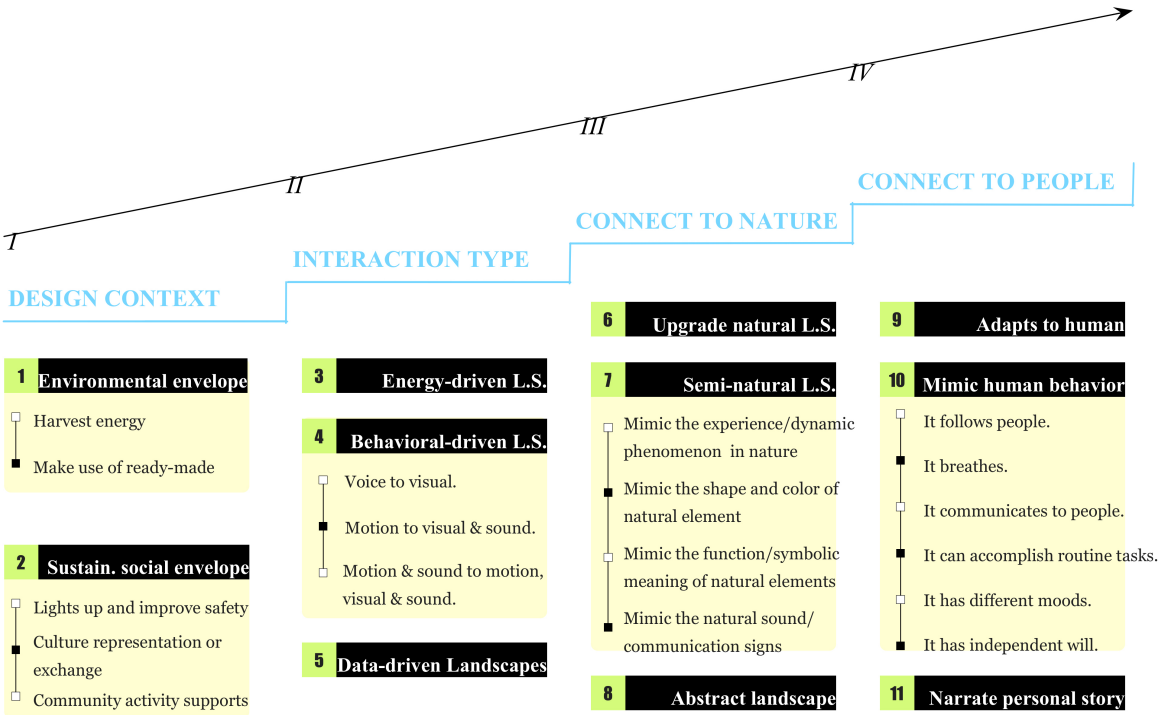


Figure 13: Four Steps and Eleven Rules

In the end, the four-step process and eleven rules are relatively straightforward (see Figure 13): The first step is to choose a design context from the sustainable environmental envelope or sustainable social envelope, considering of your design strength and

technology level. The second step is to determine a design direction from three types of interactions, namely energy-driven landscapes, behavioral-driven landscapes and data-driven landscapes. The third step is to connect your design to the wild nature or urban environment. It can be achieved in three ways, updating the natural landscapes, creating a semi-natural landscape, or creating an abstract landscape. The fourth step is to connect the design work to people and their social lives in the every-day situation. Three ways to achieve this would be, adapting to human behavior, mimicking human behavior, or narrating a personal story.

STEP ONE (I): Choose a design context

The context of the conception is necessary, including demographic, social, political, economic and psychological factors as well as temporal and ideological structuring of domestic practices (Hand et al. 2007). Although the details of each design context varies, such as location, modern culture, and technologies, the idea of taking advantage of each context to trigger different qualities of the work are the same, which makes the design work more sensual, more attractive and more adaptive. The success of a design work mostly relies on its context. Even the same job would tell a different story in different context.

To design an interactive landscape, sustainable technology, and social connection are both imperative. If a plan aims at encouraging sustainable consumption, the feasible technology itself should be sustainable. A review of existing interactive landscape designs that are already on a sustainable edge showed they use either sustainable resources or be energy efficient. On the other hand, technology serves people. It’s equally important that people connect with modern technology and participate. Especially when it comes to encouraging green consumption, using technology as a way to guide people towards green lifestyle and value propositions need to balance between individual concerns and social rules, as well as the boundary between personal experience and group experience.

It is apparent that the design contexts of the twelve (12) interactive landscapes could categorize into two groups: there are six (6) cases in a green envelope, nine (9) instances in a social envelope, and three (3) cases contain characteristics from both the two groups.

It is suitable for a technology company or research institution to join the green technology envelope while low-tech companies or individual designers are better to join the sustainable social envelope and concentrate on people. Of course, if a design institution or studio is well equipped with both software and hardware, it can walk on the edge of both rules and create more design values.

Rule One(1): Sustainable environmental envelope

This rule means that sustainable technologies and materials are necessary to the design base in building up an interactive landscape. This types of designs or artworks focus on the environmental technologies rather than the application of these techniques. Mostly the aims lie in the progress of developing sustainable technologies. Researchers concentrate on creating a better environment rather than figuring out how do better environment increase life quality. Works in this group frequently use environmental-friendly materials or energy-efficient technology. Without the technology or the material, there will be no such designs.

Six (6) related landscape case studies among the total sum of twelve (12) had apparently followed this rule. The six works further form a subcategorization of two (2): developing technologies to harvest renewable energy resources, or making use of conventional materials in sustainable ways. Formation of the subcategory is according to different technology capabilities and design focus. If you are a high-tech company, you can develop techniques to harvest sustainable energy or to make reusable materials. If technology is not you strength, such as some art studios, you could still choose to take advantage of the ready-made technologies and materials to build your work. The term ‘making use of ready-made’ is borrowed from Wouter Eggink’s categorization. (Eggink 2013)

Harvest sustainable energy

Sustainable energy is the form of energy obtained from non-exhaustible resources, such that the provision of this kind of power serves the needs of the present without compromising the ability of future generations to meet their needs (REEEP 2010). Three (3) interactive landscapes among twelve (12) case studies are designed to harvest sustainable energy include kinetic energy and solar energy in the context of developing a sustainable technology.

Fibre tower is an example of the interactive technological landscape that captures kinetic energy by the structure interacting with the wind. Glass fiber threads on the roof mechanically moved by the wind motion, and convert the pressure and deformation into an electric current. One step further was made by another expressive high-tech roof landscape-the Future Field. It not only captures the kinetic energy from wind motion but also induce natural sunlight into interiors to support human activities. The movement of the optic stands caused by the wind collects different amounts of daylight and make a dynamic transition. The human experience highly influences light. Therefore, the light plays as an agency to interpret an experience of motion. The use of daylight also has advantages of increasing productivity and the general health while keeping the energy demand low by decreasing artificial light. (Leffers 2011) Sonumbra crafted PV fibers into an architectural landscape to shade a community of people in the day and provide luminescence at night. The solar cells embedded in the canopy of parasol collects solar energy. (Loop.pH n.d.)

Make use of ready-made

Today, there are more and more ready-made materials that are sustainable edge cutting, such as LEDs, recycled polymers. Environmental friendly materials create concerns and meanings beyond functionality. Exploring new roles of traditional material such as seeds, foods, steels are also Eco-friendly solutions to modern environmental problems. Taking advantage of these non-regenerated materials, increasing their efficiency and functionality will clearly show concerns for the planet. More and more artists like to make use of the wastes or reusable materials to call for a reflection in audiences' mind, to remind them the essence of material or make them rethink the meaning of life. From this communication

perspective, making use of ready-made sustainable material converts a message of solving everyday problems by saving the non-regenerated energy resources for a healthier environment.

Three (3) interactive landscapes have followed this rule in making use of existing sustainable materials in the sustainable environmental context. Helix tree is fabricated from 12 tons of largely recycled scrap metal, fitted with LEDs lights that powered by the human voice (Ramus Illumination n.d.). Dune 4.2 is made of recycled polymers, and hundreds of LED lights operated by interactive software provides lighting for an expansive of 60-meter dimensions for less than 60 watts (Kilic 2014). Sonumbra is constructing bio-textile material into architectural dimensions, where people experience the use of new technologies in solving practical problems and address different ways of using food, energy and water in for urban qualities of life. It creates interactive experiences and responsive environments that allow people to dream and re-imagine (Loop.pH n.d.).

Rule Two(2): Sustainable social envelope

This rule means that environmental concern is communicated through the social connection between people and interactive landscapes or among people themselves. Design cases within this group concentrate on building relationships between technology and people and focus on using techniques rather than the sustainable technology itself. Compared to the group of green technology envelope, the sustainable social envelope does not stick to particular technology or material, the technology or materials could be replaced if one does not fit into the target performance or budget. Designers concentrate on using a better environment to improve life quality rather than just creating a better environment. Works in this group typically put lots of efforts in designing interactions and services within urban public space-places of our daily life. The starting point of such interactive landscapes may be the benefit of people rather than good for the environment. Without people to participated, there will be no such designs.

This rule had been seen in nine (9) interactive landscape designs or artworks, among a total sum of twelve(12) case studies. The nine works can be further categorize into three(3)

groups according to their primary social values: lights up and improves safety, cultural representation or exchange, and community activity supports.

The interactive landscape had achieved social values in security, culture, and community events. Different projects are made in particular circumstances. Discussing the three types of social values are important in encouraging green consumption due to the following reasons: On one hand, sustainable consumption is a new social value, it can be an extension of existing social values or being added as an additional value to make a richer design outcome. On the other hand, through a study of how do existing interactive landscapes affect the individuals and the masses, it can presume that interactive landscape has equal potentials to encourage green consumption since consumption behaviors are highly influenced by people's physical activities, a psychology pursuit for security, value propositions, and community culture.

Designs within sustainable social envelope do not need much expertise in technology, but there are still differences in requirements between the three sub-categories. The rule of lighting up and safety improvement is better applied to the outdoor environment since interior space in shopping centers are frequently over-exposed of light. It is recommended to put less concentration on technology and follow the rule of cultural representation or exchange values if time and resources are limited. The state of community activities support are worth a try if the design aims to influence people's behavior in everyday context and generate a buzz in community or groups.

Lights up and improve safety

Three (3) interactive landscape designs among twelve (12) case studies were developed in a social context to provide light in poorly lit areas such as parks, streets, dangerous quarters to prevent some bad situations, thus, it creates a greater sense of safety. As a reduction of danger, outdoor activities are increased. The playfulness of the design itself also contributes to stimulating social interactions among people in an urban environment. The tactile urban landscapes integrate the city, light, and the population, and contributes to the idea of improving the world through the daily behavior of residents (Catala 2012),

which goes in agreement with the idea of transforming consumption behavior of the residents from over consuming to sustainable purchases.

Sensor Valley, for example, the work consists of fifteen shrub-height tall LEDs pillars to light up the stairs to an entrance of the Palace of Culture, to prevent the risk of tripping on the stairs (Assenstad 2015). Since the interactive landscape was accomplished, the once dark platform had become a hangout spot for young people, and the pillars were called "hugging pillars" by the residence. There's even a restaurant that put a dessert representing these luminous pillars on its menu (Roosegaarde 2012), which indicates the design work had become a culture icon by a long-term daily participation from the residents and in turn to shape the everyday life of the citizens. It also indicates safe environment attracts people and increase their social activities. Dune 4.0 was another example originally designed for security in some dark areas of the cities such as lined corridors or dark tunnels (Roosegaarde n.d.). The initial idea is someone close to a sculpture can activate a light with his movement, and be recognizable (Scaravaggi n.d.). To develop its various uses, Dune 4.1 was set to illuminate a public pedestrian, and it had successfully showed the potentiality of reducing traffic accidents by an interactive landscape. Dune 4.2 had turned the once desolate riverside into a beautiful city spot during the night, which once again proved that people will automatically modify their behavior and become more social if they feel psychological secure in an environment. The project transformed social rules from staying away from the riverbank to regular visits, which once again proved environmental influences in turning traditional conformity of the residents into new social practices. The similar outcome could be expected in the case of green consumption where the majority does not accept growing culture, and the interactive landscape could have the potential to change their conventional attitude.

In a larger scope, At Loop.pH state that they were driven by the present situation in Africa, where almost 80 percent of the population lives without electricity (Bojovic 2013). The interactive trees were to be installed in towns and villages that cannot afford power to light up night paths. Providing safety in dark and dangerous spaces for people could be the

first step to getting people back to the streets and increase social activities.(Ktinalaskowski 2012)

Cultural representation or culture exchange

Interactive landscapes can represent culture in an architectural form, or by the extended meaning of materials used in construction. Three (3) case studies of a total number of twelve (12) had apparently designed for this value in a social context.

Culture can take the form of architectural appearance and structure in interactive landscapes. For example, the structure of Sonumbra was designed in represent of three European cities. Three columns defined by charged lines of light spring from the ground to define an ephemeral space reminiscent of a classical vault (Loop.pH n.d.). Since landscapes could represent cultural meaning, culture exchange could also take place when introducing foreign landscapes are introduced into a different cultural context. Usually, one significant culture representative is being put in a high contrast with surrounding architectural environment. Take Boo, for instance, the interactive zen garden was designed with the inspiration from the unspoken connection between the tech-savvy Europe and the zen-like Asia (Lightopia 2013). This interactive zen garden had brought an oriental touch to a European urban environment and achieved culture exchange.

Besides the culture meaning in landscape architectures, there are also sub-culture that can influence people's behavior on different occasions. An illustration would be that most museums prohibit people from touching. Dune X on the occasion of the 18th Art Biennale of Sydney had challenged this sub-culture in museums and warmly invites people to touch (WTN 2013). Same inspiration appeared in the work Volume, which encourages the visitor to touch and listen at the museums where the culture of participation only stays in standing and looking. It gives a hint on challenging or merging the culture of sustainable consumption with the sub-cultures among different groups of consumer. Interactive landscapes were able to influence consumer decision from a cultural perspective.

Community activity supports

Three (3) interactive landscapes among the twelve (12) works has social values of supporting community activities and events. In general, these cases are participatory environments in or near a community to invite people to go out and get socialized.

One way to increase community activities is by providing a comfortable and attractive spot. Before Dune 4.2 had been set to lit a prominent river bank, few people would like to visit the bank in the dark. “I look at the landscape as the place where people, meaning, and even potential conflict come together.”Said by the designer (Illumni 2015). So he had successfully transformed the port and forged a new dynamism in otherwise static places (Mela 2013). With the artificial landscapes lighting up the port bank, the interactions brought fun to the joggers. The formerly plain and desolated site had turned into a beautiful and entertaining place, where the residents in this area enjoy their daily walk of light and other communal activities. This case illustrates interactive landscapes can influence people’s physical interactions and day-to-day operations.

Another example of taking people outdoor and do exercise is the Tactic Sound Garden. It draws on the culture of urban community gardening to posit a participatory environment where new spatial practices for social interaction within technologically mediated environments are explored and evaluated (Shepard 2006a). Anyone exercising with an iPod or mobile devices can collaborate in shaping the sonic topography of urban public spaces, and drift through virtual gardens as they move throughout the residential quarters. Technology had connected community and the environment in such a way that everyone takes part in changing their shared living spaces, and while they are doing it, space temporarily transforms to a private space for each participant. The same idea goes within Helix Tree-an interactive landscape artwork created for a public winter program. As a center spot to celebrate the spacial occasion and make people active, the interactive view creates a reflective space for the community to engage with one another. Each evening a choir succession sang the tree to live, and each visitor sang to create own light displays (Loop.pH n.d.).

STEP TWO(II): Choose a type of interaction

After determining the design context, a design direction or a kind of interaction should be selected. The attractiveness and technology feasibility of an interactive landscape largely depends on the type of interaction that connects the installations, people, and the environment. The relationship and connections between the facilities, people, and the environment, is led by the design aim and target outcome in each case. However, commonalities are found in general. According to different types of interactions, the twelve (12) interactive landscapes could be categorized into three groups: energy-driven landscapes, behavioral-driven landscapes, data-driven landscapes, and there are few works contain characteristics of more than one groups.

The three types of interactions in interactive landscapes have different values in encouraging green consumption as energy, consumer behavior, and consumption data all plays important roles in the various stages of shopping progress in a consumption context. Energy and resources are over-consumed in current society. Consumers lack environmental awareness during shopping or in other consumption-related activities. Energy-driven landscape harvest or saves energy from consumer activities, for example, kinetic energy from consumer movement, which raises environmental consciousness in consumer mind while creates an environmentally friendly atmosphere. Sustainable technologies stressing energy and resources efficiency becomes a symbol of the green culture and lifestyles. When people realize the environment must be protected, it may be still hard for them to control and change their consumption behavior. Behavioral-driven landscapes focus on people's behaviors and will assist them to change own shopping behavior towards more responsible and green. Moreover, today we are living in an age of information explosion. Consumers receive large amounts of information and start to be less care and sensitive to what was going on around them. They resist spending time in figuring out the useful information. In the meantime, most shopping centers possess large amounts of customer data. These data could be experienced in a sensible way. Data-driven interactive landscapes let consumer experience their purchase data or shopping behavior in a new way, which calls up understanding and retrospect to own purchase behavior and consequences.

Because the relationship and connections between the installations, people and environment are led by the design aim and target outcome in each case, selection between the rules must consider the goal of your design and technology specialty. It is suitable for a technology company or research institution to follow the rule of energy-driven interactive landscapes while companies without strong technology background such as small design studios or artists to follow the rule of behavior-driven interactive landscapes. Design studios that collaborates with big shopping centers or brand shops which possess lots of consumption data could consider developing data-driven interactive landscapes. Of course, if a design institution or studio is well equipped with both software and hardware, it can follow more than one rules at the same time, offering multiple interactive experiences to the visitor.

Rule Three(3): Energy-driven Landscapes

This rule means that the interactive landscape harvests or saves energy resources from consumer activities and interactions. There is an energy flow between the installations, people, and the environment. Energy-driven interactive landscapes are designed to produce re-usable energy to support energy-use in daily activities. Technological landscape is complementary to the function of the public space (Leffers 2011).

The interaction starts directly or indirectly between human and environment. The energy flow can take place in space itself without the presence of a person, such as wind blowing in a natural environment to produce kinetic energy. In this case, the presence of human makes no difference to the interactive process, but people can benefit from the outcome of the interaction. Or the interaction can take place directly between human and an intelligent environment, such as to collect kinetic energy from human motion. In this case, human activity is significant in the interactive process as well as to the outcome. In all cases, the energy-driven interactions generate energy to support further human activity. The interactive installations in energy-driven landscapes are often made of large scales, such as in an architectural dimension, and relies on sustainable technology. It is more stable and more practical compared to behavioral-driven or data-driven landscapes, while less playful and customizable.

The advantage of an energy-driven interactive landscape in the green consumption context is to collect regenerated energy for shopping activities, attracting consumer by its advanced technology as well as showing concern for the environment. It provides the green culture and sustainable shopping atmosphere, waking up environmental concerns.

Two (2) case studies among the total sum of twelve (12) implied this rule. Fibre tower and Future Field are both examples of energy-driven interactions that project architectural landscape interacting with nature and people to produce electricity and sufficient lighting for interior activities. In Fibre Tower, kinetic energy is captured by glass fiber threads slowly moves in the wind. The interior space changes in shape and surface transparency according to the conditions of outdoor weather and indoor activities(Watanabe 2004). In Future Field, the motion of natural wind outside is captured as kinetic energy and further translated into a visual impact of facade-a combination of movement and light. The changing wind patterns result in waves of artificial light moving over the ceiling. It leaves a strong visual impact to the visitors, and they can experience the motions of outdoor weather (Leffer 2011).

Rule Four(4): Behavioral-driven Landscapes

This rule means that the interactive landscapes interacts with people and let them be more aware of their behavior and the relating consequences. There are physical movement and emotion exchange between people, installations and the interactive environment. Multisensory interactions and cognitive interactions are apparently found in behavioral-driven interactive landscapes and play a significant role in influencing consumer consumption behavior. Communication and social interactions are also found in most of the works.

The interaction takes place directly between human activity and interactive environment and enhances the physical connection between people and environment. Human presence and action will influence the behavior of the interactive landscape, which in turn affects human behavior. The conversation between people and interactive scenes communicates to

multiple senses. Sensory technology creates a sensual engagement with the environment and updates our tactile sensation and emotions by reconnecting them with nature (Mair 2012). Social interactions happen when more than one person are showing up in or near the interaction area. The installations in behavioral-driven landscapes are often in product dimensions and relies on sensory technology. It is more playful and customizable than energy-driven landscape and data-driven landscape.

This rule had been seen in eight (8) interactive landscape design works. The eight works form into three (3) sub-categories according to different types of sensor features involved in interaction: Voice to Visual; Motion to Visual&Sound; Motion&Sound to Motion, Visual&Sound. The complexity of the interactions increases with technology requirement. The company equipped with simple sensory technology can design sound or visual response interaction. Large studios or technology company provided with a high level of multiple sensor technologies can integrate sound, visual, motion and even scent, to develop a complex interactive landscape that triggers multiple human senses.

Voice to visual.

Helix Tree could be one good example of the voice-to-visual interactive landscape, it attracts visitors by swirling LED lights activated by the volume and pitch of a human voice. The work makes people aware of the power of their voices and offers them an active personal experience on a cold winter night.

Figure 14: Interaction mood board I. (Aucar n.d.; Fairweather 2013)

There were physical and emotional interactions (see Figure 14). A girl is looking up at the installation with mouth curiously opened (Scene 1). A group of boys was taking the picture from a distance, looking excited and happily (Scene 4). Social interactions can be found

when a girl is pointing to the light while talking to the other boys, seeming to show the others what she had discovered (Scene 2). From an interaction videos (Ramus Illumination n.d.), we can see groups of people are standing together and singing collaboratively, viewers in the crowd constantly smile at each other which indicates emotional exchange and social interactions happens at the same time. Audiences gathered in small groups and were talking with each other, and it could mean that space stimulates conversations for the community to engage with one another. Taking pictures are also gestures that indicate follow-up social activities, such as sharing the story with family and friends after the event.

Cognitive interaction can also be found on another interaction video (Fairweather 2013). There were people stand in a distance to the structure looking at others and later came closer to join the choir, and this could mean that at first they were trying to figure out the interaction and process. It is the first sign of cognitive interaction (Dalsgaard et al. 2011). The second sign appears when a man lifts up his phone to broadcast songs by his cell phone to test the light change (Scene 3). It could mean people are creatively thinking and exploring more ways to interact with the structure. Beyond observations, one of the goals of this project it to create a reflective space that explores the power of human voice. If the designer had achieved his goal, people should have become more aware of their personal singing behavior, and this could be the third while the most important sign of cognitive interaction.

The appearances of physical interactions, emotional interactions, cognitive interactions and social interactions together proved that people are attracted and actively engaged in voice-to-visual interactions in a behavioral-driven interactive landscape.

Motion to visual & sound.

Sensory Valley, Boo and Hello Stranger are examples of interactive pavilions with visual and sound effects in respond to human behavior (Roosegaarde n.d.). Technically they work in a similar way, the sound system and LED lights are wirelessly connected with motion and a touch sensor. The digital pillar-fields generate sounds or music and light up when it detected human presence and touch. This type of behavioral-driven interactive landscapes

stimulates human senses by sounds and light displays. Physical interactions happened when people were walking circuitously through different pillars, like wandering in the woods. More interactions can be found from the interaction videos. Taking Sensory Valley for an instance (see Figure 15), a woman runs up and down the stairs (Scene 5), hugging the pillars now and then, with a curious expression on her face (Scene 6), which seems like she is testing the reaction of the post. Another woman knocked at it to check the response (Scene 7). She put an ear on the surface to listen to the cricket sound and laughed, showing that cognitive interaction accompanies emotional communication and physical interaction (Scene 8). When the pillars were getting more popular, it became a sign of inviting, there is even a restaurant that put a dessert representing the luminous forest on its menu (Catala 2012), which clearly showed the social values beyond interaction.

Figure 15: Interaction mood board II. (Roosegaarde n.d.)

Sonumbra is another straightforward example with a sonic shade of light react to human motion. Sensors detect the position of a visitor under the constellation. Electro-luminescent fibers are lace-worked into a construction of the light emitting fabric.The interplay and activity of people orbiting around govern the algorithms that animated the lighting pattern and musical composition of the artificial trees (Bojovic 2013). Physical engagement can be found on the interaction video (Loop.pH 2010). A man is walking from center to the edge and back to the center repeatedly. Cognitive interaction seems to happen as he walks back and forth while looking up to see the change of the light continuously. He also changes his walking speed and stops unnaturally, assuming that he is intended to figure out the connection between his position or walking speed with different light patterns. It could also mean that the behavioral-driven interactive landscape had made him aware of his behavior and his connection with the surrounding environment.

Volume is a complex example that allow a human motion to trigger audio-visual displays. A camera is placed strategically above, with infrared lights illuminating the space, to watch people moving through the installations. Data of recorded motions passed to the acoustic and visualization systems that control a series of audio-visual themes (Polaine 2007). From the interaction video of Volume (UVA 2010), we can see physical interactions mainly involves touching and walking through the installations. People stares at the graphics waves on the display while walking slowly, which seems to show confusion and continuous reading of the displays. People are moving their hands up and down on the screens, assuming to catch the flowing streams or probably thinking the lights runs along their fingers, which indicates the cognitive interaction between people and installations-visitors are looking for ways to communicate with the modern landscape media. Beyond physical and emotional interactions, later half of the video showed people's awareness of shared social practices and spatial layout of the environment. Lots of people are standing in a distance to the installations who seems to pay attention to the social aspects and behave like the watching group. This could be construed as an emergent social engagement as someone runs from the watching area to the interaction area to experience the interactions. This indicates the engagement of the interaction cannot be decoupled from an awareness of the established practices of public behavior.(Dalsgaard et al. 2011) In the interaction area, visitors are moving and making ways for others, in other words, keeping a personal distance with each other, which communicates a certain social etiquette and territorial regards.

Other works such as Botanicus is an interactive plant that reads the user's gestures and translate different gesture patterns into a graphical change of an avatar representation in the virtual display. When a physical plant has been watered and well cared for, its avatar representation exfoliates, growing tall and branching off in multiple directions; when it has not been well cared for, the avatar sheds its leaves, shrinks, and diminishes. (Casalengno & Lipshin 2014)

Motion & sound to motion, visual & sound.

The Dune Series are striking examples of complex interactions in behavioral-driven interactive landscapes. Sensors in the installations decode human behavior with movement and sound, and numerous flexible stalks tipped with LEDs consequently generating pulsating shifts in light. The actions and appearances of the digital plants are an extension of human behaviors (Roosegaarde 2009). Thus, audiences are more aware of their behavior as well as their influences on the public environment. Physical interaction occurs in many forms, observed from the interaction videos (see Figure 16).

Figure 16: Interaction mood board III. (Roosegaarde n.d.)

A man walks along the river bank, and the light walks with him (Scene 9). People walk past the corridors intuitively touches the landscape, it sways and makes noises (Scene 10). It also responds to the hands clapping by flicking in rhythms. An audience review on the physical interaction journey: “On both sides, I can distinguish black tubes with white tops. When I make my first move, they light up. The murmur of wind and water sounds resonates in the background. I continue on my way. The light is with me. I start to understand, and I scream! A wave of light and sound rolls through space, is reflected and comes back to me” (Swagerman 2007). The description showed that different types of interactions synchronized in response to multiple behaviors of the audiences. Multisensory interactions in behavioral-driven interactive landscapes can tell stories in a way that our bodies can physically experience the narratives. In the video of Dune X, a girl started to dance and run in the light field, and the stalks fluttered in response. There is a trail of emotion change on her face, from cautious and cool at the beginning (Scene 11), to be inspired, and finally very cheerful (Scene 12). Another interesting comment from a Slovene expressed fears of Dune,“I don't dare to enter this. In our culture, we are used to thinking that walls have spying ears”, which seems to indicate that emotional interaction is

base on different cultural interpretation. Cognitive interactions occur at the moment participants entering towards the interactive landscape. By looking at others, the visitors are trying to figure out how it works. Because the interactive landscape is designed with the mystery of nature, cognitive interactions are often accompanied by a sense of exploration.

Rule Five(5): Data-driven Landscapes

This rule means that the interactive landscapes are connected to the online data in real-time to give people a sensual experience of the information, and to make consumers actively experience habitual behaviors showed from abstract data instead of receiving the information passively. The data-driven interactive landscapes is a dynamic expression of static data, a physical interpretation of abstract patterns. It is a platform to experience big data in a multi-sensory form. The interaction between human behavior and interactive environment is indirect. Data plays as a third person to translate habitual behavior, and represents patterns of human activity. Interactive environment directly responds to data change. For example, in consumption, habitual purchasing behavior reveals itself in consumption data collected by shopping center, and the data could be translated into a change of visual appearance of the interactive landscapes.

Shopping behaviors of individuals accumulated into a big number could have a significant effect on the environment. Thus, the advantage of data-driven interactive landscape in a green consumption context is to make abstract data more understandable and to attract consumers by offering them reliable shopping information as well as showing concerns for the environment. However, a premise for designing this type of interaction is that one should have the access to an adequate amount of data, and it needs to connect to the online network during processing, and probably it needs a cloud storage too.

Three (4) interactive landscapes among twelve(12) case studies had shown similarity in this rule. Most of the existing data-driven landscapes exert visual leverage on weather conditions or musical data. Integrating more parts of the body beyond sight, such as sound, touch, scent should have more potential effects. Especially when the regular rhythms of our

daily lives are affected by our overexposure to multiple forms of media and advertising, it is interesting to see what happens when information comes out of our electronic devices to become an integral part of our shopping landscape and even our bodies (Catala 2012).

Sonumbra connects to the METAR network to read wider atmosphere in Geneva, Madrid, and London. The entire structure is an electrical circuit with 288 individual light outputs connected to 12 custom electronic driver units. It translates the ever-changing weather data into a seasonal change of light pattern. (Loop.ph n.d) The Volume represents data-driven interactive landscapes in the way it processes acoustic data. The forty-six columns of light matrixes and speakers were assigned to different sets of notes. The composition of the notes is in harmony so that there are forty-six channels of sound and visual display, any encounter of the channels generates a beautiful sound. Forty-six versions of custom-built software function simultaneously on a computer that can keep going for hours without crashing. No matter individual or groups present at the grids will get an immersive audio-visual response from the installation. The sound and color palette are so specially synchronized that the whole artificial landscapes work as a huge playable musical instrument. (The Times 2006) Botanicalls could also be considered as a data-driven interactive plant because the initial idea for the design is to provide the gardener with vital statistics on plant's health. The system and applications use networked open source hardware and software to allow the plant to send messages to user's cell phone (Botanicalls n.d.). TSG is another form of the data-driven landscapes, and it is a combination of natural landscapes with audio data from the community.

STEP THREE(III): Connect it to nature and environmental resources

After the design context and direction being settled, the third step is to choose a type of connection between the installations and natural environment. The urban landscape is intrinsically part of the natural environment, the closer bond it has with nature, the more it will raise concerns for the planet. To influence people's behavior towards more responsible and green for the living environment, the interactive landscapes should connect to the environmental resources in an urban landscape or behave like the wild nature in some way to remind people of the beauty or intimacy of real nature that were often overlooked in an

urban context. Thus, a balance between natural elements and artificial works should be found from successful interactive landscapes.

In most cases, Interactive landscapes have strong association with nature in color, shape and natural phenomenon, which makes natural landscapes remain emotionally connected to us. It creates scenarios of our experiencing and exploring the living environment in an advanced form. According to how many characteristics of natural landscapes are integrated into an urban interactive landscape, the twelve (12) case studies could be categorized into three (3) groups in general: There are three (3) natural landscapes, seven (7) semi-natural landscapes, and three (3) abstract landscapes.

Interactive landscapes in the group of natural landscapes upgrade existing urban living plants and make them responsive to human presence. The installation serves as a platform for people to interact with an urban or natural environment, so as to increase intimacy between people and living plants or other types of natural resources. Artificial interactive landscapes are hybrids of nature and technology. Those who belongs to the group of semi-natural landscapes remain recognizable as a natural landscape in some design features, such as color, shape, or behavior. It wakes up our visual and tactile feeling to our living conditions, and raise our empathy for plants or other living organisms by making them “alive”. Abstract landscapes are pure artificial landscapes that have no similarity to natural landscapes. They connect to surrounding environment in an abstract form, either in harmony or high contrast to the architectural background as a decoration or supplement.

It is recommended to create an interactive platform If you want to add interactivity and activities to existing environment. If there is a need for new urban landscapes that integrates more fun, interactive landscapes in the semi-nature landscape group can offer such experience. Abstract landscapes can be right choices If an urban landscape is wanted to fit the modern environment as a decoration to enrich the aesthetics or cultural meanings while the utmost attention of the audiences remains on the architectural backgrounds.

Rule Six(6): Upgrade natural landscapes

This rule means that the interactive installations are designed to attach to existing natural landscapes and make it responsive to different types of human activities. The installations serve as a platform for people to interact with an urban or natural environment, as well as to increase intimacy between people and plants or other living organisms. The technologies are invisible and hide themselves into the natural landscapes. One sentence from Mark Weiser (1999) perfectly illustrated this: “The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.”

To upgrade the natural landscapes and make them into intelligent components of our daily activities is informing us the importance and necessities of a healthy living environment. Our conceptual understanding of the biological resources and ecosystems may develop from direct and concrete exploration of our urban environment with the use of our senses, such as touch and smell. Today urban landscape has alienate us from the original textures of nature. Environmental resources are often overlooked due to their immobility and non-threaten presences. Consumers often take it for granted that shopping is for improving their life qualities until they realize that a healthy environment is the foundation of their daily lives, and the earth cannot be recovered at once from environmental damage. A fuzzy knowledge on the scarcity of environmental resources are not helping them to have a conceptual understanding of the environmental costs hidden behind production processes. By making natural landscape experiential and communicable, consumers may start to notice the existence of native plants and other living organisms, which are the initial form of environmental resources they can have access to in an urban context. When people have a chance to participate in taking care of a plant and to collectively construct the urban environment, they get to know the material form of resources, for instance, the soil, oxygen, water and minerals. By integrating natural landscapes into communal activities or other every-day situations, people became aware that the environment is part of everyday life and it has a significant contribution to raising life standard.

Three (3) interactive landscapes among a sum of twelve (12) case studies had apparently followed this rule. To illustrate, Botanicalls is a technology used on the natural plants to make it more expressive. With the help of outfitted sensors in measuring moisture, temperature, light exposure and CO2 levels, the user is able to construct his own personal "smart garden". Like any other plant sensors, It utilized the physiochemical properties of soil and integrated it with the social network to create a communication channel between human and plant (Casalegno & Lipshin 2014). It offers real-time feedback on health condition and other vital statistics for monitoring the growth of a plant, as well as providing attractive tasks and behavior management system for incentivizing responsible behavior. Based on sensory plant technology, another clear example would be Botanicus Interacticus, who almost turned living plants into sculptural interfaces for game monitoring through an electric circulation system. Botanicus Interacticus enables us to use gestures as sliding the fingers on the stem of the orchid (see Figure 17), detecting touch and grasp locations of a bamboo, tracking proximity between a human and a plant, and estimating the amount of touch contact leading to a rich amount of interaction possibilities.(Botanicus Interacticus n.d.)

Figure 17: Interaction mood board IV. (Botanicus Interacticus n.d.)

Consider the case of TSG, the toolkit is parasitic technology fed on the common WiFi access points in an urban environment as infrastructures for cultivating sonic community gardens in contemporary public space. Anyone creates personal audio garden attached to a locative physical environment, which supports the creation of shared social spaces and gamification of the urban environment. (Shepard 2006a)

Rule Seven(7): Create semi-natural Landscapes

This rule means that the interactive landscapes are artificially built by modern technologies and materials while resembles prominent characteristics from natural landscapes. They represent nature but behaves like animal or pets to establish a deep relationship with people. Interacting with semi-natural landscapes can also help us build a conceptual understanding of public spaces through visual and tactile senses, so as to raise our concerns for the living objects around us.

Semi-natural interactive landscapes is a mix of digital elements and organic references. Seven (7) case studies among the total sum of twelve (12) had apparently followed this rule. They form four (4) sub-categories in accordance to different types of references: Five (5) works are same in mimicking experiences in nature. Five (5) works have taken the shape and color of a natural element. Three (3) cases are found similar in borrowing the functional meaning of natural component. Three (3) works have captured the sounds or phenomenon that occurs in a wild nature and used it in the urban designs. The four types of semi-natural interactive landscapes associate with nature in different rules and stimulate imagination from different facets.

Mimic the experience/dynamic phenomenon in nature

This rule means that the interactive landscape was designed to capture an intense moment of natural phenomenon. The idea behind creating such interactive landscapes was normally found by observing natural phenomenon during a journey into nature. Some impressive scenes or experiences are reconstructed from the memory of the artists or designers and pass on to the audiences. These experiences updated our senses and reconnected us with nature.

One typical example of interactive landscapes mimicking the dynamic phenomenon of nature could be the Dune Series. The fluttering experience of Dune was directly inspired by the motion of horizon line of the desert. “At first sight, everything seemed completely static. But I finally noticed that this line was constantly interrupted by moving silhouettes of nomads crossing the landscape. The hot air of the desert totally blurred the silhouettes,

producing a curious effect in form.”An explanation from the designer (Catala 2012). Located by the riverbank, the sparkling lights from the tip of the installations echoes the reflection of light on the sea surface as well as the stars in a night sky.

On one hand, the dynamic effects of Dune have reminded us the beauty of natural phenomenon we used to take for granted and offer us a chance to be physically involved in part of their beauty. The work reminds people of a field wheat or tall grass in which the wind blows and the plants dance in the breeze. Also, when walking in this area, the movement is recorded in the way the place bounce back from the touch and the wind (Roosegaarde 2012). It appears to let us tune into our bodies as the "grass" tunes into us. The interaction coupled with the opportunity to brush one's hand through the "grass," much as might happen in any dune ecosystem, creates an experience not available in the real world. Far from being an emulation of real life this work extends beyond what nature taught us, for the grass is visibly interactive. (Langill 2010)

On the other hand, Dune has also explored our emotions for nature. Nature’s mystery and virtual experiences activate a sense of excitement and exploration in urban space. One comment from the designer Daan Roosegaarde:“From day one, from you and I on the prairie, living in caves, we’ve always created things to explore life, to explore reality”(Wallin 2014). Due to the randomness in the algorithms, the smart landscapes feels alive when the lights glow near your hand and then runs away.

Other examples following this rule include Future Field and Fibre Tower, whose glass fiber threads move slowly in the wind like fields of wheat. Sonumbra animates and appears to move as its various strands and forms switch and ripple. As someone walks by it, the branches seem to wave as if in a breeze in response to the presence. (Ktinalaskowski 2012)

In the work of Hello Stranger, different natural phenomenon is embodied in several themes by changing light color and soundtracks. Blue lights and sound of water dropping in the theme of rain. Interval red lights together with heartbeat sound to create an ideal state of

the heartbeat of the forest. Other themes such as flowering, tornado, and forest fires are simulated in similar methods. (Zodzwingli 2007)

Mimic the shape and color of natural element

This rule means that the interactive landscape was designed in resemblance of color and shape to natural landscapes that lead our imagination to an organic reference and environmental resources. By mimicking the visual characteristics of natural landscapes, the artificial landscape expresses the organic beauty of nature and attracts people to explore the missing connections between urban life and rural life.

Visual associations to the images of natural landscape have made us aware of our physical connection with nature and environmental resources. It could be conceived that the Dune took its image from a patch of grass and light. The interfaces look like reed stalks. The rounded shapes and the flexible surface of the digital creatures encourage touch. In addition to physical relations, emotions also merge into a space that combines aesthetics from the different natural scenery. Boo contains bush-size pillars that shaped like bamboos for expressing a tranquil view of an eastern zen garden. The light color gradient fades on the scenes of the Volumes flows like water columns and makes the entire space more mesmerizing. Helix Tree and Sonumbra were designed in tree-like structures.

Mimic the function/symbolic meaning of natural elements

This rule means the interactive landscapes has borrowed the functions or symbolic meanings from natural elements and living organisms. Inspirations for this types of interactive landscapes came from symbolic meanings or functional mechanisms of an organic reference. They are tangible representatives of abstract meaning and the unnoticeable changing process of natural elements. It tells stories about things we do not understand in a way we can sense and experience, and it remind us the importance of nature which are often overlooked in our daily lives.

To demonstrate, Helix Tree was inspired by the organic shape of a helix - a three-dimensional curve in space found in the structure of a tree, continuously twisting and

turning as a symbol of power without resistance. As described by the designer,“ Trees symbolize power without resistance. They bend, they sway, in harmony with their environment…I was interested in how it depicted an infinite flow of energy, always moving, always in harmony. It felt like a wonderful metaphor for family and community, moving through life together.” (City of Melbourne 2013)

Sonumbra is also designed in the shaped of a tree accompanied by correlating functions to provide shade and absorb energy from the sun during the day time. At night, the structure provides energy to light up the dark areas. One more functional usage of natural shape from the work Boo, apart from referring to the form of bamboo, the interactive pillars was also used for its cultural meaning and functions as an eastern symbol.

Mimic the natural sound/communication signs

This types of interactive landscapes have used sounds from natural environment or communication signs among animals in interaction process. The acoustics record the sounds of living organism or imitating communications signs in natural phenomenon. The ideas behind these interactive landscapes were to create a virtual environment that can keep us emotionally connected to the real nature through hearing. Sound effects lead our imagination to the wild nature that far away from urban life and enhance the intimacy between people and the natural environment.

The soundscape in Dune is an oxymoron for a rural setup. Closing one’s eyes and listening to the sounds brings an image of a rural bush at night when the bugs’ sounds are loudest. The installations also produce a grooming sound like an animal when the visitors overstay in one position (Qessays n.d.). The chirping of crickets sounds in Boo added to the already mystical ambiance. The lights on the bamboos were scattering intelligently and communicate with each other like jellyfish. Interesting notes from the designer, “When you look at jellyfish, they use light to communicate with each other. If you look at the stars in the sky, they provide information to us at the speed of light, from the past. This reminds me of where we come from, and it reminds us where we are going, in the future” (Illumni

2015). Sensory Valley also used cricket sounds in the intervals of respiration of the light forest.

Rule Eight(8): Abstract landscape

Abstract landscapes are artificial landscapes that have no similarity to natural landscapes. They adapt to surrounding architectural environment either by being in harmony or being in high contrast to the original atmospheric expression. As a decoration or supplement, it triggers different qualities of original architectural space and makes it more mesmerizing. In some designs, it is utilized as a piece of supplement to enlarge the essence beauty of background environment. In other cases, it decorates a conventional space as if the piece of work came from alien. As a consequence, abstract interactive landscapes calls for attention from audiences and gives them a strong visual impact on the space.

Three (3) design works among the twelve (12) case studies can illustrate this rule. The most straight-forward example of the abstract landscape could be the Volumes. The glossy aluminum columns with sparkling LED pannels were in opposition to the old stone building. Even in a silent mode, the contrast between its aggressive, regimented minimalist appearance and the Victorian backdrop of the garden creates a powerful sense of presence (Polaine 2007). It becomes a huge playable musical instrument as well as a massive urban intervention at once juxtaposing new technology against usual architecture from the past while also highlighting the city landscape and space. Playing with the energy fields throughout the area sounds like just the thing to brighten up a soggy English winter. (Onedotzero n.d.)

Abstract landscape creates visual impact and extends the beauty of space. The garden is a fantastic location for work like this, the water puddles creating reflection, shadows around the architecture changing and sounds traveling around space (O'Shea 2006). The aesthetic qualities and the on-site experience it provides seems to have excited a lot of people. Seen from audiences' expression in the interaction video, It also have impacts on their mood (Chiemi 2007; UVA 2010). Visitors are pleased while confused at the same time. Many people walked up very close to the pillars and stared at them or touched them as if they are

trying to work out how to communicate with them. Cognitive interactions stepped in. The space ambiguity creates a mesmerizing effect that people were approaching the installations as if they came from the aliens. Audiences are moved emotionally to take part in the interaction. A journey through the columns is surprising and explorative, as explained by the designer, “The idea here is that you’re pulled into this calm, secure place, and then something surprising happens”(Murphy 2014). People also started to take pictures, which indicates the work had offered them something to memorize.

Similar to the "Pieces from Alien”, Boo is a "Zen garden from Mars"(Collectors 2013). The slim pillars contrast with the hard concrete Hotel-school building, and make the square a small piece of Asia (Collectors 2013). The once grey complex square became enlightening and attractive. Helix Tress is also an extremely abstract landscape due to the swirling symbol and irresistance meaning, which led the structure far from the image of a tree.

STEP FOUR(IV): Connect it to people

The fourth step of designing an interactive landscape encouraging green consumption is to connect the design work to people and their social lives in an every-day situation. Interactive landscapes communicate with individuals in sensory language. Being a part of public spaces, it has social values of gathering people and inducing conversations. By studying the twelve (12) existing works, I hope to see how did they influence the individuals and the masses, to predict the potentiality of interactive landscapes to encourage behaviors of the masses in green consumption.

According to different kinds of relationships between behaviors of the design installations and behaviors of the audiences, the twelve (12) case studies are categorized into three (3) groups: There are six (6) cases adapting its performance to human behavior, which creates a non-impulsive playground. Eight (8) works behave similarly in mimicking human behavior as a way to communicate to people in an understandable way. Four (4) works followed the rule of customization in narrating a personal story for the audience. All three

rules have its unique meanings in building a close relationship with the masses and further influencing their behaviors in a consumption context.

Adapting to human behavior is the most straightforward way to connect to people. It is non-implosive because the work shapes itself to the activities of different types of individuals by visualization or interaction with the user in real time. Audiences do not have to speak the language of technology, nor do they have to understand the regular patterns of communicated information, but that there is a sort of intuitive intelligence in play (NIMK 2006). Mimicking human behavior is the most popular method for starting a relationship with people. When our physical living environment was endowed with different human characteristics, people and the installation begins to communicate with each other in a new type of conversation rather than mutual adaptation. Interactive landscapes with human-like characteristics are easier to collect empathy and sympathy from audiences, which can contribute to raising consumer empathy for the living plants and animals. Personalization and customization are found in accompany with the other two rules. This third state helps the work to create a narrative story behind the design and transient attendance of the participants. The interactivity of the landscapes is another configuration of human behavior in time of presence, thus, it captures meanings of a fleeting moment in their lives and transform the public space into a temporary personal space.

In case, the site and location of interactive landscapes are not legitimate for making active and playful interactions, or people there are likely to interact passively, the interactive features should be non-impulsive and harmonious to the site condition. It is recommended to follow the rule of adapting to human behavior if the company have sufficient developing time. In the event that playful and engaging interactions are expected, and the design company is equipped with high technology capability, building interactive landscapes that mimic human behavior can be a good choice to get people's attention and participation. If technology capability and resources are limited, the design could focus on experience and services in making meanings on the edge of personal-public space.

Rule Nine(9): Adapts to human behavior

This rule means that the Interactive landscapes are adapting its practices to human activities. The interaction systems are adjusted several times through observing human reactions to the installations on the real site. The behaviors of the interactive landscapes are non-impulsive because they do not challenge the behaviors of the audiences and plays as tools in supporting their activities. The work also shapes its functions and appearance to different types of people and social practices.

There are six (6) interactive landscapes in this group. The Volume was designed as a subtle responsive environment to please our eyes and ears. It fits those people who took a brief look and walked away unmoved. “We have seen subtle behavior shifts when showing the same work in different parts of the world, I think that's more down to how people are expected to act socially in public places within their society,” Explained by the designer,“ Since the problem of predicting the responses of groups of people is more or less intractable…People quite regularly fail to work out the simplest interactive models, because they’re not expecting any interaction”(Polaine 2007). Other works like Future Field, Fibre Tower, have been put into this sub-category because sustainable technologies were used to generate electricity under the human influence and collect natural sunlight to increase productivity and general health. Helix Tree changes its light patterns to enlighten a social space for the singing choir. TSG parasites on the behavior of people who cross the community with headphones and mobile devices, offering them a platform to cultivate a shared sonic garden. Botanicalls helps the gardener to monitor vital statistics of plant growth by sending a real-time reminder to the cell phone. Botanicus Interacticus recognize human gestures and makes the plants into interfaces for issuing routine tasks such as flip channels on television or select a date on the calendar. The plants become a computational platform for education and entertainment activities (Poupyrev et al. 2012).

Rule Ten(10): Mimic human behavior

This rule means that the interactive landscapes are designed to have anthropomorphic qualities and interacts with people intuitively like animals or pets. This type of responsive environment communicates to people through both physical gestures and emotion flows. It

fulfills the psychological needs rather than providing practical functions as the group of adapting to human behaviors does. Moreover, it reacts to different states of human actions rather than different types of people. The interactions are proactive and engaging, inducing us to understand the dynamic mechanisms of urban landscapes around us, and sending us a message that we have the ability to modify our environment in a pleasant way, which may raise consumer empathy for the natural plants and other living objects.

Eight (8) among twelve(12) works had apparently followed this rule. The eight works can be further developed into six (6) rules of human quality integrating into the design: Four (4) have shown the anthropomorphic quality of interactive landscapes in following people. Two (2) were conceived in the growth of living organisms, such as breathing, heart-beating. Two (2) cases evidently monitored communications with people in a new type of dialogue. Two (2) examples for accomplishing routine tasks. Different moods were found within five (5) cases when an interactive landscape is in contact with people. And independent will to provocative behavior can be clearly seen in two (2) cases.

It follows people.

Dune can move with a passerby. When people stop, the movement of the installations pause. When people move hectically, the interactive landscapes react in a similar way. According to human activity, it has 128 steps in turning the lights, which was achieved by several microphones and presence sensors inside the installations, which has a 70% output on motion and 30% of the sounds (Regine 2006). Same performance showed in Boo and Sensory Valley, where the light walks with the walk of people. In the last video scene of the Volume, when single audience present at the interaction area, it shows clearly that the screens near the audiences lights up and seems to go along with her walk. There are also pure lights following visitor in the work Hello Stranger.

It breathes.

In Sensory Valleys, the lights flash intermittently at a rhythmical pace with a fade-in effect that seems like the interactive pillar field is breathing. The similar effect is also found in Hello Stranger, in which the work intend to create a heartbeat effect. These behaviors of

the interactive landscapes are qualities we tend to attribute to living humans (Wertheim 2012).

It communicates to people.

In the work of Dune, visitors are invited to touch, the work responds. They are encouraged to vocalize, and it glows in reply. The interaction forms a new grammar. There was a case of communication when an old lady was making loud barking sounds at Dune several times because she was wondering how the interactive landscapes would react to the bark of her little dog. Another case occurs in Hong Kong when a group of Chinese children intends to treat Dune as their friend and communicate with each other by mimicking the electronically generated sounds made by Dune. Social interaction was also found in this case when the children seem to enjoy their new playground and come back each day with more and more friends. “Also, it reacts in a different way when you are together with other people. So in its best case, the work becomes a mediator between people-A place for communication by human interaction.”Note from the designer. (Swagerman 2007)

The green pillars of Boo echo the visitors with their Asian-inspired voice, which was made possible through the lenses, LEDs and integrated within the same bamboo speakers. Thus, the passage of a visitor, the chirping of crickets is heard as and when it moves. Similarly, green lights are flashing, inviting the person to take in. (Katz 2013)

It can accomplish routine tasks.

Botanicalls allow plants to send cultivation request and greeting message via text format. The plants can also update her status on social websites, simultaneously broadcasting to the world both her health and responsibility of the owner (Casalegno & Lipshin 2014). Botaniucs also allow plants to perform routine tasks such as flip channels on television or select a date on the calendar (Poupyrev et al. 2012).

It has different moods.

The interactive landscape instinctively responds to the slightest movement or sound of people passing by and leave a trait of its presence in various illuminations or sound effects.

This co-control mode endowed the interactive landscape with anthropomorphic tempers and moods.

There are four(4) different moods within Dune (Regine 2006):
A sleeping mood when nobody presents. The stalks cast a soft glow and creating glooming sound in the dark which creates a peaceful atmosphere.
A welcoming mood when somebody approaches. The patterns of light grow more intense as people move closer and challenge them to interact.
A playing mood when people start to interact with it. Just one touch and a wave of light emerge. The light appears where you walk, as an extension of your activities.The fibers make a soft cricket sound as they tap together.
A crazy mood when there are lots of human activities. When you make a lot of noise, the lighting crashes.

There are also four(4) moods within the Volumes (Polaine 2007):
A sleeping mood and waiting to be awakened when no participant is around.
A welcoming mood when people approach, the soothing colors and calming sounds turn louder and harsher, Inviting them to walk into the grid. When you walk up to a column, and it activates its sound and visuals; When you walk back off a column, and it fades out the sound and visuals.
A blinking mood when participant stands still too long and becomes invisible to the system.
A ceasing mood in between scenes when the light slowly dies down and pulsate with sound in anticipation for the next visitors.

Son-umbra also showed different moods (Chino, M. 2009):
A sleeping mood when the canopy of photovoltaic panels captures light during the day.
A waking-up mood as the tree blooms in an interactive flourish of light and sound when the sun sets.
A greeting mood created as they felt any presence of people and respond to them with a spectacle of light and sound.

There are also different moods within other interactive landscapes. In Boo, there is a ghost mood when the lights awaken and wanders through the empty garden, creating a visual story viewable from afar (Roosegaarde 2013). The landscape changes to a chipper mood when visitors interact with the installation. In sensory valleys, there is a waking-up mood when the interactive pillars respire to live by the movement and touch of visitors. If visitors are quiet, the landscapes stay in a calm mood. With increasing activities from visitors, It will transform into an active state with constant shifts in colors.

It has an independent will.

Some interactive landscapes seem to like having an independent will of its own and will not be continually challenged by the audiences. In the work Dune, lights will induce the visitors to participate, but the system will recognize repeated actions and respond by ignoring them. “Like when you adjust your ears to the noise of a discotheque. It self-calibrates.”An analogy from the designer (WTN 2013). Sensory Valley behaves similarly, where excessive movement and touch made by the audiences increase the activities of interactive landscapes until an explosion of light, the installations return to their fundamental soft respiration again (Materia 2012).

Rule Eleven(11): Narrate a personal story

This rule means the appearance and behaviors of interactive landscapes are customizable to create meanings in their daily lives, transforming the public space into a temporary personal space. The design or artworks distinguish different situations and respond intelligently which often prompted different audiences to try different things. Penalization and customization of an interactive landscape captures a temporary presence of the audiences and tells a story of their personal experience. People play as the main ingredients to complete an artwork (Regine 2006). It makes people more aware of their behavior and the relationship with the living environment.

This rule was seen in eight(8) design or artworks among twelve(12) cases. In the work Dune, the appearance of the landscapes is customizable as an extension of visitors conduct.

Visitors take part in modifying surrounding spaces rather than being passive observers who can only decide whether they like it or not. There were frequent visits from married couples who treat Dune as a witness of their special moments in life. They used the interactive landscape as backdrops of wedding photos because the appearance of the landscape is a consequence of how their bodies behave. The visitor modifies the responsive environment at the time they are in a presence, and, in turn, the environment is customizing their lives. It is a way to highlight the mutual relationship between people and environment in their daily experiences. (Swagerman 2007)

Personalization and customization are basic features in TSG. By planting sounds to specific locations or listening to the sound others had planted, a shared social space created. Theses sounds were bound together with different landscapes and had built a story of collective cultivation.

More examples show customization in both individual and group interactions. In the Volume visitors create their unique journey in light and music through a weaving path within the responsive environment. It also builds a different story with group interaction. The interactive landscapes work like an enormous instrument while everyone plays as a note in the whole composition and being in harmony with each other. It could be both an individual melodic journey as well as a collective social experience. Helix Tree is another example using collective power. The choir sings to the interactive landscape producing a swirling illumination effect, which is an entertaining winter experience for participants to memorize. In Sonumbra, the engagement of visitors assembles the geometric lighting pattern of space.

CONCLUSION

The main finding of this research can be the identification of a set of design rules that can support designers to understand the process of making an interactive landscape into the context of green consumption practice.

Design an interactive landscape to encourage green consumption you can follow the four steps of rules. Step one. Choose a design context, either to develop within a sustainable envelope or to create social values. Step two. Choose a design direction among energy-driven, behavioral-driven, or data-driven interactive landscape. Step three. Select a type of connection between your interactive landscapes and environmental resources, either to upgrade existing natural landscape and make them interactive, or to design a semi-natural landscape in a future-look, or to build an artificial landscape that connects to the environment in a more abstract form. Step four. Choose a type of relationship between the behaviors of the design installations and behaviors of people. The design work can adapt to human behavior, mimic human behavior or to create a personalized story for the visitors.

This study also approached several links between urban landscape design and green consumption behavior. Since the primary motivations of green shopping behaviors for the majority belong to two groups: Environmental concern or Utilitarian orientation. Interactive landscapes can encourage green consumption from the environmental perspective and social perspective. On the physical level, Sustainable environmental landscapes can be part of the fundamental infrastructures of a shopping center to provide sufficient energy for its operation as well as supporting consumer activities. Exploring new roles of materials calls for a reflection from the audiences on environmental issues. Energy-driven landscapes show concern for the planet and contribute to the positive image of green culture. It also met the need of communication and knowledge acquirement on advanced technologies. Sustainable social landscapes can meet consumer need on the emotional levels. The interactive and collective experiences are beneficial and explorative, which offers the individual an escape from routine and boredom. On the communicational level, sustainable social landscapes bring collective and shared experiences. Exploring collective power is significant in encouraging green consumption since the majority are

focused on individual interest and overlook the accumulative effect. It can merge the culture of sustainable consumption with the sub-cultures among different groups of the community and further to affect consumer decision. Behavioral-driven landscapes use technology as tools to guide people towards a healthy lifestyle. Through physical, emotional, and cognitive interactions, the landscapes let people aware their personal behavior and, in particular, converting conventional consumption attitude into green social practice. Data-driven interactive landscapes can make abstract consumption data physically sensible, which allow the masses to experience own shopping behavior in a new way and retrospect on the connection between their behavior and the consequences.

The interactive landscape is an environmental media that carries the relationship between people's consumption behavior, interactive technology, and the natural environment. By integrating natural landscapes into communal activities or other every-day situations, people became aware that the environment is part of everyday life, and it has a significant contribution to raising life standard. On a physical level, they influence the aesthetics of space and the atmosphere of the shopping environment. Interactive natural landscapes can have more effects on ecocentric consumers while anthropocentric consumers would show more interest in the culture aspect of abstract landscapes. To upgrade the natural landscapes and make them into intelligent components of our shopping activities can increase environmental concerns and responsive behavior. The installation serves as a platform for people to interact with an urban or natural environment, so as to increase intimacy between people and living plants or other types of natural resources. The semi-natural landscape raises consumer empathy towards living environment by making the plants "alive" and wakes up the tactile feelings towards the physical condition of resources.

Interactive landscapes in a shop can adapt itself behavior to the consumption conduct of people, or communicate to them by imitating their characteristics and behaviors. A closer connection with the shopping environment serves communicational need such as watching others behavior and receive information. The landscape with an anthropomorphic quality behaves like an animal or a pet who can establish a deeper emotional relationship with the visitor. Because interactive scenes capture a momentary presence of the buyer, it creates a

narrative story in urban public space. People voluntarily attach meaning to their lives, and the collective story created by their attendance is saying that everyone has an ability to modify their living environment in a pleasant way. To those who once believed that individual actions are negligible, customizable landscapes also send a message that the quality of life really depends on every possible choice and decision you have made.

PROBLEMS AND LIMITATIONS

This research had approached several problems for future research in designing an interactive landscape that encouraging green consumption. Firstly, using natural component to raise people's environmental awareness must carefully consider how much artificial factor is going to integrate or increment to the natural elements because human prefers naturalness. Secondly, appropriate technology should use sustainable source and be energy efficient. Thirdly, expressing green consumer's lifestyle and value propositions needs to balance between self-expressive and privacy concern, as well as the interactive boundary between individual effort and community effort. Fourthly, due to the intrinsic nature of the landscape and its attached meaning, it is set to fit both the natural environment and the commercial environment. The outcome of the benefit should both influence consumers' behavior on green consumption, and not to reduce the business profits.

There are also several limitations in this research. The data collected from the qualitative research are not general enough to make solid patterns. The sample amount can only reveal a small portion of public opinions. Besides, sustainability is a sensitive issue, and respondents stated participating in green behavior might not practice green consumption, and who votes for the design may not buy it in reality. Moreover, the unfamiliarity of the topic limited the depth of the research. Future work is recommended to focused on a more specific shopping area or a residential sector, or concentrate on a particular domestic resource consumption.

REFERENCES

Anderson, J. L., Ellis, J. P., & Jones, A. M. (2014). Understanding Early Elementary Children's Conceptual Knowledge of Plant Structure and Function through Drawings. *CBE-Life Sciences Education*, *13*(3), 375-386. Retrieved from: http://www.lifescied.org/content/13/3/375.full.pdf+html

Assenstad (2015, Mar 16). Rechtzaak om sensorkunstwerk Assen. Retrieved Dec 25, 2015, from: http://www.assenstad.nl/nieuws/assen/4812-rechtzaak-om-sensorkunstwerk-assen

Aucar, M. (n.d.) Helix Tree [Photo]. Retrieved Dec 25, 2015, from: http://squaredproduce.tumblr.com/post/52030054693/helix-tree

Bojovic, M. (2013, Oct 18). A Sonic Shade Of Light. Retrieved Dec 25, 2015, from: http://www.evolo.us/architecture/a-sonic-shade-of-light/#more-27927

Bloch, P. H., Ridgway, N. M., & Dawson, S. A. (1994). The shopping mall as consumer habitat. *Journal of retailing*, *70*(1), 23-42.

Botanicalls (n.d.) Botanicalls. Retrieved Dec 25, 2015, from: http://www.botanicalls.com

Botanicus Interacticus | A technology for designing highly ... (n.d.). Retrieved from http://www.botanicus-interacticus.com/

Boyce, C., & Neale, P. (2006). *Conducting in-depth interviews: A guide for designing and conducting in-depth interviews for evaluation input* (pp. 3-7). Watertown, MA: Pathfinder International.

Casalegno,F., & Lipshin, J. (2014). SeedMate: Building the Smart Urban Garden. Retrieved Dec 25, 2015, from: http://jasonlipshin.net/wp-content/uploads/2014/10/Lipshin_RAI_Book.pdf

Catala, L. (2012, Sep 6). Interview: Daan Roosegaarde. *Digitalarti Mag*,10, Retrieved Dec 25, 2015, from: http://media.digitalarti.com/blog/digitalarti_mag/interview_daan_roosegaarde

Chiemi (2007, Apr 14). LED enlightenment from United Visual Artists. Retrieved Dec 10, 2015, from:http://pingmag.jp/2007/04/13/uva/

Chino, M. (2009, Sep 28). SonUmbra Solar Powered Tree Lights up the Night. Retrieved Dec 10, 2015, from: http://inhabitat.com/sonumbra-solar-tree/

City of Melbourne (2013, Jun 1), The Light in Winter: Designing the Helix Tree. Retrieved Dec 10, 2015, from: http://blog.thatsmelbourne.com.au/blog/2013/06/01/light-in-winter/

Collectors, P. (2013, Feb 14). BOO | STUDIO ROOSEGAARDE. Retrieved Dec 28, 2015, from: http://www.pulpcollectors.com/boo-studio-roosegaarde/

Council, D. (2007). A study of the design process. (2014, Feb 11). What is Design and Why it matters. Retrieved Dec 10, 2015, from: http://www.thecreativeindustries.co.uk/uk-creative-overview/news-and-views/view-what-is-design-and-why-it-matters

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches.* 2nd ed., Thousand Oaks, CA: Sage publications.

Dalsgaard, P., Dindler, C., & Halskov, K. (2011). Understanding the dynamics of engaging interaction in public spaces. *Human-Computer Interaction–INTERACT 2011* (pp. 212-229). Springer Berlin Heidelberg.

Eggink, W. (2013) Designing Meaning; The Rules of Unruly Design [Pdf format]. Retrieved from lecturer

Fairweather, D. (2013, Nov 16). Helix Tree[Video documentation]. Retrieved Dec 10, 2015, from: https://www.behance.net/gallery/12165171/Helix-Tree

Gilg, A., Barr, S., & Ford, N. (2005). Green consumption or sustainable lifestyles? Identifying the sustainable consumer. Futures, 37(6), 481-504.doi:10.1016/j.futures.2004.10.016

Gondor, D. (2009, Dec 14). Why Do We Over-consume? Retrieved Dec 10, 2015, from: http://ourworld.unu.edu/en/why-do-we-over-consume

Hand, M., Shove, E., & Southerton, D. (2007). Home extensions in the United Kingdom: space, time, and practice. *Environ Plan D*, 25(4), 668 – 681. doi: 10.1068/d413t

Heiskanen, E., & Pantzar, M. (1997). Toward sustainable consumption: Two new perspectives. *Journal of Consumer policy*, *20*(4), 409-442.

Hwang, S., Lee, K., & Yeo, W. (2010, June). My green pet: A current-based interactive plant for children. In *Proceedings of the 9th International Conference on Interaction Design and Children* (pp. 210-213). ACM.

Illumni (2015, Apr 29). The Daan Roosegaarde Interview Director of Studio Roosegaarde. Retrieved Dec 25, 2015, from: http://www.illumni.co/the-daan-roosegaarde-interview-director-of-studio-roosegaarde/

Inglis, D. (2005). *Culture and everyday life*. Abingdon, England: Routledge.

Kaltenborn, B. P., & Bjerke, T. (2002). Associations between environmental value orientations and landscape preferences. *Landscape and urban planning*, *59*(1), 1-11.

Katz (2013, Apr 21). The Zen Garden In An Interactive. Retrieved Dec 10, 2015, from: http://www.infoheaps.com/the-zen-garden-in-an-interactive/

Ktinalaskowski (2012, Oct 19), Shedding Light in Dark Places. Retrieved Dec 25, 2015, from: https://arch3150.wordpress.com/2012/10/19/shedding-light-in-dark-places/

Kilic, G. (2014, Jul 26). Dune projected by Daan Roosegaarde. Retrieved Dec 25, 2015, from: http://mymagicalattic.blogspot.com.ee/2014/07/dune-projected-by-daan-roosegaarde.html

Kim, Y. J., Njite, D., & Hancer, M. (2013). Anticipated emotion in consumers' intentions to select eco-friendly restaurants: Augmenting the theory of planned behavior. *International Journal of Hospitality Management*, *34*, 255-262.

Langill, C.S. (2010). Bridge State. Waxing and Waning: Attention and distraction in the work of Wang Yuyang, Daan Roosegaarde, and Ken Rinaldo. *HorizonZero*,19. Retrieved Dec 25, 2015, from: http://www.horizonzero.ca/textsite/bridge.php?tlang=0&is=19&file=7

Lee, H. J., & Park, S. Y. (2013). Environmental orientation in going green: A qualitative approach to consumer psychology and sociocultural factors of green consumption. *Journal of Global Scholars of Marketing Science*, *23*(3), 245-262.

Leffers, L.G. (2011). Future Field. Design study on a building envelope with an experience of motion. Retrieved Dec 25, 2015, from: http://homepage.tudelft.nl/x4x4j/saddbtreports/0910vj/conceptFutureFieldGijsLeffers.pdf

Lightopia (2013, Apr 15). Studio Roosegaarde's BOO Light Installation. Retrieved Dec 25, 2015, from: http://blog.lightopiaonline.com/lighting-events/studio-roosegaardes-boo-light-installation/

Loop.pH (n.d). Sonumbra de Vincy. Retrieved Dec 25, 2015, from: http://loop.ph/portfolio/sonumbra-de-vincy

(2010, May 29). Sonumbra de Vincy[Video documentation]. Retrieved Dec 25, 2015, from: https://vimeo.com/12132543

Lynn.v1.libguides.com. (n.d.). SOC-200 Research Methods in the Social Sciences: Exploratory Design. Retrieved Dec 25, 2015, from http://lynn-library.libguides.com/researchmethods/researchmethodsd8

Mair, M. (2012, Jul 27). DUNE X Is An Incredible Interactive Landscape Of Light. Retrieved Dec 25, 2015, from: http://www.mutantspace.com/daan-roosegaarde-dune-x-interactive-landscape/

Materia (2012, May 25). Interactive artwork by Studio Roosegaarde. Retrieved Dec 10, 2015, from: http://materia.nl/article/interactive-artwork-by-studio-roosegaarde/

McLeod, S. (2007). What is Conformity? Retrieved Dec 27, 2015, from: http://www.simplypsychology.org/conformity.html

Mela, A. (2013, Jul 9). Experiencing light. Retrieved Dec 25, 2015, from: http://www.domusweb.it/en/art/2013/07/09/daan_rosegaarde_experiencinglight.html

Michon, R., Chebat, J. C., & Turley, L. W. (2005). Mall atmospherics: the interaction effects of the mall environment on shopping behavior. *Journal of Business Research*, *58*(5), 576-583.

Murphy, S. (2014, Feb 13). United Visual Arts trip the light fantastic at new show Momentum. Retrieved Dec 27, 2015, from: http://metro.co.uk/2014/02/13/united-visual-arts-trip-the-light-fantastic-at-new-show-momentum-4301066/#ixzz3nKD9wGud

Nagy, J. & Fawcett, S.B. (n.d.) Section 1. Designing community interventions. Retrieved Dec 10, 2015, from: http://ctb.ku.edu/en/table-of-contents/analyze/where-to-start/design-community-interventions/main

NIMK (2006). DAAN ROOSEGAARDE, DUIN 4.0. Retrieved Dec 10, 2015, from: http://nimk.nl/eng/daan-roosegaarde-duin-40

Onedotzero (n.d.). Triptych, uva. A stunning installation by uva commissioned by onedotzero. Retrieved Dec 10, 2015, from: http://onedotzero.com/projects/uvatriptych

O'Shea, C. (2006, Nov 27) Volume. Retrieved Dec 10, 2015, from: http://www.pixelsumo.com/post/volume-uva

Peattie, K. (2010). Green Consumption: Behavior and Norms. *Annual Review of Environment and Resources,* 35, 195-228, DOI: 10.1146/annurev-environ-032609-094328

Perez, C. (2014) Technical Change and Techno-economic Paradigms [Powerpoint slides]. Retrieved from lecturer

Polaine, A. (2007, Oct 3), Interview with United Visual Artists. Retrieved Dec 25, 2015, from: http://polaine.com/kirbytest/articles/interview-with-united-visual-artists/

Poupyrev, I., Schoessler, P., Loh, J., & Sato, M. (2012). Botanicus Interacticus: Interactive Plants Technology. Retrieved Dec 10, 2015, from: http://www.ivanpoupyrev.com/e-library/2012/botanicus-interacticus-etech.pdf

Qessays (n.d). the-biennale-exhibition-essay. Retrieved Dec 10, 2015, from: http://www.qessays.com/the-biennale-exhibition-essay/

Rabiee, F. (2004) Focus-group interview and data analysis. *Proceeding of the Nutrition Society*, 63(04), 655-660

Rahaman, H & Tan, BK (2009), 'Interactive space : Searching for a dual physical-virtual world', in TW Chang, E Champion, S-F Chien & S-C Chiou (eds), 14th International Conference on Computer-Aided Architecture Design Research in Asia (CAADRIA 2009), Yunlin, Taiwan, pp. 675-684.

Ramus Illumination (n.d). Helix Tree Melbourne 2013. Retrieved Dec 25, 2015, from: http://ramus.com.au/project/helix-tree

REEEP (2010 Sep). Glossary of terms in sustainable energy regulation. Retrieved Dec 25, 2015, from: http://www.reeep.org/sites/default/files/Glossary%20of%20Terms%20in%20Sustainable%20Energy%20Regulation.pdf

Regine (2006, Dec 10). Daan Roosegaarde talks about Dune 4.0. Retrieved Dec 10, 2015, from: http://we-make-money-not-art.com/dune_40_develop/

Reyhle,N. (2012, Sep 21). Engaging All 5 Senses of Your Customers. Retrieved Dec 10, 2015, from: https://retailminded.com/engaging-5-senses-customers/

Roosegaarde, S. (n.d.). Roosegaard Studio. Retrieved Dec 25, 2015, from: https://www.studioroosegaarde.net
(2009 Oct 29). A dynamic glowing landscape takes shape along the River mass. Retrieved Dec 25, 2015, from: http://www.a10.eu/news/meanwhile/light_installation_rotterdam.html
(2012, Feb 26). Dune. Retrieved Dec 25, 2015, from: http://schiricodart339.weebly.com/research-presentation.html
(2013, Mar 05). BOO an interactive zen garden by studio roosegaarde. Retrieved Dec 10, 2015, from: http://www.designboom.com/readers/boo-an-interactive-zen-garden-by-studio-roosegaarde/

Scaravaggi, S. (n.d.). Daan Roosegaarde. An interactive and sustainable world. Retrieved Dec 25, 2015, from: http://www.digicult.it/digimag/issue-021/roosegaarde-a-interactive-sustainable-world/

SERN (2010 Sep). Glossary of terms in sustainable energy regulation. Retrieved Dec 25, 2015, from: http://www.reeep.org/sites/default/files/Glossary%20of%20Terms%20in%20Sustainable%20Energy%20Regulation.pdf

Sheng,Y.C, Tian, T.K., Hong, N.P., Khee, C.T.V., & Siang, L.C. (2014, Jul 10). What is landscape? Retrieved Dec 25, 2015, from: http://www.slideshare.net/ktball/landscape-architecture-36831933

Shepard, M. (2006a, Mar). Tactical Sound Garden [TSG] Toolkit. In *3rd international workshop on mobile music technology, Brighton, UK*.. Retrieved Dec 25, 2015, from: http://mmw2008.dieangewandte.at/isebuki/katalog/proceeding/2006/mark%20shepard%20-%20tactical%20sound%20garden/TacticalSoundgardenToolkit.pdf
(2006b). Tactical Sound Garden [TSG] Toolkit. Retrieved Dec 25, 2015, from: http://www.andinc.org/v2/writings/306090_09_shepard.pdf

Swagerman, P. (2007). Dune. *Progressive Realities*,01,14-15. Retrieved Dec 25, 2015, from: http://issuu.com/paulswagerman/docs/progressive_realities_01/29

Tanner, J., Raymond, M.A. (2012) Personal Factors That Affect People's Buying Behavior. Marketing Principles. Retrieved Dec 10, 2015, from: http://2012books.lardbucket.org/books/marketing-principles-v1.0/s06-03-personal-factors-that-affect-p.html

The Times (2006, Nov 4). A journey into the art of noise. Retrieved Dec 25, 2015, from: http://www.thetimes.co.uk/tto/arts/article2404956.ece

TSG (2006) Tactic Sound Gardern [TSG] Tookilt. Retrieved Dec 28, 2015, from: http://www.tacticalsoundgarden.net

UVA (2010). Volume. Retrieved Dec 25, 2015, from: https://uva.co.uk/work/volume

Urbanowicz, K., & Nyka, L. (2012, November). Media architecture: participation through the senses. In Proceedings of the 4th Media Architecture Biennale Conference: Participation (pp. 51-54). ACM.

Vernekar, S. S., & Wadhwa, P. (2011). Green Consumption: An Empirical Study of Consumers Attitudes and Perception regarding Eco-Friendly FMCG Products, with special reference to Delhi and NCR Region. *Opinion* , 1(1), 65-74

Wallin,Y. (2014, Sep 22). The Landscape Artist, An interview with Daan Roosegaarde. Retrieved Dec 25, 2015, from: http://magazine.good.is/features/an-interview-with-daan-roosegaard

Watanabe, M. S. (2004). FIBER TOWER. A new cultural/media complex for Milan. Retrieved Dec 25, 2015, from: http://www.makoto-architect.com/MILAN2004/milan2004e.htm

Wiberg, M. (Ed.). (2010). *Interactive Textures for Architecture and Landscaping: Digital Elements and Technologies: Digital Elements and Technologies.* IGI Global.

Weiser, M. (1999). The computer for the 21st century. *Mobile Computing and Communications Review*, *3*(3), 3-11.

Wertheim, B. (2012, May 31). Featured Works From The Gallery: Week 45. Retrieved Dec 10, 2015, from: http://thecreatorsproject.vice.com/en_uk/blog/featured-works-from-the-gallery-week-45

Westbrook, R. A., & Oliver, R. L. (1991). The dimensionality of consumption emotion patterns and consumer satisfaction. *Journal of consumer research*, 84-91.

Wikipedia (2015, Oct). Green Consumption. Retrieved Dec 25, 2015, from: https://en.wikipedia.org/wiki/Green_consumption

WTN (2013). Daan Roosegaarde vertelt over Dune[Video format]. Retrieved Dec 25, 2015, from: http://www.wtn.net/content/dune

Young, W., Hwang, K., McDonald, S., & Oates, C. J. (2010). Sustainable consumption: Green consumer behavior when purchasing products. *Sustainable Development*,18(1), 20-31. Retrieved Dec 10, 2015, from: http://openair.rgu.ac.uk

Zimmerman, I. (2012, Jul 18). What Motivates Impulse Buying? Personality, pleasure, and product connections can all lead to impulse buys. Retrieved Dec 10, 2015, from: https://www.psychologytoday.com/blog/sold/201207/what-motivates-impulse-buying

Zodzwingli (2007). Hello Stranger-interactive pillar field. Retrieved Dec 10, 2015, from: https://www.youtube.com/watch?v=SAeys1fK3Zo

APPENDIXES Selected Interview Quotes

Desire for safety and comfort

“When I know I had a baby I start to change everything in my life to green. I buy organic food, cotton clothes, even do something I never did before such as recycling waste by categories. It is not only due to the health concern but also, that I want to maintain the environment clean for my child to grow up.” I3

“I’m used to buy organic foods because I think it is good for my body. I also buy non-toxic clothes sometimes within my financial ability. I believe it worth paying the money if it is less harmful to my health when compared with other ordinary ones.”I10

“I always choose food with green labels in the supermarkets. I believe there should be some standardized safety examination behind the green labeling. So I prefer to buy more healthy food.” I11

“The food crisis is so horrible nowadays that I don’t feel like trusting the food supply in most restaurants. So I buy organic food and cook for myself. ” I12.

“I renovated my home with eco-material and furniture. I feel more safe and comfortable in a friendly environment.”I1

Product quality, product designs, and efficiency

“I buy notebooks made from recycled papers. They seemed of excellent quality, and indeed, they are!” I4

Moral responsibility, Personal statement and Lifestyle

“I feel a sense of achievement when buying products that are energy-efficient or made from recyclable materials. I encourage my family to do the same. I believe everyone should understand the importance and their responsibility by making a small contribution to the sustainable development of our community” I19

“When I see there are more and more Eco-brand appear in the television I knew green is going to be a new lifestyle. It’s more rational, more human, and even luxury. “ I6

“I often buy environmentally friendly products.I always feel proud when I shop in Eco-brand stores. I think that shows to others I have sufficient income and a better taste.” I16

“All of my clothes and home decoration are bought from Eco-brands. My husband does that too. We think it is a lifestyle. We pursue to live a high quality but simple life.”I2

Discomfort, inconvenience

“I know I can get 12 oz free coffee if I bring my own cup to the coffee shop, but it is too inconvenient. Normally I will ask for reusable mugs and drink in the shop to minimize the use of paper cups.” I12

“I always forgot to bring a bag with me when I go to supermarkets. As a result, I have to pay for a new plastic bag each time.” I13

Price

“I may have to pay a bit more at first, for example, an energy-efficient refrigerator, but it will help me reduce the energy bill, later on, I can enjoy the pleasure brought by most advanced technology, and I feel socially responsible .” I29

Inherent purchasing habit

“Eco-products are too monotonous and boring; they are just not my type.” I7

“I just like to buy cheaper products. Using the same amount of money I can buy a lot more stuff. Those green one are made for the wealthy.” I8

Lack of information and credibility

“I don’t buy green…Well, If it writes on the product that I could live one more year by using it, I think I will buy it.” I14

“I don’t buy organic food. I mean there is no difference compared to ordinary ones, but the price is significant!…Seeing the production process may help…But how can I make sure the companies are trustworthy?” I7