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The review of literature of semiotics developed by Ferdinand de Saussure, Christopher Alexander's work on the concepts of hierarchy and abstract organizational structures, and the definition of systems and its properties by Michael Pidwirny provided a foundation for further understanding of the development of a system of design that is a tool to communicate identity to products. To develop this understanding, the system of design was expressed through a Graphic Matrix. The purpose of the Graphic Matrix was to decompose the elements of craft examples from El Salvador to create vessels and light fixtures using digital fabrication technology.

The Graphic Matrix grouped information by elements, attributes, and relationships. The hierarchy of information helped to organize and visualize efficiently all the phases of decomposition. The craft examples from El Salvador go through all the phases in order to extract characteristics to be incorporated in the new product. The process of design starts parallel to the research because it combines all the concepts of the theories presented in the review of literature with the information presented in the Graphic Matrix. The use of the computer aided design, CAD, software, such as Rhinoceros, helped facilitate the production of the vessels and light fixtures. It provided files that were used with computer aided manufacturing, CAM, technology. Without the use of CAD and CAM the reproduction of the shape units to cut would not have been fast and precise. The goal of combining both, old and new, manufacturing technologies was reached by the use of the Graphic Matrix.

DECODING CRAFT: COMMUNICATING IDENTITY

THROUGH A SYSTEM OF DESIGN

by

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Stoel Burrowes
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APPROVAL PAGE

This thesis written by Claudia Aguilera Guardado has been approved by the following committee of the Faculty of The Graduate School at the University of North Carolina at Greensboro.

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CHAPTER I

INTRODUCTION

The process of decomposing El Salvador's crafts examples for the purpose of developing new products is done through a system of design visualized graphically. My design process combined the concepts of hierarchy developed by Christopher Alexander and the theory of semiotics developed by Ferdinand de Saussure. Those theories of hierarchy and semiotics helped me to understand how to express information in a visual structure that describes a design process through an organization of steps.

An abstract structure that describes how a collection of many small systems can be combined to create a larger and more complex system is a hierarchical decomposition (Alexander, 1965). Alexander considered decomposition, the process of breaking down into simpler forms or matters, a useful way to understand a design problem or to describe a product. Hierarchical decomposition can help designers to comprehend the structure of resulting products or systems (Peters & Peters, 2013).

As an introduction to semiotics, David Crow in his book 'Visible Signs', talks about the study of a structural model of signs (Crow, 2003). Crow suggests that signs and signals have a very sophisticated level of codification but the fact that we are able to read them is due to how deeply rooted the concept of hierarchy is in our societies.

I selected specific characteristics from El Salvador's crafts cultural industry with the purpose of incorporate them into the analysis of the production of the product. The information is presented in a Graphic Matrix in which craft examples, gestures, and their relation to specific criteria of materials, manufacturing techniques, and craft techniques are, juxtaposed to inform the design process (See Chapter IV). El Salvador's basket and craft technique of weaving with natural fibers is analyzed. The final products are vessels and light fixtures created to embody the life and tradition of indigenous craft with 21st century design and manufacture technique.

The creation of the Graphic Matrix served as a tool to describe the logic and steps of decomposition of craft examples. The Graphic Matrix was developed and used through the entire research with the purpose of organizing the information in an effective way as part of the design process. The system of design described from the Graphic Matrix to the design process served as a channel to transfer the identity into new products because it transforms characteristics of both cultural and industrial fabrications. The use of digital fabrication methods and the Computer Aided Manufacturing (CAM) equipment available at The University of North Carolina at Greensboro helped to accomplish the goals of this thesis.

The difference between the role of the professional software developer and the designer has been blurred (Aish, 2012).We can all create that final layer of scripting that represents our unique design logic, so that we can all say: 'Before I design I will first build my tools'(Peters & Peters, 2013).

Through the study of weaving technique applied to craft, I have gained better understanding of how objects can be moved from two dimensions to three dimensions using flat raw materials. I am using sheet goods as a contemporary intersection point of craft-based techniques and digital fabrication. I better understand how the properties of materials that provide a great potential to self-assemblage products, as well as how context can bring into focus form, function, and structure.

Research Question

First Nations people all over the world are responsible for the linguistic and cultural diversity of our traditional knowledge. Their traditional knowledge has been, and continues to be, an important heritage and source that benefits all (UN, 2009). Design is a vehicle for the communication of ideas; how can the use of digital technology become an aid for designing products that communicate identity or a sense of craft-based technique?

Significance

This study is important to interior product design because it encourages the study of the interrelation between visual communication and communication through objects. This study will make an analogy of the system of signs in semiotics and design; it creates a methodology for designing that will decode forms and materials. The graphic approach constitutes a contribution to the discipline because it relates concepts that define a new methodology for designing.

This project promotes:

-Innovation: It helps to maximize materials, time, and fabrication processes using Computer-Aided Design (CAD) and Computer Aided Manufacturing (CAM) techniques.

- Identity of a culture: It takes examples from a specific group inside a culture (First Nations people from El Salvador) and their craft products' cultural industry; involving people with objects.

-Creates a channel of communication between languages that are non-tangible (graphs) to tangible ones (objects).

This study about identity responds to the need of giving a product not only a value in the market, but a value itself for its meaning and context taken from the roots of a society.

Definitions

Systems: Connected parts that work together through a process. Systems share characteristics and are visualized as component blocks that have connections drawn between them (Pidwirny, 2006).

Decomposition: The process of breaking down into simpler forms or matters.

Decode: The act of translating back to its original language or form a message that has been encoded.

Gesture: Form of non-verbal communication or non-vocal communication in which visible bodily actions communicate particular messages, either in place of, or in conjunction with, speech. Gestures include movement of the hands, face, or other parts of the body. Gestures differ from physical, non-verbal communication that does not communicate specific messages, such as purely expressive displays, proxemics, or displays of joint attention (Kendon, 2004). The use of the word gesture in this document refers to the drawing of the craft example through points and lines. The purpose of this

gesture drawing is to simulate the shape of the woven baskets taken as examples during the second phase of the Graphic Matrix.

First Nations: Within Canada, "First Nations" (most often used in the plural) has come into general use—replacing the deprecated term "Indians"—for the indigenous peoples of the Americas. Individuals using the term outside Canada include supporters of the Cascadian independence movement as well as American tribes within the Pacific Northwest. The singular, commonly used on culturally politicized reserves, is the term *First Nations person* (when gender-specific, *First Nations man* or *First Nations woman*). A more recent trend is for members of various nations to refer to themselves by their tribal or national identity only, e.g., "I'm Mayan," or "We're Pipils," in recognition of the distinctiveness of First Nations ethnicities (Mandel, 1994).

Cultural Industry: The product or distribution of cultural goods or services that embody cultural expressions, not related with the commercial value that they may have. This industry includes: publishing, books, literature, music, cinema, audio visual production, multimedia, craft and design, architecture, visual arts, and performing arts (UN, 2009).

Semiotic: The theories which we apply to graphic design and visual communication are taken from a study of the general science of signs known in Europe as semiology and in the USA as semiotics (Crow, 2003).

CAD: Computer-Aided Design is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve

communications through documentation, and to create a database for manufacturing (Narayan, Rao, & Sarcar, 2008). The use of the software Rhinoceros aided the manufacturing process of the products designed in this thesis.

CAM: Computer-Aided Manufacturing is the use of computer software to control machine tools and related machinery in the manufacturing of work pieces (Daintith & Oxford University Press, 2004). The use of the software Rhinoceros 4.0 and 5.0 served as tool to design shapes that later were cut in a Laser Cutter machine for precision, efficiency, and maximization of materials.

SG: Smartgeometry, it was founded in 2001 as an informal network of designers interested in harnessing the powers of computation for architectural design (Peters & Peters, 2013).

CHAPTER II

REVIEW OF THE LITERATURE

During the design process, inspiration can be one of the designer's guides to create new ideas. In this study, new products are developed by seeking shapes and materials. The following literature review brings together ideas of designers in the industry, concepts, and theories that helped to inform my approach throughout my design process.

As Paul Jacques Grillo says in his book *Form Function & Design*, design involves everybody because we live, eat, pray, and play in it (Grillo, 1975). Everyone, in every society, provides input into design and perception plays an important role. The perception of the users or observers of the final products of this thesis vary because the understanding of the objects depends on their previous personal experiences and their interpretation of shapes.

New products and materials have been developed in the last decade. As a result, a codifying language is being created to approach the materials and the traditions that joined them. The connection between the new and the old manufacturing techniques is made by using materials with similar properties that emulate the strengths and flexibility of the inspirational craft example, thus giving products an individual personality, non-commoditized in the market.

Apple is an example of a non-commoditized company. In Marc Sigal's analysis of the Apple market segmentation strategy he explains how Apple uses a vertical integration segmentation strategy with the creation of billing relationships between their products. They provide an overlap of the products linking their strategy and tactics across product lines and product lifecycles. These products are specialized and their accessories are created for specific functions. Apple products can also be customized by the client; this is one of the marketing strategies that enable the company to be non-commoditized.

> In the real world of building products and attacking market opportunities, market segmentation is the process of defining and sub-dividing the aggregate, homogeneous market into addressable, targeted needs and aspirations buckets. Buckets that are in turn, threshold by demographic, psychographic and/or budgetary constraints. Market segmentation strategy enables a company to drive complete, unified product solutions that are harmonious with messaging, customer outreach, and channel strategies for selling and supporting customers. In this regard, Apple's product strategy is a study in market segmentation. Versus merely trying to stuff a product, burrito-style, with as many different features as possible, they target specific user experiences, and build the product around that accordingly (Sigal, 2010).

In the past, the understanding of how materials worked as compared to present-day knowledge was different. Materials are often now referred to as the latest trends, instead of integrated into the concept of the product itself. The meaning of contemporary products is too often lost in the design process and during its manufacturing. The meaning of some products is just the function or less, leaving apart the identity or the sense that one day they belonged to a place (Pérez Arroyo, Atena, Kebel, Berlage Instituut, & EMVS (Firm), 2007).

My views during the design process were influenced by James Martin's statement:

> Surely our destiny is to build something better than a society with endless, mostly trivial consumer goods. We have created consumer societies on a grand scale. In such societies, a growing number of people are unhappy and seeking therapy, and most of them complain of feelings of emptiness and pointlessness. Extreme consumer societies become devoid of deep values (Martin, As cited in Fiell & Fiell, 2007, p. 7). It is needed that all take a moment and step back to look at this type of society. One thing that we will discover is that new products that speak a direct language to the people will start to be on demand (Fiell & Fiell, 2007).

The products created in this thesis, during their production and design, acquired a cultural meaning and identity when selective characteristics from the Graphic Matrix were integrated into them. The research of the shapes and materials added a layer of significance to the products. The products are intended to be mass-produced using both craft-based and computer-aided techniques. The products designed bridge the realms of making and communicate the meaning of a sense of identity.

Materials and Craft Technique

Natural fibers include those produced of animal, vegetable, and geological resources. For this study I focused on vegetable fibers, and more specifically wood fibers, used in El Salvador for crafts. The soil in El Salvador has great potential. Agriculture is the primary source of economic support. The main crops are coffee, cotton, sugar cane, rice, wood fibers, tobacco, fruits and vegetables. Most of the wood fibers (approximately 70%) in El Salvador grow in the rural areas.

Some of the craft done in El Salvador is made out of these wood fibers: Plantain, Kenaf, Henequén, Carrizo o Vara de Castilla, Bamboo, Loofah, Palm, Coconut and

Vetiver; these are fibers that come from trees or plants, and grow all over the country. Such raw materials have great potential to develop craftsmen communities. Local wood fibers have become the raw materials that start the chain of processes and product fabrication (Campos, 2007).

Weaving is one of the most common craft techniques found in many cultures all over the world, and the main tool for the creation of woven goods is the craftsmen's fingers. Woven wood fibers are used for different applications including basketry, clothing, and furniture. It is believed that basketry is one of the most ancient applications of wood fibers' in El Salvador. Because of the wood fibers property of disintegration, it is uncertain when this technique was applied for the first time. However, it was certainly used before the development of pottery techniques and it was used for transporting and keeping food (Campos, 2007).

Semiotics: Visual Communication

It is important for artists and designers to understand how meaning is formed and the way that viewers can be directed to meaning through the juxtaposition of words and images. David Crow in his book *Visible Signs*, talks about a system of visual language in order to explain how visual communication works. Hierarchy in communication is deeply embedded in our societies. The environments that surround us have made us develop a sophisticated sense to read signs and signals; decoding meanings from a composition subconsciously (Crow, 2003).

Ferdinand de Saussure, Swiss professor of linguistics, and United States philosopher Charles Sanders Peirce, were simultaneously developed parallel studies of

signs. Although their studies took place independently, they have similarities in their concern with the structural model of signs. The three main areas of understanding about semiotics are: the signs themselves, the way the signs are organized into systems and the context in which they appear (Crow, 2003). The meaning of an image changes from the people who are involved in the process of making it to the observer. This is why the perception of the observers of the products adds a layer of meaning to it; not only for what they think they see but, for what they understand and relate to after they have seen it.

According to Saussure, language is formed by units called phonemes. These are sounds that are used and combined to create words. Phonemes can only be judged as language when trying to communicate an idea. In order to communicate ideas, they must be part of a system of signs.

Saussure's system refers to a word used to represent an object. Both, word and object, make a sign, so sign = word + object. For instance, in the sky we find clouds. A Cloud has five phonemes: \'k-l-a-u̇-d\. While it is in English the word is 'Cloud', in Spanish 'Nube', in German 'Wolke' and in French 'Nuage'. The relationship between them is arbitrary, because the word will be the consequence of a specific language. The separation between meaning (word) and form (object) is called duality. For instance, just the letter 'C' in Cloud, does not represent the cloud. The word 'Shoe' does not help you walk; or the word 'Glasses' does not aid you see well. Please see the word cloud not as an object but as the representation of the object in Figure 1.

Photo of a cloud (representations)	Drawing of a cloud	Arbitrary
		

Figure 1. Semiotics (word + object), Representations of a Cloud.

Some words when translated to another language will bring up a variety of different words, languages don't just find names for objects or ideas which are already categorized, languages define their own categories.

The Graphic Matrix approaches aspects of a design process as one might see signs and symbols in semiotics.

Hierarchical Decomposition

Christopher Alexander suggested the use of formal graph methods mainly as a descriptive technique could help designers understand the structure of resulting products or systems (Alexander, 1965). Alexander stated that there are two types of structures in hierarchical decomposition. First, a tree where no piece of any unit is ever connected to other units except through the medium of that unit as a whole. He exemplified this by saying that each element works as a member of a family that is not allowed to make friends outside the group unless the family as a whole makes a new friendship. For Alexander, the structural simplicity of his tree is like the compulsive desire of neatness and order. Second, a more complex abstract structure called semi-lattice that is not a tree

because they contain overlapping units. He exemplifies this structure by making a comparison with a complex piece of fabric, great paintings, and symphonies. The tree, he commented, is a mental device that offers a simple and clear way of dividing a complex entity into units (Alexander, 1965).

The Graphic Matrix incorporates, in its logic, criteria that help to organize and categorize the information presented. This contributes to the unity of the language of design that is shown in each of the final products. The Graphic Matrix combines information in a semi-lattice way, where elements and attributes overlap. Please see a tree structure and a semi-lattice structure in Figure 2.

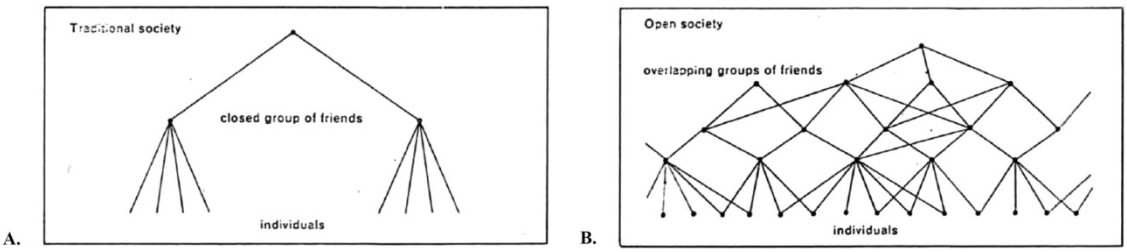

Figure 2. Hierarchical Decomposition by Christopher Alexander.
Letter A: Tree Structure, Letter B: Semi-lattice Structure.

The structure depicted in the Graphic Matrix was generated with a sense of hierarchy. The Graphic Matrix is structured in four phases prior to the design process. The theory of semiotics and the concepts of hierarchical decomposition were a strong influence when designing the Graphic Matrix, which serves as a channel for the communication of identity. Each of these phases is composed of layers of data that help to extract information in order to create a profile. This thesis focused on the relationship

between the components of the signs. The relationship is the one that allows us to turn them into whatever form the signs take. The main difference between the studies of Saussure and Sanders Peirce is that Saussure presented little interest in the part that readers play in the process but a lot of interest in the meaning of the words. The meaning of the products developed in this study comes from the analysis done in the Graphic Matrix, which is a visual graph approach to develop new products. The information extracted from the decomposition of woven baskets serves as the context that determines the form, function of the product, and the type of structure the new product adopted.

CHAPTER III

METHODOLOGY: DESIGN PROCESS

The review of the literature included ideas of designers, concepts, and theories that informed the approach in the design process and final product. Because this is a design thesis, during my first year Studio, I had the opportunity to narrow down some of the criteria I used to develop the visual graph approach of the Graphic Matrix. The design process was evaluated through desk critiques and studio reviews. During these reviews I received feedback from industry experts, faculty, and classmates. Such feedback was an important part of the design process.

Next, I explain the design process I followed during the first year Studio. The design method describes the design process I utilized to create a cardboard stool. The inspirational craft for this project was the petate rugs which is a woven mat made out of palm tree leaves. First year studio was the foundation to keep studying this weaving craft technique for this thesis, with the purpose of developing a further understanding of how objects can be created from two dimensions to three dimensions using flat sheet goods.

I got to understand that by relating the logic behind craft-based techniques and digital fabrication new products can be created effectively. The interpretation of forms, function, and structure lead me to the study of the properties of materials. Having these interpretations in mind, I saw the potential to create self-assemblage products. In this part of the project I also combined characteristics of Ready to Assemble Furniture

(RTA) and flat pack. The precedent study included IKEA as a company that builds its entire business around both, RTA and flat pack objects.

During the studio a stool was created by decoding information and transferring concepts from visual images of petate rugs, to sketches and tests, to the final design. The methodology used in my fist year studio developed the design process that contributed to the Graphic Matrix.

Design process follows after defining the theory and approach to the object to be designed. As a framework in the ideation phase, information was gathered from precedents and examples, both in the field of design and in the cultural industry. See Figure 3 to 5. From theses precedents I gained two types of information. First, they provided information regarding other people are doing in the field of design and I looked for similar characteristics to incorporate in the product that was developed through the process of design. Second, the cultural industry provided valuable information regarding the craft technique and the processes of fabrication. These two types of information contribute to the final design, linking both craft industries and digital fabrication processes. First year studio project was titled "An Identity for Mass Production". Design and product statements narrated the processes and approaches of the Cardboard Stool.

Theory and Approach

Material culture is the study of the beliefs (values, ideas, attitudes, and assumptions) of a particular community or society at a given time through artifacts. The word 'material' refers to objects, sometimes known as artifacts(Prown, 1982). Objects made by humans, or modified by humans, show facets of the culture in other times and

places. Material culture is about re-experiencing objects in order to find information about the culture through the object. Material culture is a broad subject; in first studio project I focused on the ways in which function, structure, and material could be reinterpreted to create a new design.

RTA and Collapsible Furniture

Ready To Assemble (RTA) is also known as knock-down furniture, collapsible furniture, or flat pack furniture. It is created with multiple pieces that require assembly and is usually packed in a box that contains assembly instructions. RTA was invented by Gillis Lundgren (IKEA, 2013). He developed the idea after wanting to fit a table into his car. For this, he disconnects the legs of his table and reassembled the table at home. Afterwards, he discussed the idea with his employers at IKEA. The company eventually built its entire business around this concept.

This type of manufacturing allowed products to be produced less expensively. In addition to the lower cost of products, merchants also benefit from lower costs of transportation and storage. Consumers find the assembly task worth the benefits of more affordable products and the process of assembly part of the experience of using the products.

Precedent Study in Design Field

1. Reversible Chair by Nicola Enrico Stäubli

My projects represent an approach to design which has more to do with mathematics than with a personal and inward looking composition. I am always in search of the primary source of design – the initial point. It is by far the most important step because each and every decision in the design process is based on it. You end up with a physical manifestation of this idea which is to be judged not after the concept of beauty but as the logical result after a series of consistent decisions in the designing process (“‘Reversible’ chair | Furniture Design by Nicola Enrico Staubli,” n.d.).

Figure 3. Nicola Enrico Stäubli, Reversible Chair (www.dailydesignjoint.com).

2. Triplette' chair by Paul Menand

'Triplette' chair can be defined more as a "nesting chair" than a "stackable chair" Practically, the chair sums up to three chairs in one and can be used in every combination from one to three because of the unique configuration of each chair. 'Triplette' chair not only saves the precious space in your room but also saves the space that would be occupied by three stackable chairs. The best thing of 'Triplette' chair is that you can still use it while you nest all his three "children" together. And because of this you do not need to store them- which mean you cannot use them, plus you need the space to do it (“COOL DESIGN: Triplette chair by Paul Menand (Pic) | Daily Dawdle,” n.d.).

Figure 4. Paul Menand, Triplette' Chair (http://www.dailydawdle.com/2011/05/cool-design-triplette-chair-by-paul.html).

3. Yael Mer and Shay Alkalay

A collection of furniture assembled out of interlocking iconic urban benches into a plaid surface. Stripes arrangement is a common element in iconic benches. Many of the very common archetype benches happen to be shaped in this way. Stripes are also the fundamental element in textile check/plaid pattern where they arranged together in a vertical and horizontal fashion. Making a graphical connection, Raw-Edges created this large set up of different wood benches that interlocked to each other perpendicularly in order to achieve a Plaid/Check patterns. Actually… this project is great an excuse to play with combination of colours textures and materials ("Projects - Raw Edges Design Studio," n.d.).

Figure 5. Yael Mer and Shay Alkalay, Pattern Bench (http://www.raw-edges.com).

Example Study in Cultural Industry

Petate rugs: Nahualt term to describe rugs made out of palms. Their main function in ancient civilization times was for sleeping.

Figure 6. Petate Rug, (www.fotosdeelsalvador.com).

Design Process

Manufacturers utilize assembly line techniques to produce many copies of a design in a shortened time period. This can be beneficial to manufacturers due to lower costs and higher production, but how many of these products contain a story behind their production? Current mass-produced products lack the connection to the history and traditions of products made by hand; leaving behind the memories that once characterized such products.

The design process included not only the analysis of the structure, function and aesthetics of the craft (Petate Rugs), but the analysis of precedents in the industry that helped me to understand how to transfer information in the craft to a digital form that

connected digital fabrication with craft-based techniques. This enabled me to communicate a meaning through the product. Therefore, the stool became an embodiment of a story, imparting an experience that was not commoditized.

The stool shape is based on the folding strips of a Petate. The patterns created by the cardboard were inspired by the Petate. The final structure was created by seeking a modular shape that could be replicated and rotated to create the whole stool.
After exploring several possibilities with the patterns, I formed a pentagon shape by overlapping and folding one single strip several times. This modular structure goes from 2D to 3D by folding it down the middle. It created the structure used as the leg for the stool when opened. Three of these modular structures are connected with a fourth piece, the top, which wraps and interlocks the shapes. The project included three components: to be ready to assemble (RTA), to be collapsible, and to be flat-packed.

Production Statement

The purpose of the cardboard stool was to develop a communication between craft production and industrial manufacturing processes, and to link the characteristics that they share. After analyzing properties of cardboard, I chose it as the media for designing the prototype of the stool, especially due to its capability to be folded. Cardboard is an eco-friendly option and its folded structure can hold up to 250 lbs. See Appendix E.

The production process started from a small scale model and moved towards a full scale digital fabrication model. Through this manufacturing process, the design incorporated a tab system with the purpose of reinforcing the structure.

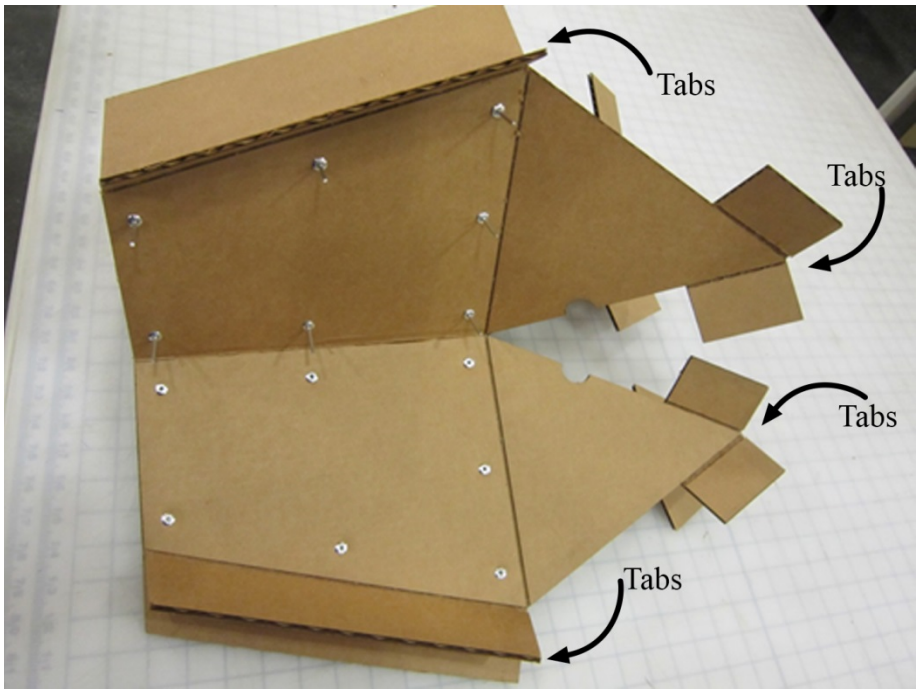

Figure 7. Tab System in Cardboard Stool.

The modular shape was unfolded and drawn in Rhinoceros 4.0, and then printed on cardboard in a laser cutter printer for precision. This was done in the Computer Aided Making Studio; a digital fabrication facility (CAMstudio), at the University of North Carolina at Greensboro.

The assembly was conducted in two processes. First, all the internal parts of the three legs were glued and pop-riveted together, creating the main structure of the stool. Second, the outside pieces were glued together. When both parts were ready to be assembled, they were glued to the main structure. See Appendix E for more photos of the process.

The stool's construction, cost, and its target consumer will vary depending on the material chosen. Cardboard stools are appropriate mainly for children's environments because of their temporary nature and the profitability in terms of cost and production.

Figure 8. Cardboard Stool. Front, Lateral, and Bottom Views.

CHAPTER IV

ANALYSIS: GRAPHIC MATRIX

When markets were not as developed as they are now, products used to be customized (Groover, 2011). Characteristics from a particular region were infused into the product and its significance went beyond the function itself. Much of the significance of currently products is lost because the process of mass production leaves behind the memories, traditions, and even the culture that once characterized them.

Design is a non-verbal language and is a way to communicate ideas. The idea of creating a Graphic Matrix that served as a tool to design was to be able to describe graphically the process of decomposition of craft examples that filtered information and selected characteristics in a profile and chart for a point of departure in the design process. The Graphic Matrix describes several levels of transformation, demonstrating that design is a form of communication that can be transferred from linguistics.

Most of the guidelines to create the Graphic Matrix were taken from the semiotics theory of Ferdinand de Saussure, who explored the way systems of meaning work. The Graphic Matrix also makes a reference to the concepts of Christopher Alexander, who describes an abstract semi-lattice structure that overlaps systems in order to develop the logic of a design.

Saussure's theory is considered very subjective; because of this, many authors have had different interpretations of semiotics (Crow, 2003). The Graphic Matrix I have

developed visually represents a system of design that pulls apart and examines the meaning of its components and its individualism with the purpose of understanding characteristics that can be extracted for later incorporation in the final product. Four phases in the Graphic Matrix make up the system of design. Each of these phases overlaps with the next phase, creating a path that generates a profile for the new products. (Figure 9).

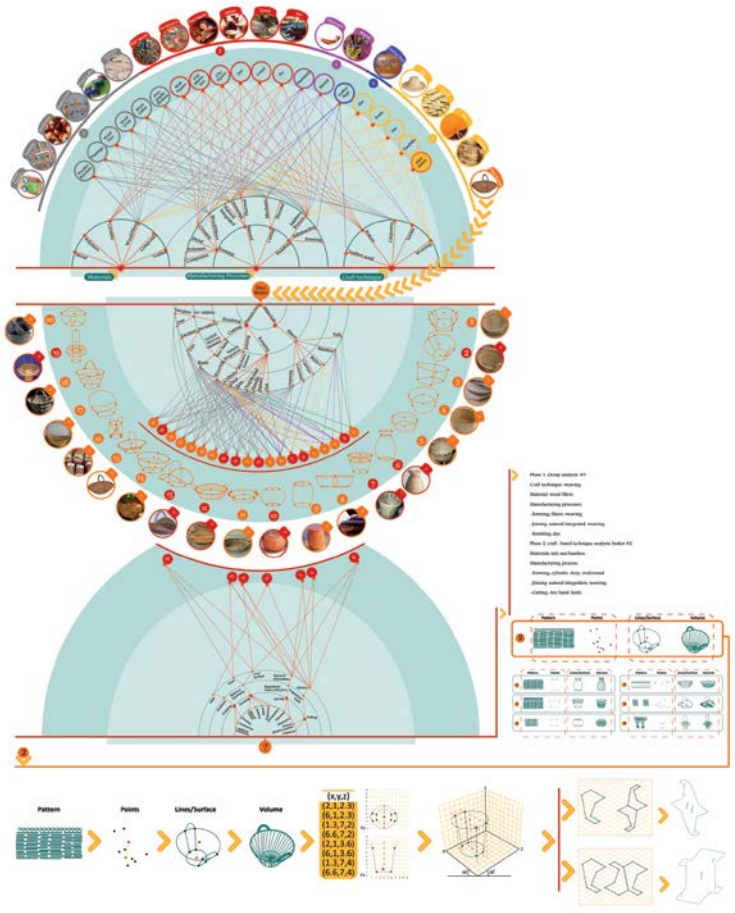

Figure 9. Complete Graphic Matrix Showing all the Phases.

Connected parts that work together through a process, make a system (Pidwirny, 2006). Systems share characteristics and can be visualized as component blocks that have connections drawn between them. A system is defined by the value of its three properties: elements, attributes, and relationships. Elements are parts that make up the system. Attributes are characteristics of the elements that may be observed, measured, or related. Relationships are all of the associations made between elements and attributes. In the Graphic Matrix, groups of attributes were divided into subgroups. These subgroups of attributes were then related to the craft examples, which are the elements presented in the first two phases of the Graphic Matrix.

There are three types of attributes: materials, manufacturing processes, and craft techniques. The associations made between the attributes and elements provided specific information for the profile extracted from the Graphic Matrix. In the Graphic Matrix attributes with the greatest number of relationships helped to define the shapes of the new products. Attributes and elements were placed inside of an offset semi-circle that created visual layers in the Graphic Matrix. Each of them represents a point in the matrix that works as a reference to define the relationships (lines) between them.

A manufacturing process is a design procedure that results in physical and/or chemical alterations to a material, with the intention of increasing the value of the material. The alteration is usually implemented in a number of transformations that are required to convert the material into a final product. The manufacturing operations can be divided into two basic types: (A) processing operations, which transform a work material from one state of completion to a more advanced state that is closer to the final desired

product, and (B) assembly operations, when joining two or more components to create a new object (Groover, 2011).

There are four operation groups inside the manufacturing processes analyzed in this Graphic Matrix.

(1) Forming: refers to the shapes that materials adopt when exposed to specific conditions to create bends, continuous forms, molds with sheets, hollow, bulk, and internal shapes. The subgroups for materials in the Graphic Matrix are: metal, ceramic, polymers, wood/fibers, and composites. The subgroups for shapes in the Graphic Matrix are: cylinder, spin, oval/rounded, square, flat depth, deep depth, and shapes with handle.

(2) Joining: makes reference to the types of joins, such as naturally integrated, mechanical, and thermal.

(3) Cutting: makes reference to the type of cutting used in the manufacturing process. The subgroups are: mechanical (guided/ machine assisted), thermal (laser cutter), freehand (knife).

(4) Finishing: makes reference to the final operation processes of the product. The subgroups are: additive processes (natural lacquers or dyes/artificial lacquers or dyes), subtractive processes, and printings.

Materials in manufacturing can be classified into one of four basic categories: The first three categories - metals, ceramics, and polymers - have mechanical and physical properties that vary, and that affects the type of manufacturing process that produce products from them. The last category is composites, which are nonhomogeneous mixtures of the other three basic types rather than a unique category

(Groover, 2011). In the Graphic Matrix, the subgroups for materials are: metal, ceramic, polymers, wood/fibers, composites, and leather. The type of cultural craft technique is related to these materials. The subgroups for craft are: pottery, leather goods, carpentry, looms, and weaving.

First Phase

The elements analyzed in this phase are twenty different crafts examples from El Salvador divided into five groups by craft technique. The three groups of attributes related to the craft examples are materials, modern industry of manufacturing processes, and cultural craft techniques. All the subgroups when related to the twenty different crafts examples from El Salvador provide specific information about each craft. The five groups of craft example include (1) carpentry: wooden keychains, paintings over wood, toys, painted wooden crosses, wood coffers, and pyrography pictures, (2) pottery: hanging figures for wall, clay miniatures, jars, comals, and pots, (3) looms: hammocks and morrales, (4) leather goods: leather bag, (5) weaving: hats, petates, fans, tumbillas, fiber baskets (Figure 10).

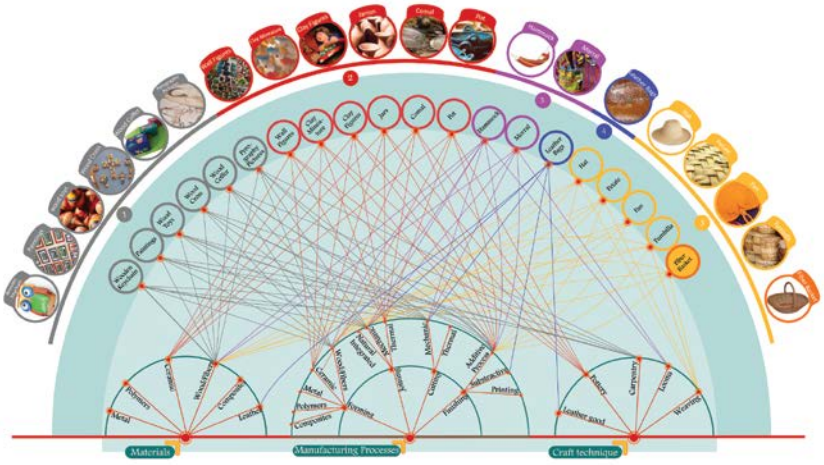

Figure 10. First Phase of Graphic Matrix.

For this study, the weaving craft techniques and fiber baskets were the elements analyzed. The information collected is a list of the relations between the attributes (three groups) and the elements (craft examples). My interest in the study of weaving and baskets was initiated in the first year studio. Therefore, I wanted to continue to develop a better understanding of weaving and its characteristics. Following are the profiles per group in first phase.

Group #1:

Craft technique: carpentry

Material: wood

Manufacturing processes:

-Forming: wood carving, turning wood

-Joining: mechanic: joinery

-Cutting: mechanic: jigsaw

-Finishing: paint, lacquer

Group #2:

Craft technique: pottery

Material: clay

Manufacturing processes:

-Forming: ceramic: clay throwing, modeling, and casting

-Joining: kiln fired

-Finishing: paint, lacquer

Group #3:

Craft technique: looms

Material: natural fibers: thread

Manufacturing processes:

-Forming: fibers: weaving

-Joining: weaving

-Finishing: dye

Group #4:

Craft technique: leather goods

Material: leather

Manufacturing processes:

-Joining: mechanic: sawing

-Cutting: mechanic

-Finishing: dye

Group #5:

Craft technique: weaving

Material: wood fibers

Manufacturing processes:

-Forming: fibers: weaving

-Joining: natural integrated: weaving

-Finishing: dye.

Second Phase

In this phase the elements were 20 different fiber basket examples. They all belonged to the fifth group of craft techniques: weaving. The attributes were associated with the craft fabrication technique. The crafts or artifacts sample chosen provided data on: diversity of shapes, materials, and manufacturing processes to be listed in the profile of the second phase. All of these craft examples were drawn in gestures. The gestures were represented with points and lines. The lines describe the shapes of the fiber baskets. The points were located describing the intersections of lines.

Seven basket examples were chosen for the next phase, the criterion for the choice of these baskets was the shape. All of the 20 basket examples presented similar characteristics in materials and construction method, but those seven had more remarkable distinctions in their shapes. The natural fibers used as materials to build these

baskets were: Mimbre, Carrizo, Coconut, Bejuco, Bamboo, and Tule. Following are the profiles collected from the seven fiber baskets (Figure 11).

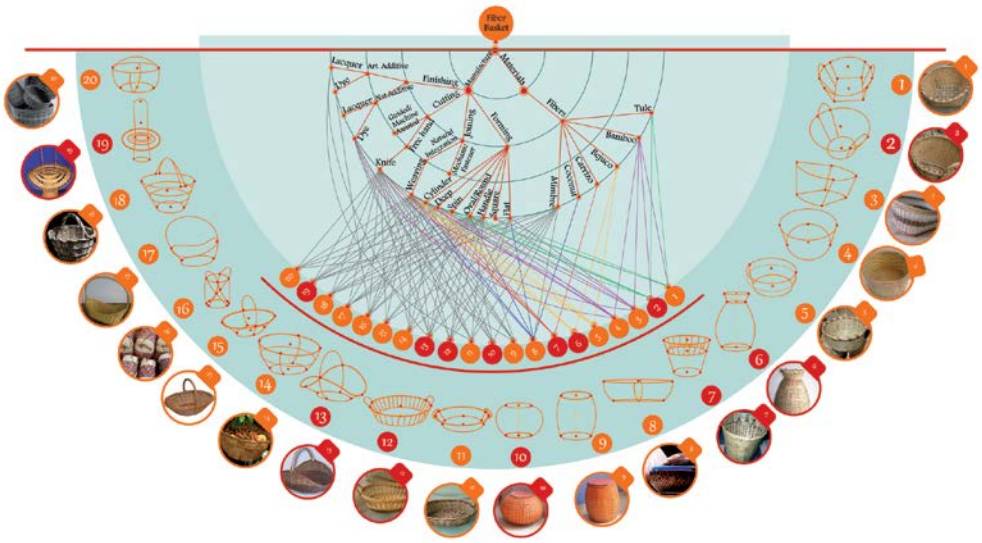

Figure 11. Second Phase of Graphic Matrix.

Profile Basket #2

Materials: tule and bamboo.

Manufacturing process:

-Forming: cylinder, deep, oval/round

-Joining: natural integration: weaving

-Cutting: free hand: knife

Profile Basket #6

Materials: bejuco.

Manufacturing process:

-Forming: cylinder, deep

-Joining: natural integration: weaving

-Cutting: free hand: knife

Profile Basket #7

Materials: carrizo.

Manufacturing process:

-Forming: cylinder, deep

-Joining: natural integration: weaving

-Cutting: free hand: knife

Profile Basket #10

Materials: mimbre.

Manufacturing process:

-Forming: oval/round, deep

-Joining: natural integration: weaving

-Cutting: free hand: knife

-Finishing: natural additive: dye

Profile Basket #12

Materials: mimbre.

Manufacturing process:

-Forming: oval/round, flat, with handle

-Joining: natural integration: weaving

-Cutting: free hand: knife

Profile Basket #13

Materials: mimbre.

Manufacturing process:

-Forming: oval/round, flat, and spin

-Joining: natural integration: weaving

-Cutting: free hand: knife

-Finishing: artificial additive: lacquer, natural additive: dye

Profile Basket #19

Materials: mimbre.

Manufacturing process:

-Forming: oval/round, with handle, deep, cylinder

-Joining: natural integration: weaving

-Cutting: free hand: knife

Third Phase

In this phase, the elements were the seven fiber baskets chosen in the second phase. The attributes in this phase were a combination of principles of design, elements of design, and manufacturing processes. I combined and grouped principles and elements with one of the manufacturing processes for the purpose of associating design and fabrication criteria that provided information for the next phase; a principle and elements of design chart, and a profile.

After exploring these relationships, I placed a question mark at the point when the Graphic Matrix ends. This represents that, at this point, I only had information related to the fabrication processes of the craft examples (Figure 12).

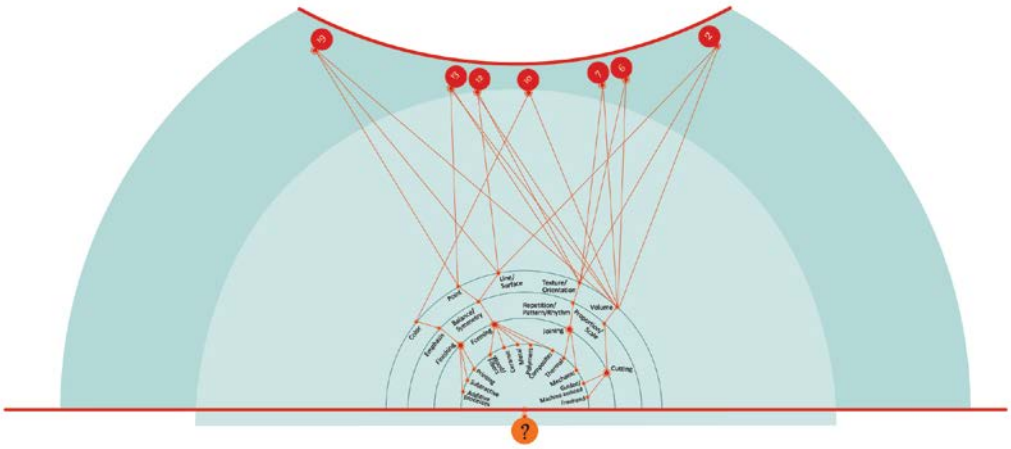

Figure 12. Third Phase of Graphic Matrix.

Elements of Design Combinations

Point: most of the weaving baskets are built around a center point; the gestures express the main points, axis, and crossing points in order to link shapes with lines.

Line/Shape: these two elements have been grouped, the guidance to create the shapes is based on the location of the points, and lines were drawn through the points to better understand the baskets.

Texture/volume: visual and tactile forms give information to understand volume. The texture is generated by the weaving; and the technique of it would depend on the type of fiber used.

Color: Most of the baskets were left with the natural color of the fiber and a finish of lacquer was applied. In some other cases, the fibers were dyed in pigments that could be natural or artificial. The colors applied helped to create the volume; by using several lines and combinations of colors, craftsmen created patterns in geometrical motifs.

Principles of Design Combinations

Balance/ symmetry: It is created when the whole element is visually divided by halves; most of these weaving baskets were built around a center point, as if an imaginary line were traced vertically in the middle. Each basket provided different information about shapes. If an imaginary line were drawn in the center horizontally most of the basket examples presented similarities in the lower half, such as a flat surface where the entire element sits.

Proportion/Scale: When comparing all the baskets; the relation of their parts within the whole, provided an understanding of how baskets were configured, and how many of them could be integrated into their shapes, so that, there are some baskets tall and rounded, and some others flat and rectilinear. One element that they all shared in common was geometry. Their configuration based in geometrical shapes allowed me to organize them into groups. The geometrical volumes more commonly represented were the cylinder and inverted cone, and the introduction of curve or twisted lines gave the impression of spherical portions in some cases.

Repetition/Pattern: the weaving technique for these baskets consisted of interlocking natural fibers, in which a pattern was created using two or more lines of fibers. The design created depended not only on the amount of weaving lines but on the colors or shapes the crafts people wanted to create. The creation of these patterns varied, and depended on the type of fiber. In some cases one, or several lines, were skipped in horizontal or vertical ways to create them.

Rhythm: It was created with lines; they could be organized by colors in the patterns or derive from the structure of the baskets when they represented rectilinear shapes. In some cases the rhythm was easy to be notice because of the spaces left in the weaving, in others, by the amounts of line woven.

Fourth and Final Phase

I drew a chart with the principles and elements were drawn. This chart assisted with important decisions for the next step: the design process. Patterns, points, lines,

surfaces, and volumes of each of the seven craft examples analyzed in the previous two phases were organized in the chart (Figure 13).

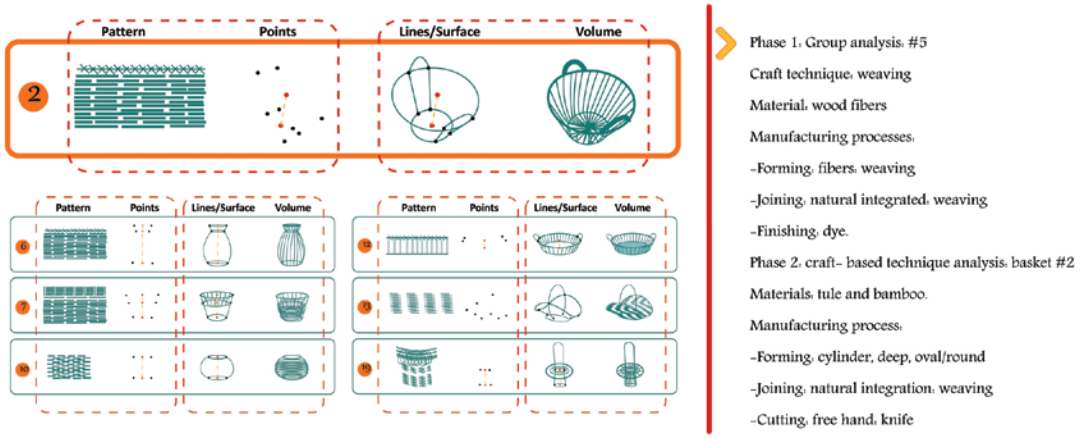

Figure 13. Fourth Phase of Graphic Matrix.

Parallel to this chart, a profile lists the characteristics extracted from the entire Graphic Matrix. This list shows the materials, manufacturing processes and craft-based techniques of the craft example that were taken to start the process of design. The intent was to develop all seven fiber basket profiles and to take them to the next step of the design process. However, I continued with only one of the fiber basket examples because of the complexity of the development process. The fiber basket #2 served as inspiration for the vessels and light fixtures developed.

Phase 1: Group analysis: #5

Craft technique: weaving

Material: wood fibers

Manufacturing processes:

-Forming: fibers: weaving

-Joining: natural integrated: weaving

-Finishing: dye.

Phase 2: craft- based technique analysis: basket #2

Materials: tule and bamboo.

Manufacturing process:

-Forming: cylinder, deep, oval/round

-Joining: natural integration: weaving

-Cutting: free hand: knife

Design Process

The design process, revisions, and evaluations of the products were influenced by the Graphic Matrix, graphic system profile, and chart because they served as a system for design and constituted the fundamental concepts and solid research for each of the products developed.

The Graphic Matrix served as a tool for design and to unite both methods of fabrication, craft-based and industrial. The process of hierarchical decomposition allowed a process of neutralization. This neutralization consisted in the pure decomposition of shapes into points. I took the shapes out of the gestures created in the second phase and later re-located in the chart with the principles and elements of design.

When analyzing the points in the gestures, I observed that the perspective of the object was arbitrary because the gesture served as a drawing of the basket craft example.

This not only denoted a flat representation of the craft example but made it impersonal to my research because I was not able to handle the object. The solution to this was to locate the points of the gesture in virtual space. In this manner, I was able to manipulate the points as needed to create a new shape. In this moment of re-location of points into the virtual space, the neutralization process acquired personality, and with it, identity. Because of this, I would make decisions based on my experience as a designer from El Salvador.

The object was then analyzed in virtual space. This was possible by encoding each of the points in a system of orthogonal projections. Each of the points represented a coordinate with axis Height (z), Width (x) and Length (y). The points were drawn in Rhinoceros software. The Graphic Matrix introduced the concept of decomposition of units to a whole, I wanted to take that concept into the design process. I designed units that, after being analyzed, created a whole object.

In order to achieve the units, when all the points were located in the software, a screen capture of the points in an isometric position was taken. These 30° angles now represented a constant. The points were then translated into a 30° net to visualize the shape that would now be part of the unit. This unit was achieved by linking all the points to generate a perimeter. The commands of the software and the application of principles of design - such as balance, symmetry, proportion, repetition and rotation - helping to create a unit complex enough to be analyzed (Figure 14).

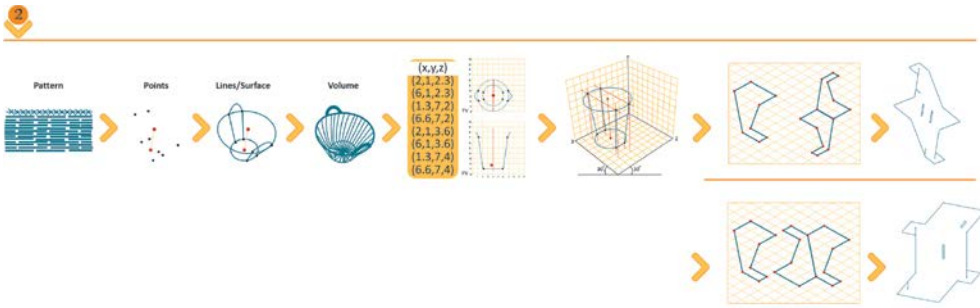

Figure 14. Creation of the Unit for Basket Example #2.

At this point of the process the shape itself would not create the object. I had in mind the craft example of the fiber basket #2 and the craft-based technique of weaving. To complete this analysis from the starting point to the end point of the creation of the product, I contemplated the shapes, function, and construction of the woven basket to design a product with similar characteristics. For this, I would create vessels as an analogy of the baskets. With this intention, the analysis of the production led to the creation of light fixtures under the lens of a conceptual basket that will provide light.

I did a material exploration parallel to the development of the body of work in this thesis was done in Materials and Methodologies Seminar, IAR 565. In this class, I had the opportunity to experiment with the polymer, polystyrene. I tested the material with the purpose of learning digital manufacturing processes such as forming (bends with heat guns and heat lines) and thermal cutting (laser cutter). The thickness of the material I tested were 20 grams, 40 grams, 1/16 of an inch, and 1/8 of an inch. These experiments demonstrated that the use of polystyrene could be successful for the production of the prototypes of this thesis.

Precedent Study in Design Field

Having the polystyrene and the concept of generating an object from two dimensions to three dimensions, I did a search for design precedents in the field. These precedents and the study of the craft-base technique of the woven basket example influenced the final product.

1. David Trubridge

David Trubridge Design is an internationally renowned company that designs and manufactures lighting and furniture. It is based in New Zealand. He offers a contemporary and natural flavor of the South Pacific. His design is very environmentally conscious. Some of their general practices include:

-A timber is from sustainably managed plantations, no rainforest timber.

-A pieces are designed to use the minimum amount of material.

-Wood is left natural where possible.

-When plastic is used - it can be easily separated out and recycled under the cradle-to-cradle ethic.

-Many designs are packed flat and kitset for easy and low energy shipping.

-All waste from the factory is sorted and sent to separate recycling facilities. (Figure 15).

Figure 15. David Trubridge Flat-Pack Light Fixture (http://www.davidtrubridge.com).

2. dform

dform products (Figure 16) explore the relation of flat sheet materials to textural and sculptural forms. The resulting lighting and screens are characterized by their three dimensional surfaces of pattern and shadow. In addition, further exploration of the potential of the products is done by developing unique forms and patterns. In 2001 dform was founded by designer James Dieter. All of the products are domestically manufactured and hand assembled in the company's Brooklyn, NY studio.

Figure 16. dform Light Fixtures (www.dformdesign.com).

Example Study in Cultural Industry

Figure 17. Example of Woven Basket Craft-Technique.

Production Statement

The study of the shape led to the development of two different units. Each of these units was analyzed separately with the purpose of creating two different products. Several pieces of these units were laser cut from polystyrene. The initial material size for these prototypes was 2x4 feet and 20 grams polystyrene. The laser cutter allowed precision in the cuts and a fast method to reproduce the shapes. The file was created in Rhinoceros 4.0; the layout of the pieces was for the purpose of maximizing the material and reducing waste.

The analysis of the pieces consisted in applying the craft-based technique concepts to the development of a volume that would replicate the logic of construction of the craft. For this, the pieces have to be linked together without the use of mechanical fasteners.

During this process, modifications to the units were needed in order to achieve the weaving process of the craft-based technique. The pieces were rotated, curved, scored, intersected, bent, and cut across until they created a logical way to connect the parts to create the entire object. The profile of the fiber basket #2 demonstrated that cylinder, deep, and oval/round were the predominant shapes of the craft example. Taking this as parameter, the following are the volumes created with both units.

Figure 18. Vessel and Light Fixture 1.

Figure 19. Vessel and Light Fixture 2.

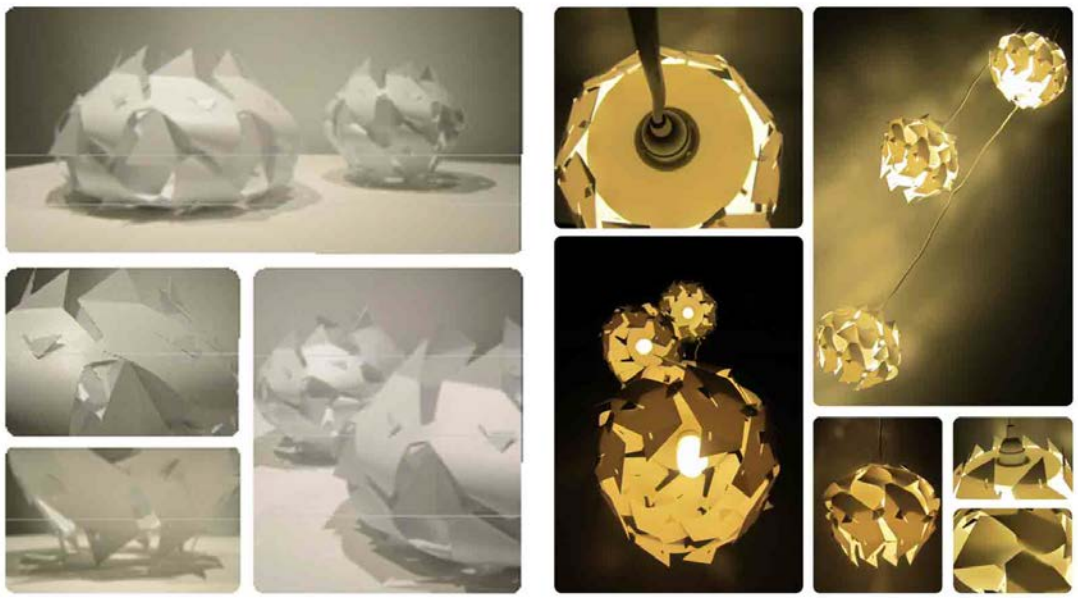

Figure 20. Vessel and Light Fixture 3.

It was important to take the time to review and evaluate the design process because it provided smoothness to the shapes and the sense of the weaving craft-based technique.

The use of the UNCG facilities and equipment helped to fabricate all full scale prototypes. The main tool used at CAMstudio was the laser cutter. To assemble these products the pieces were interlocked without the use of fasteners. For the light fixtures an extra piece was designed as a connection to the electrical cord and socket. The sockets used standard size E26 bulbs. This configuration allows the light fixtures to be suspended from the ceiling.

Vessels and light fixture construction, cost, and its target consumer may vary depending on the material chosen. These products were created with the purpose of testing the system of design. Polystyrene was chosen as an alternative material to prototype them. I am doing further experiments to test other materials and its relation to marketing strategies.

Design Thesis Exploration

The products developed in the thesis were exhibited at the Gatewood Studio Arts Building Lobby. The duration of the exhibit was expected to be for one week but, thanks to the response from observers, the exhibit stayed for another week. The opening was February 25th 2012. Professors, faculty, students, and friends attended the event (Please see Appendix C the poster for the opening, invitations to the event and boards with graphics displayed in the exhibit). During this time the exhibit called the attention of the UNCG press (Please see Appendix D articles and news inside our campus).

The design production for the exhibit was digitally fabricated as well. The use of pylon walls, modules (platforms), and lobby space owned by the Department of Interior Architecture were the initial input for the space planning.

The shape of the space was taken from previous graphics developed for the thesis cover with the intention of having unity between the document and the exhibit. The space was measured and a file was created with the dimensions and object distribution. The products presented were: 10 light fixtures, 3 vessels, and 3 cardboard stools.

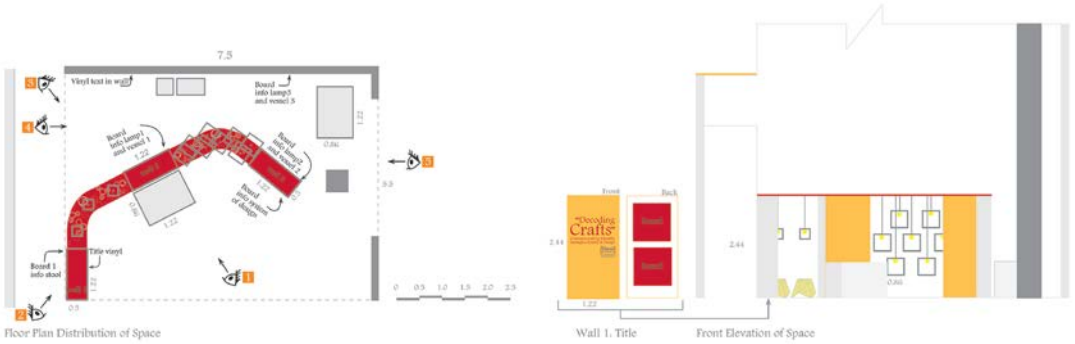

Figure 21. Space Planning Sight View and Elevation.
The numbers represent the pictures located in the next figure.

Figure 22. Space Planning Pictures.
The numbers represent the eyes located in the previous figure.

Figure 23. Location of the Product Exploration of this Thesis.

CHAPTER V

CONCLUSIONS

The review of literature of semiotics developed by Ferdinand de Saussure, the concepts of hierarchy and abstract organizational structures developed by Christopher Alexander, and the definition of systems and its properties by Michael Pidwirny provided a foundation for further understanding of the development of the systems of design. To develop this understanding, the system of design was expressed through a Graphic Matrix. The purpose of the Graphic Matrix was to decompose the elements of craft examples from El Salvador to create vessels and light fixtures using digital fabrication technology. Feedback from industry experts, faculty, and classmates served to validate the design process and products.

The Graphic Matrix outlined in this thesis provides a visual approach to understanding design as a vehicle for the communication of ideas. This understanding helped me to address the primary research question: How can the use of digital technology become an aid for designing products that communicate identity or a sense of craft-based technique?

Evaluations

The Graphic Matrix grouped information by elements, attributes, and relationships. The hierarchy of information helped to organize and visualize efficiently all

the phases of decomposition. The craft examples from El Salvador went through all the phases in order to extract characteristics to be incorporated in the new product.

The process of design starts parallel to the research because it combines all the concepts of the theories presented in the review of literature with the information presented in the Graphic Matrix.

In the first phase, the profiles extracted from each of the groups provided specific relations with materials, manufacturing processes, and craft-based techniques. Those relations helped me to understand the type of forms, joins, cuts, and finishes that each of the groups were able to take in manufacturing operations.

In the second and third phases, the craft examples went through a transformation process; each of the phases was analyzed as gestures (points and lines). The approach of visualization of the craft changed because then they were encoded to specific coordinates and re-drawn in Rhinoceros software (virtual space). This process allowed me to combine principles and elements of design with Computer Aided Design (CAD).

The Graphic Matrix gave me the opportunity to show the logic of the processes in a visual context. The use of the chart of patterns, points, lines/surfaces, and volumes served as a reference when re-evaluating the designs of the vessels and light fixtures.

The goal of combining both, old and new, manufacturing technologies was reached by the use of the Graphic Matrix. It served as a tool that described the logic of processes and the information to introduce when using digital fabrication as media to produce the vessels and lighting fixtures.

The use of the CAD software, such as Rhinoceros, helped facilitate the production of the vessels and light fixtures. It provided files that were used on computer aided manufacturing (CAM) technology, such as laser cutter. Without both of CAD and CAM the reproduction of the shape units to cut would not have been fast and precise. Learning Rhinoceros software and the way to format the files for laser cutting and Computer Numeric Controlled shaping (CNC) was important in the production stage of the products and the thesis exhibit. It gave me a better understanding of the communication between software and machines, and the behavior of the machines when the files are not formatted correctly.

I learned that the setting that each machine in CAM is different because their purposes are specific for what they do. For instance, in laser cutting, the speed and power configuration can provide different results when applied to different materials. I had a better understanding of this after all the tests done in cardboard, cardstock, veneer, balsa wood, and polystyrene of 1/16", 1/8", 40 grams, and 20 grams. Also, the use of the Rhino guide to setting up a laser file, found at the Interior Architecture Department website gave me valuable information on cut lines, layout areas, line sharing, sharp corners, and the adjust for kerf to use when creating the files and during the modifications of the shapes in the design process.

The thickness of the materials influences on the product stability. Because the vessels and light fixtures were designed under the lens of the craft-based technique of weaving, the pieces do not use any type of fastener to connect between them. If the object is scaled up, the material used should be scaled up in thickness. For instance, when

experimenting, I scaled up one of the light fixtures, and left the same thickness of 20 grams polystyrene material, the entire object was so flexible that the shape would need an internal structure to keep it from coming apart. Please see light fixture behavior in figure 24 and 25.

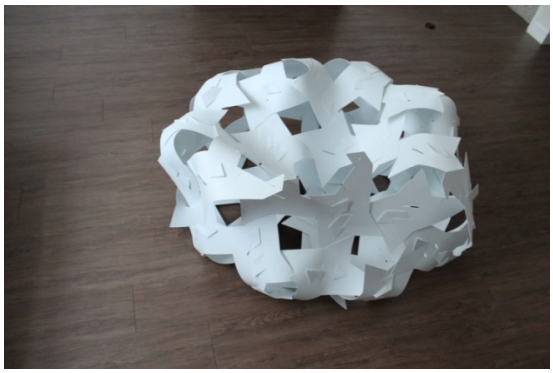

Figure 24. Light Fixture Scaled Up to Double Size of the Original without an Internal Structure.

Figure 25. Light Fixture Scaled Up to Double Size of the Original with a Stool as Internal Structure.

Another important lesson learned was related to the ventilation of the space and the machinery. Depending on the material to cut, it is important to consider the type of fumes or waste that the machine is going to produce. For instance, when using the CNC

machine, I had the opportunity to cut ½ and ¾ MDF wood for the thesis exhibit exploration. The waste of material was calculated, and the boards were laid out to maximize the use of it but, during the cutting process, the material produced a lot of dust in the environment even though vacuums were connected to the router arm when cutting.

Another example of this was when using the laser cutter. Since it is a thermo cut that involves high temperatures, some materials would burn on the edges. This produced smoke or fumes inside the chamber of the machine. An adaptation of a vacuum pump controlled by a compressor helped this situation. It would suck the air from the chamber and drive it to a ventilation system outside the facility.

The above mentioned, helped me to gain experience in manufacturing processes with computer aided technologies. It is important to reflect on the experiments and prototypes created during this study because it provides me with a broader picture on how to manufacture products in a small scale, the production time involved, and the behavior of materials before and after the manufacturing process.

Future of the Research

The system of design allows the development of products by extracting characteristics from Salvadorian craft example of woven baskets. This fact makes the study very specific to a culture and a craft-based technique. The use of the Graphic Matrix in other contexts could allow other types of decomposition of examples that would enable the creation of products with a different approach for the design process.

Revisions of the Graphic Matrix related to the format have been done after attending and presenting the light fixtures at the 2013 IDEC South Regional Conference.

Feedback from faculty and experts in the industry has suggested looking for and contacting organizations such as World Market and Ten Thousand Villages to introduce the products to the market. A parallel study of marketing is currently being done as future consideration to place the products in the marketplace. As a starting point, I have listed features of my products and benefits and value of those benefits (Table 1).

Table 1. List Presenting Features and Benefits of Vessels and Light Fixtures.

Features	**Benefits**	**Value of those benefits**
Design based on El Salvador's cultural artifact (craft)	Provides the product characteristics of El Salvador culture	Provides the customer interest of the sense of belonging to a place
Possibility of flat pack and RTA	Provides small packages or kit sets that can be assembled by the customer	Volume at the time of transporting or shipping is less, directly affecting production costs
Kit in boxes with instructions	Provides the customer with all the parts to assemble the product	Customer gets involved in the process of production
Story behind the production	Provides the product with a strong concept and image	People feel more confident in buying the products and will trust in the brand as part of the whole image sale
Colors and materials	Provides the product with unity and the selection of colors and materials are done as part of the design concept	People will recognize the culture by the colors (and maybe the brand) and the materials will help them understand better the objects.
Function: Sit (stools), Illumine (Lights), Sculpture (Vessels)	Provides the customer with a satisfaction of a want or a need	People will not only use the objects for its function but will look at them for the design.
Shapes and design	Provides the product with structure, no need of mechanical fasteners to hold the pieces	No need for tools to assemble the product in hands of the customer

During the semester of fall 2013, interviews with experts and businessman in the field of design allowed me to research the initial steps to create a sales plan. Following, a

list of questions that needs to be addressed in the near future in order to promote the products developed in this thesis (Zimmerer & Scarborough, 2011).

1-Define market (as accurately as possible)

- Who are my current customers?
- Why do they buy from me?
- What common characteristics and interest do they share?

2- Look at the competitor targeting

- Who are their current customers?

3- Specific Demographic

- Who is most likely to buy my products?
- Age
- Location
- Gender
- Income level
- Education level
- Marital or family status
- Occupation
- Ethnic background

4- Psychographics of target

- Personality
- Attitudes
- Values

- Interests/hobbies
- Lifestyles
- Behavior

5- Evaluate my decisions

- Are there enough people that fit my criteria?
- Will my target benefit from my products?
- Can they afford my products?
- Can they reach me with my message?

6- Sales goals

7- Sales tactics

8- Target: how to reach them?

9-Timeline

I took two companies as precedent study, IKEA and TARGET, both of them which have defined their market and segmentation strategies. IKEA's target customers prize the value of the product and are willing to spend their own time in order to save money ("Ikea is so good at so many things. Why is it so bad at delivery? - DailyHerald.com," n.d.). A person who buys at IKEA takes the products from the warehouse and assembles the items themselves. Part of this segmentation strategy is to allow customers to test their products and spend time in their stores.

Target shoppers have a median age of 46, the youngest among major retailers. The median household income of a Target guest is $55,000. It is marketed for everyone (lower to upper class). Target guests are thoughtful about how they spend and where they

shop. They know that any retailer can match price, but what about value? Target guests strive to make the most of their time and money by recognizing the difference between price and the more enduring concept of value ("Target's Unique Guests | Target Corporate," n.d.).

As a first step to further develop a financial plan and pricing strategy, I need to become familiar with the following definitions.

Financial Plan

Logical financial plans are the most important step when launching a new business. If this strategy for earning a profit is not developed the business can fail (plan for profits). Balance Sheet, Income Statement, and Statement of cash flows are the basic financial reports to measure a company's financial position.

Balance Sheet: is a snapshot of the business's financial position. It is built on the fundamental accounting equation: Assets= Liabilities + Owner's equity (Zimmerer & Scarborough, 2011).

Assets: valued at cost, not actual market value. It shows the total value of everything the business owns. (Cash and items to be converted in cash) (Zimmerer & Scarborough, 2011).

Liabilities: debts that must be paid within a year or within the normal operating cycle of the company, whichever is longer (Zimmerer & Scarborough, 2011).

Owner's equity: the value of the owner's investment in the business (Zimmerer & Scarborough, 2011).

The Income Statement: called as well as Profit and loss statement, or P&L. It is a moving picture of a firm's profitability over time. To calculate net profit or lost an entrepreneur records sales revenues for the year including all income that flows into the business from sales of goods and services (Zimmerer & Scarborough, 2011).

Operating expenses: are all those costs that contribute directly to the manufacture and distribution of goods (Marketing promotion) (Zimmerer & Scarborough, 2011).

The Statement of cash flows: It shows the changes in the firm's working capital from the beginning of the year by listing both the sources and the user of those funds (Zimmerer & Scarborough, 2011).

Pricing Strategy

Art and Science determine prices (Zimmerer & Scarborough, 2011). Setting prices is a balance of complex and often opposing forces. Prices produce profits. It is an important factor in building long term relationships with customers, and arbitrary pricing techniques can confuse and alienate customers and endanger the profits of smalls business. Pricing influences everything, from marketing and sales efforts to its operations and strategy. The price of a product is a sign of the service or goods' value to an individual, and customers assign this value differently to the same services or goods. Price collects into three potent forces: Image, Competition, and value (Zimmerer & Scarborough, 2011).

Image: customers look at prices to determinate what type of stores they are dealing with. Having high prices usually conveys in the idea of quality, prestige, and

uniqueness to customers. The price of products should be compatible with what customers expect and are willing to pay. Small business owners sometimes underprice their goods and services, believing that low prices are the only way they can achieve a competitive advantage. Lowering prices may be a dangerous cycle that can destroy a business. Rafi Mohamed, author of "The art of pricing", found that those companies that raised prices by 1% saw their profits increase 11%. Those that raised their prices by 10% realized profits increase of 100% (Zimmerer & Scarborough, 2011).

Competition: prices are an important factor but it should not automatically match or beat the competitors. Price is not the only consideration customers do when shopping. There are three policies to study the effects of the competition on the small company's pricing:

1-The location of the competitors

2- The competing goods and services

3-The nature of the competitors' goods and services (Zimmerer & Scarborough, 2011).

Value: The right price of the product will depend on the value that it provides for a customer. There are two aspects of value:

1-recognize the objective value of their products and services (price that the customer will be willing to pay once they understand complete all the benefits that the product provides to them)

2-the perceived value, which is the value the customer is willing to pay for the product. For shoppers three are the references points that define fair prices:

1-The price they have paid for the product in the past

2-The price that competitors charge for similar product

3-The cost the company incurs to produce the product (Zimmerer & Scarborough, 2011).

Pricing Concepts for Manufacturers

The most commonly used pricing technique used by manufacturers is cost plus pricing. It establishes a price that is composed of direct materials, direct labor, factory overhead, selling and administrative costs, plus the desired profit margin (Zimmerer & Scarborough, 2011).

Direct Costing and Price Formulation

Reliable cost accounting is required to determine the cost of processing raw materials into finished goods. To discover the combination of selling price and sales volume that covers the variable costs and earning a profit is a goal manufacturers establish, the starting point is the direct cost income statement (Zimmerer & Scarborough, 2011).

Income Statement

Sales Revenue	$---	= (Gross profit + Cost of Goods Sold)
Cost of goods sold		
Materials	$---	
Direct Labor	$---	
Factory Overhead	$---	= (The sum of the 3 previous amounts)
Gross Profit	$---	

Operating expenses

General and administrative	$---
Selling	$---
Other	$---
Total operating expenses	$--- (The sum of the 3 previous amounts)

Net Income before taxes $--- (the subtraction of gross profit minus operating expenses) (Zimmerer & Scarborough, 2011).

As an exercise of the previous concepts I participated in a competition sponsored by Phillips Collection, Inc. at the Center for Visual Artists (CVA) in downtown Greensboro. The products that I presented were two light fixtures with a similar concept and design process. These light fixtures were designed during the past summer in an internship done with the Interior Architecture Department and the Solar Decathlon - Canopy House Project. The feedback from the sponsors of the competition was related to cost of the production and the material of the light fixtures. After the competition, I had the opportunity to interview Jason Phillips, VP of the Phillips Collection, Inc. During the interview, Jason explained me about their company and marketing strategies. We were mainly talking about the relation of the concept of a company with the objects that they sell in their collections. He was putting as example the contrast between their company (Phillips Collection, Inc.) and Target. We also talked about the meaning behind the product and its significance. He remarked that the sense of detail is important, that in my case, I need to work with the technology and transmit the essence of the product with the cultural significance.

In my previous summer, 2012 I had the opportunity to do an internship with Phillips Collection, Inc. During my time with them, I learned about the office environment in a company that designs products. The training in that opportunity was more related to their company manufacturing processes and the type of materials they use to design their products. I had the opportunity as well to see the process of taking pictures for products, and how to manipulate them to present them to clients in a catalog.

The concepts mentioned above are an introduction to a marketing analysis, it is needed to research more and contact professionals related to this field of study before starting to commercialize the products. This brief study of pricing strategy and financial plan showed me the importance and need of business assistance in the near future. Considerations are done to start the process of marketing by contacting architects, light consultants, and retail stores to start promoting the products in places where the target market is already created. Also, the creation of promotional material parallel to this actions in places, such as opening a Facebook account, a website, and virtual retail places such as amazon.com, etsy.com, and ebay.com.

In addition to this brief financial and marketing study, during Fall semester of 2013 an exploration of the computer aided manufacturing 3D printing is in process. The purpose of this study is to test the generation of units using the Graphic Matrix - but with a three dimensional approach- while designing a stool. The previous study of the Graphic Matrix utilized computer aided manufacturing equipment that only uses flat sheet goods. In this new exploration, the analysis of the gesture drawings are developed in computer aided design Rhinoceros software. The analysis of points and lines is done in virtual

space with the intention of generating 3D shapes that will be produced with media where the material is supplied to the machine. Experiments of current materials available in the market are part of the test.

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APPENDIX A

COUNTRY AND CULTURE OF EL SALVADOR

El Salvador and its culture is the place used for this study. The Central American region's main influence is the Mayan Culture. Traditions in El Salvador allow people to discover the culture through folklore and legends. The culture is a mixture of Mayan, Lenca, Nahua, Ulua, and Spanish culture, which makes traditions more diverse due to the influence of all these roots. Nahualt is the dialect spoken in the region, but less than 1% of the population speaks it.

Industrialization is the process when human groups are transformed from an agrarian society into an industrial one. Social change, economic development, and technological innovation are part of a wider modernization process. It is an extensive organization of economies with the purpose of manufacturing.

An agrarian society, as in El Salvador, depends on agriculture as primary means for support. In the past, this was some of nowadays developed countries' most common form of socio-economic organization. In 2010, El Salvador ranked in the top three in Central America in terms of the Human Development Index and in the top 10 among Latin American countries; because of this, the country is experiencing a rapid industrialization (UN, 2009).

Jose R. Martinez Cobo's Study points out that indigenous people and communities, are those which consider themselves as distinct from other sectors of the societies that nowadays predominant on their territories. These communities have history in pre-invasion and pre-colonial societies that developed on their territories. They are at

the present non-dominant societies that are preserving, developing and transmitting to future generations their ancestral territories, traditions, and ethnic identity (UN, 2009).

United Nations explain some existing attempts to outline the characteristics of indigenous people, but clarifies that the international community has not adopted a definition yet.

The International Labour Organization, ILO, an specialized agency of the United Nations, in its indigenous and Tribal peoples convention, 1989 (No. 169) defines indigenous people as tribal peoples whose social, cultural and economic conditions distinguish them from other sections of the national community, and whose status is regulated wholly or partially by their own customs or traditions or by special laws or regulations.

People who are regarded as indigenous on account of their descent from the populations which inhabited the country, or a geographical region to which the country belongs, at the time of conquest or colonization or the establishment of present State boundaries and who, irrespective of their legal status, retain some or all of their own social, economic, cultural and political institutions.

The term first nations (most used in plural form), was defined by Assembly of First Nations (AFN) and has come into general use for the indigenous people of the Americas, which are all the pre-Columbian inhabitants of North and South America and their descendants.

UNESCO define artisanal products like those produced by artisans, either completely by hand, or with the help of hand tools or even mechanical means, as long as

the direct manual contribution of the artisan remains the most substantial component of the finished product. These are produced without restriction in terms of quantity and using raw materials from sustainable resources ("UNESCO and Indigenous Peoples: Partnership for Cultural Diversity : UNESCO-CULTURE," n.d.).

APPENDIX B

CASE STUDY

These cases provide a reference to my system of design and constitute a comprehensive analysis of an individual unit that emphasizes on elements that inform the development of a design process and a final product.

Case 1: Cultural Product or Mass Souvenir

Author: Giulio Vinaccia (Spain)

This case shows the elaboration of a graphic system of iconographies. This study consists of visiting a cultural place and take pictures of cultural references. Then, a selection of pictures is done in order to simplify them into icons. The final step is to apply them into different products such as textiles, shaped iron, jewelry, wood among others.

Figure 26. Giulio Vinaccia, Producto Cultural o Suvenir Masivo. Project Presented at the Third International Conference on Tourism and Handicraft, Peru: MICETUR.

Case 2: Campana Brothers and the History of the Brazilian Market

The Brazilian furniture industry has become the main producer and exporter in Latin American. This success responds to several historical events that Brazil has had, opening the path to hold the largest trade fair in the region.

Historical styles were imported from Europe, primarily from Portugal, during its colonization. Some events that strongly influenced the economy in Brazil were the sugar economy of the great plantations of Bahia and the Northeast, the discovery of gold and precious stones in the 18th century, the independence of Emperor Pedro I in 1822, and the age of coffee.

The furniture segments that this industry produces are: upholstery, living room, dining room, office, bedroom, modular furniture, and mattresses among others. The main markets are found in Lisbon, Sao Paulo, Rio de Janeiro, New York, and London. Paris, San Francisco and Los Angeles are growing markets.

Brazil in the 21st century has both, traditional and foreign companies, as part of this industry; all trendy pieces are a mix of modern and traditional styles. Manual labor force characterized them. Abimóvel, is the Brazilian Association of Furniture Industries, they have compiled some data about the forest, wood line productive, and furniture of Brazil. Sixty-five percent of its territory is forest, whereas 2/3 of it corresponds to the Amazonian forest.

Abimóvel reports that the Brazilian furniture industry has been formed in its majority by more than 16,398 domestic capital companies that includes small, medium

and large. These companies, mainly located in the center-south zone of the country, by 2005 had generated more than 208,584 jobs.

According to the International Monetary Fund and the World Bank, Brazil is the largest national economy in Latin America, one of a group of four emerging economies called the BRIC countries, and the world's sixth largest economy at market exchange rates.

Mr. Valcidio Perotti, President-Director of Alternativa Editorial Ltda., which is a publishing house that manages web portals and magazines related to the Brazilian furniture industry, states that Brazil has a very strong furniture manufacturing industry, structured and organized, supplying not only Latin American countries, but serving as a reference to them in the furniture market.

Historically the largest market of Brazilian furniture has been the United States, but during this latest period of worldwide crisis, Argentina has exceeded that demand. In 2010 China became not only a commercial partner of Brazil, but a strong investor in the Brazilian furniture market as well.

Paulo Mendes da Rocha, Architect, says that "The Object is a story about us." This concept can be extended and say that it is also a story about their time.

Maria Helena Estrada, journalist and curator of Brazilian Design, explains that there are two important moments in the Brazilian design history. The first one was during the 50's, when concrete and glass architecture began to increase in Brazil. Designers and architects took inspiration for furniture design, complimenting those modern spaces. The second one was a long silence that lasted for the 20 years of Brazilian military

dictatorship. During this period, unexplored Brazilian values were reborn, returning to traditions, and crafts are transported into a contemporary language. There is an exploration of a new language, despite the international design done with technological or market resources.

Fernando and Humberto Campana started their studio in 1983. The research of different kind of materials, giving preciousness to poor, day-to-day or common materials is their main focus. Their Brazilian roots are expressed in the creativity that has transformed their studio in an investigatory laboratory. Their influence and inspiration are based on rescue elements of their culture that have been left aside (Fiell & Fiell, 2007).

For example, Transplastic collection tells a fictional story, in a world made of plastic and synthetic matter, evoking transgenic creations by overlapping natural fibers and plastic.

This is a clear example of several concepts that the Campana brothers have developed over time. They have taken advantage of the elasticity of natural fiber. As a starting point, plastic chairs alter the original form. The pieces follow an organic dimension, adding value and comfort to the materials. All the pieces are handcrafted with the typical Brazilian material "apuí", called "mimbre" in El Salvador.

Fernando and Humberto Campana, design caring not only about creativity, but caring about expressing Brazilian social characteristics and the country where they are from.

Figure 27. Campana Brothers, Transplactic Collection:
Una Faiglia, Plastic and Wicker Chairs.

APPENDIX C

GRAPHICS FOR THE EVENT: THESIS DESIGN EXPLORATION

Figure 28. Board 1- Design Thesis Exploration.

Figure 29. Board 2- Design Thesis Exploration.

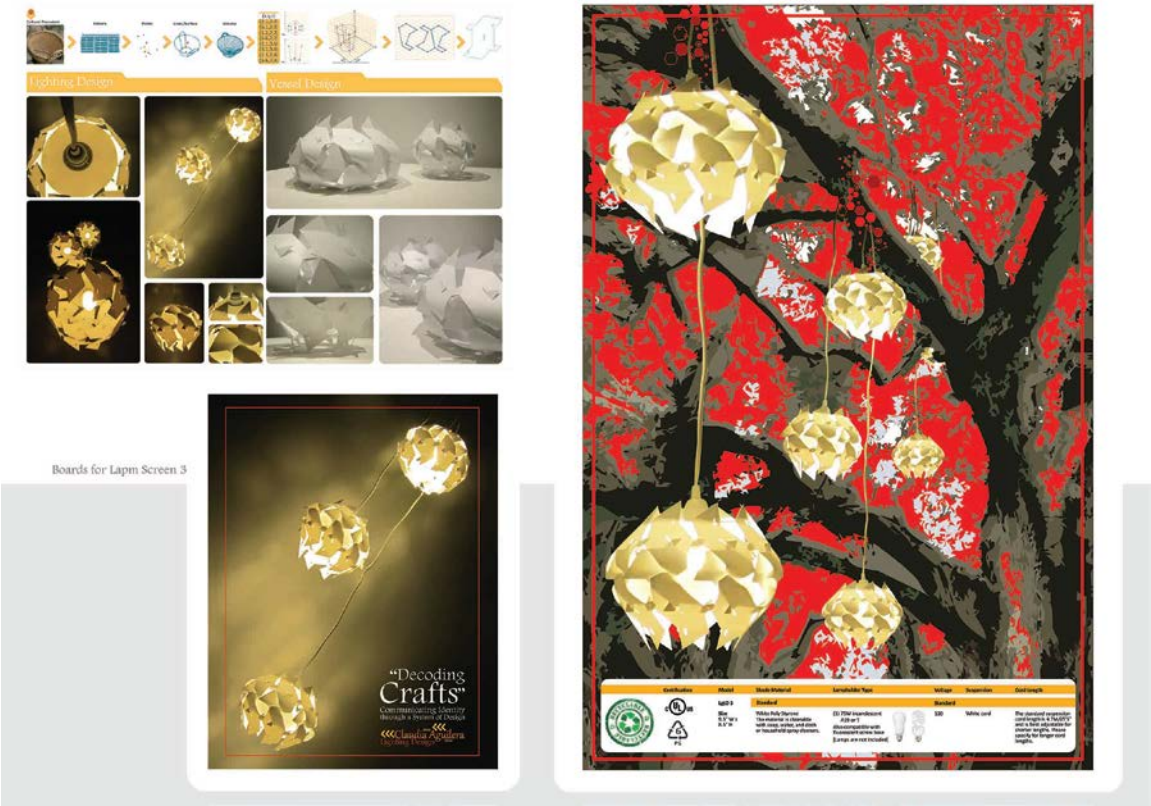

Figure 30. Board 3- Design Thesis Exploration.

Figure 31. Board 4- Design Thesis Exploration.

APPENDIX D

MEDIA COVERAGE INSIDE UNCG

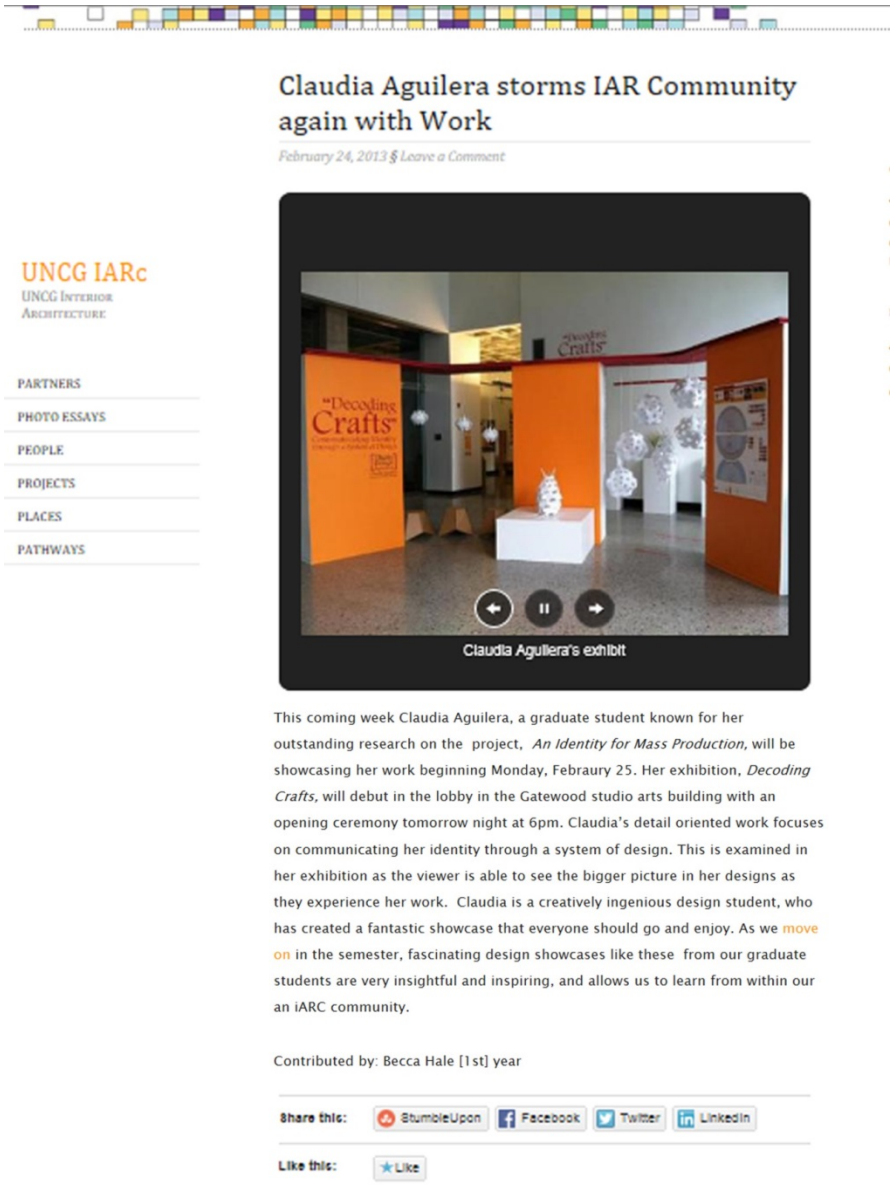

Figure 32. inews-Interior Architecture Department News Blog (http://uncgiarc.wordpress.com).

Figure 33. Campus Weekly – Online Magazine at UNCG (http://ure.uncg.edu/prod/cweekly/2013/02/26/whatadesign/).

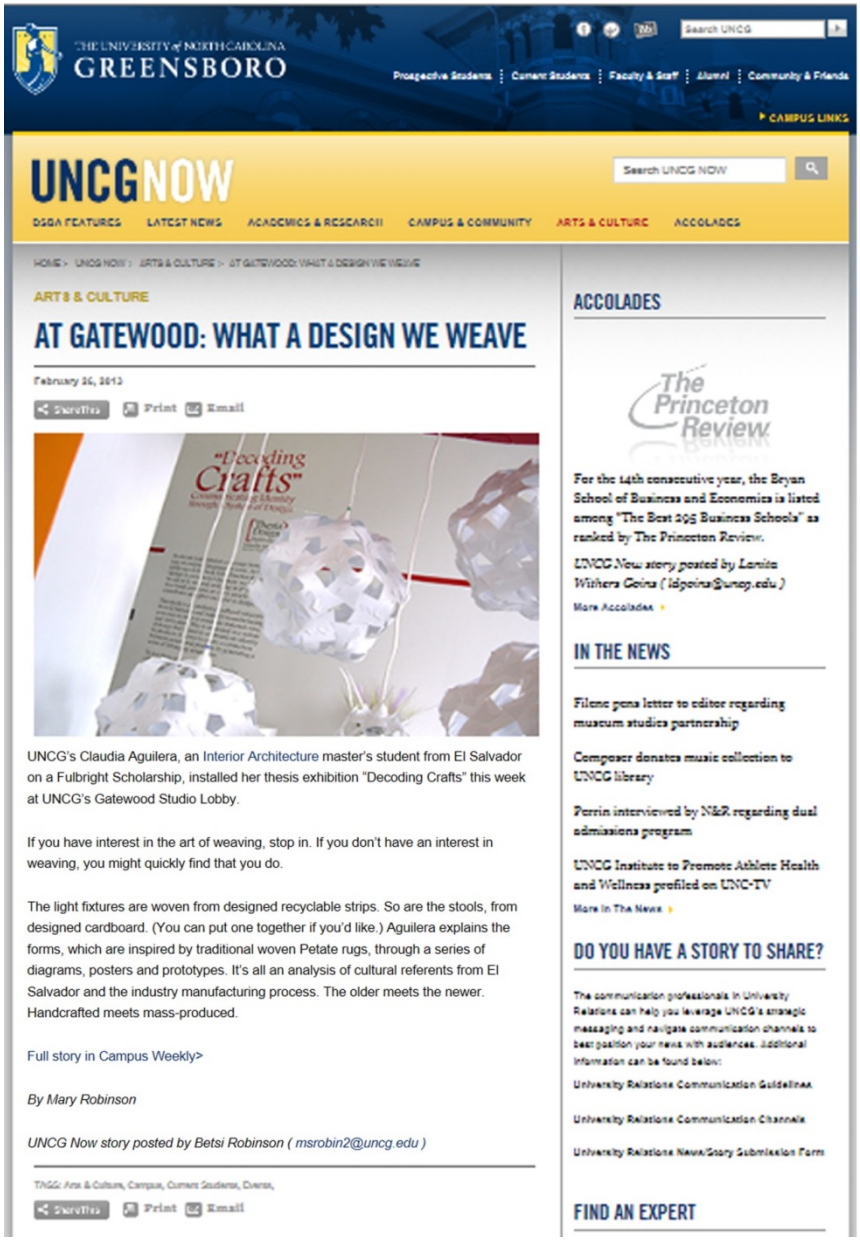

Figure 34. UNCG NOW– Online Magazine at UNCG (http://uncgnow.uncg.edu/decoding-crafts-thesis/#sthash.YrqRSc8o.dpbs).

APPENDIX E

ADDITIONAL PHOTOS