GÖTEBORGS UNIVERSITET

SILENT MACHINE

THE RESONANCE FROM THE PAST

EUN JAE LEE

School of Design and Crafts, University of Gothenburg

GOTHENBURG

2012

Degree Project, MA Program in Design, 120 hecs

Aesthetic approaches of formative features and semantic values

in the Machine Age motif

"Industrial design has a glamorous name...Design in terms of mass-production economy instead of hand craft economy."

-Gilbert Rohde (USA 1884 - 1944)

ABSTRACT

What makes an object beautiful? Can the feelings inspired by such an object be analytically defined? If so, what kind of process is needed to do so? How can the subjective interpretation of "beauty" by a designer be communicated with the public? Furthermore, how can personally reflected view coexist with an industrial designer's responsibility? These were the questions I brought out in the initial stage of research. In the present stage, I set up time and spatial background as though writing down a scenario, and explore these features. The journey to find "beauty" continues with an investigation of physical forms, illuminating immanent values, and moves toward emotional expression via design language. The story of the Machine Age began from a curiosity about aesthetics, and its meaning as one trial by reflecting the perspective of this age and then newly reinterpreting it.

The aim of this study was to explore and to define concepts through the industrial artifact-"machine" motif. Furthermore, the investigation was based on materialistic features emphasized as a core subject. As a result of the whole process, it was embodied as a form of a functional product (tea services), and used to generate a new point of view on daily life. Specific research on one industrial product and the possibility of mass production in terms of external factors such as target users, usability, and marketability were exempted from the main focus.

KEYWORDS

Machine age, aesthetics, storytelling, modernism, form, value, industrial artifacts, machine age movies, assembly

CONTENTS

1 INTRODUCTION

1.1 BACKGROUND

Telling an aesthetic

This study is ultimately defined as a journey of seeking and trying out a new vision of beauty. To explore the object of attraction, to re-illuminate it from a different angle, and to express both emotional and formative factors extracted from the search, design methods were highlighted. In this study, I use a method that involves "telling" the process, starting from the initial moment of inspiration and ending with expressive communication with the external world, rather than a purely morphological approach. This method aims to induce another "telling" from the public to invoke mutual sharing of experiences and ideas of a beauty.

The stories of the Machine Age

The background that I use for this project is the Machine Age. The advent of the machine in the nineteenth-century was to have such revolutionary significance that the subsequent years can be called the Machine Age. The period was one of experimentation and invention. Electricity-powered machines in the home and automobiles changed the shapes of cities and dwellings, radio redefined leisure, and telephones closed the distances between people.

The Machine Age emblematized wide-scale and far-reaching changes and movements in different areas. Bauhaus, Art Nouveau, De Still, and Art Deco blossomed internationally in the contemporary era, with distinct styles and cultural tendencies. The present project is rooted in these historical and cultural backgrounds in some ways, but will not follow in their wake. Rather, it mainly focuses on my vision of the mechanical being in the machine age—endlessly energetic, productive in the factory, with reflection of the immanent values of the past. It is about the honest and robust beauty of machine forms but also relates to machine age workers' stories.

Enjoyment of form from function

In Modernism, "primitive" machines were regarded as objects faithfully following an exact and efficient function, with no aesthetic consideration intended. These forms, free from impurities, were essential in themselves and involved moderated beauty. In the hundred years since this time, mechanical motifs have inspired Modern art, craft, and design, creating a variety of new concepts. These have been refined in passing through contemporary trends and the development of technology; furthermore, they keep spinning off new concepts. Although the focus in this project is on the primitive machines of the Machine age, it also seeks to reflect on subjective interpretation using both external and internal perspectives. Thus, the process began from enjoying functional forms from an aesthetic point of view.

A distant, but contrast-laden encounter

The somewhat strange encounter between two elements, the machine and the aesthetic, arouses a certain sensibility from its strong contrast. The distance between the endlessly changing essence of beauty, which goes along with current trends and individual experiences, and industrial artifact-"machines," has worked as a trigger of all.

Overall

'An approach that estranged viewers from everyday objects precisely in order to refigure them as objects of art or aesthetic interest. By placing us at some distance from the object of attention, by framing it in an unfamiliar way, by recasting out point of view and thereby allowing(or forcing us) to grasp the thing as a picture, it was thought, we might begin to recognize a deeper sense of order, regularity, and even purpose in our world.

A distant Technology (J.P.Tellote, 1999)

Machines are growing into more dynamic and intelligent tools around us, and being supplemented and improved by more recent technological advances, although it seems undeniable that their glorious time has vanished and remains a part of history. The aim of this study was to draw out recast values induced from the passing of time and transitions, and to refigure them under the present sentiment. The moment in the process whereby non-aesthetic things are re-illuminated and become emotionally connected with us was what I sought to explore as an overall purpose. It can be understand as a retrospective and commemorative intention by relocating our perspectives in the middle of the machine age.

Personal

Given my previous projects and interests, this project can be called a final act of an investigation that has been in evidence throughout my master's program. It started from looking at the craft field to experience the incorporeal values that can be acquired by manual training and through processes that require patience. These were in the process for tracing back to the origin of industrial design in the modern era. Being aware of tradition and legacy is no less vital than pursuing future endeavors. Machines can be regarded as one of our expectations, arousing revolutionary concepts and audacious achievements.

As a designer, working experience with craftsmen is important in enhancing mutual communication skills. A lot of my work had to be pursued through cooperative work because of my lack of skills and knowledge related to how to treat particular materials. The processes of exploration and rediscovery resulted in reflections on the theme, and this was a crucial purpose of my research from a personal perspective.

1.3   AIMS and EXPECTED RESULTS

The expected result was a series of tableware that can be used for tea time. As one of our intimately-communicable tools in everyday life, I saw the potential of tableware not only as a practical instrument, but also as a means of effusing the hidden story of machines.

I plan for this tableware to be feasible for mass production, even though the prototype will be finished by hand. It will be a full-scale model set, and will preferably be displayed with textiles that strengthen the main theme and design. These will have graphic patterns that support the main concepts of the project; in other words, they will not be presented as individual objects that are directly related to the theme.

1.4   FRAMING of QUESTIONS

- *What is mainly focused on in relation to the theme "machine"?-*
- *How can this be interpreted in the context of the modern design movement in the 20th century?*
- *What is the point of choosing "tableware" as a means of telling?*
- *How do I reflect my ideas on forms and materials (ceramic/metal)?*
- *What are my ideas about "aesthetics" ?*
- *What do I expect from the exhibition experience? Communication with viewers? Exposing them to my own messages? Focusing on personal expression?*
- *What mood do I intend as a dominant image?*
- *What else do I expect beyond theme-focused studies?*
- *How can I deal with materials that I am not used to within a limited time frame?*
- *How do I foresee the development of the tableware in the mass production market?*

1.5   DEMARCATIONS

I planned to design a full collection of tableware. Given my practical skills and limited time frame, it was presumably impossible to create every single object with a quality finish such as they would have if they were machine made. This study did not focus on craft skill training, but rather on visualizing ideas in reality to communicate them with the public. Thus, model making work was conducted with an expert's help to manage the project. Here, my expected role was that of directing the visualization process and extracting quality design.

2 IMPLEMENTATION

2.1 ANALYSIS and INSPIRATIONS

2.1.1 MACHINE AESTHETIC

This projected was conducted with a view to discovering aesthetic factors from mechanical structures or their physical appearances and basing the aesthetic principles of design on these. Such a purpose was referred to by many artists, intellectuals, and technicians throughout the 19th and early 20th centuries. The concept of a machine aesthetic was used figuratively as an emblem of modern civilization in literature and fine arts, since it reflects the veracity of a perfect structure and beauty. Furthermore, the aesthetic basis of functionalism in 20th century provided immediate inspiration and stimulus for developments in modern design.

Most early machines were built for working men, not for the leisured class. Compared with the architecture and furniture of the period, we can readily see a considerable difference. The machine lacked the shape and decorative devices that were applied for visual appeal. Emotive values from ornamental elements were not an essential factor of machines, but instead their harmony and honest beauty is striking. We expect specific and accurate functionality from them and clear working processes to be sure of stability and effectiveness. The communication between human and machine developed prior to a sentimental facet. People sent instructions to the machine through levers, hand wheels, push-buttons, and so on. In return, they received information from the machine, telling them how it was operating (W.H.Mayall, 1968)

No longer a "servant" of art

The art press increasingly used mass-production methods and photographic "process prints" to reproduce the effects of handcrafted images. When industry could be treated as the servant of creativity, there was no longer such a gap between handwork and the machine. The advent of mass-production enabled art be reproducible, and blurred the boundary between handcrafts and machine production. The emphasis on crafts that could be achieved by the human hand shifted into an interest in industrial design and manufacture. Machines no longer functioned as a servant of art. My study began from the subversive shifting in the art realm from a view that nature was dominant as a source of the beauty.

2.1.2 EXTERNAL APPROACHES — FORM

By beauty of shapes I do not mean, as most people would suppose, the beauty of living figures or of pictures, but, to make my point clear, I mean straight lines and circles, and shapes, plane or solid, made from them by lathe, ruler and square. These are not, like other things, beautiful relatively, but always and absolutely.   *–Plato*

Material Beauty

Industrial materials have intrinsic features related to their forms and textures. Industrially mass-produced materials tend to be strictly classified by standard and use. This brings up the image of anonymous laborers dressed alike, with no creativity in their appearance. The scene of raw and rough materials piled up in large amounts evokes a cynical but industrial image of its own. The graphical patterns from mechanically cutting planes, the repetitive rhythms from coiled up masses, and the abundant material textures create impressive contrast.

Geometrical Balance

There is an abstract beauty in straight lines, circle, and shapes, plane or solid, made by lathe, ruler, and square. Machines were designed to perform optimal functions for the best efficiency. The mathematical forms for function and complete reciprocal assembly formulate integrated and perfect balance. Visually speaking, machines are a practical application of geometry. The wheel and axle is composed of concentric circles and radiating straight lines. The watch spring is a spiral. Sphericity and circularity are the geometrical characteristics of a ball bearing. Screws, bearing springs, and propellers are various-and variously beautiful applications of the helix and helicoids.

Machine Purity

2. **Textile Spring.**
American Steel & Wire Co., Worcester, MA. Steel.

3. **Self-Aligning Ball Bearing.**
Chrome-plated steel.

Machine purity is noticeable from a perspective that was never intended. In the process of repetitive elimination due to cost reduction and increased efficiency in industrial production, it reached the essentials without of any superfluity. The efforts to realize a core factor through the optimal production approach brought about unexpected beauty. This led to the modernistic definition, which was distant from machines designed as an aesthetic intention under the Art Nouveau trend, and in turn led the modern.

Visual Complexity
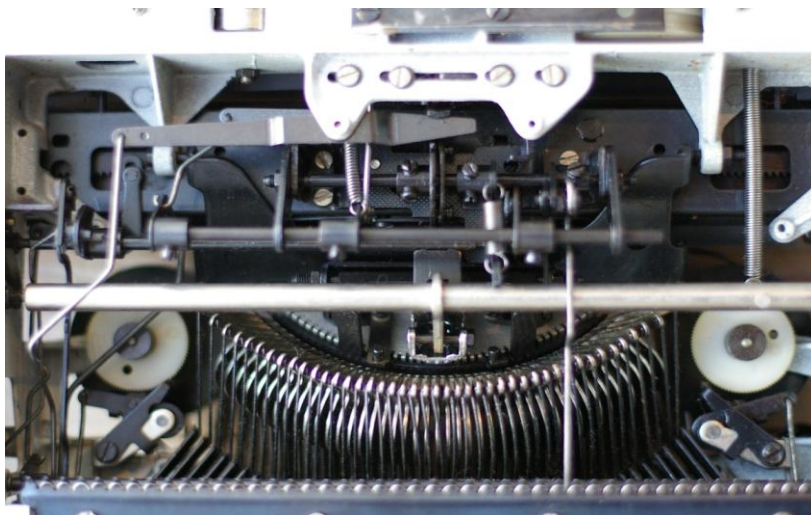
The perfect combinations of each simplified and regulated shape build up to one whole image. The components are arranged in precisely calculated positions and reveal an abundant visual attraction in contrast to and harmony with individual textures and forms.

Static and Kinetic Rhythms

The movements full of dynamics and massiveness generate powerful rhythms as itself. The acoustic and optical factors out of them are mingled together and become appealing as one of machine's main characteristics. Moreover the repetitive motifs inducing static rhythms have been worked as one of inspirations in modern art and architecture-in its cubist paintings with their freezing and dissection of motion, and in the efforts to create abstract images by photographing simple mechanisms form unusual angles and distances.

2.1.3 EMOTIONAL APPROACHES – VALUE

Machine-age Movies

As Richard Guy Wilson has offered, the coming "dominance of the machine in all areas of life and culture" and the emergence of a "special sensibility" informed the 20th century. The machine age was also the most crucial period for the development of the film industry. As it the viability of replica production and reproductions was made clear, film became popular among the public as a medium for communication and expression. Radical evolutions and changes were reflected through a variety of visions in society using this medium. Specifically, realistic representations and contemplations of technological development were realized by science fiction films. These trends were prominently shown in movies by some major industrialized countries, particularly Germany, France, the United States, and England. In such films, technology as a dominant force redefined the human role, even threatening human nature. These problems have continued to the present, and remain difficulties that we will keep facing as long as we live with technology and machines.

Interrelationship between theme and expected outcomes

-Viewed in *Modern Times* (1936)'

One of the quintessential examples of film reflecting on machines, the movie *Modern Times*—Charlie Chaplin's last silent film—has been referenced as a major inspirational material in this project. Chaplin's "Tramp" character had made Chaplin the world's most famous man in the 1920s, and his critiques of industrial consumerism and mechanization were dramatized by humorous and satirical undertone. He enthusiastically brought forward issues by means of movies examining the gap between a visionary point where machines would release human from the bondage of labor and the preposterous situation of man being eaten by machines. Here, I want to focus on the feeding machine scene in *Modern Times*. This is a machine meant to feed workers while leaving their hands free, and it announces its functions with an associated LP record. The device's viciously mechanical, repetitive quality, and its urge to present itself as superior, are emphasized by how the recording points out no less than three times that the lunch hour can now be eliminated from the workday. The scene shows a fragmentary but visionary perspective on eating behavior (one of Chaplin's leitmotifs), turning into a burlesque that depicts human feeding as a mechanical operation separated from its cultural and historical context, through effort to regulate and mechanize human behavior. One of the characteristics of the machine age comedy genre was a silent protest against advancing technology, which was simultaneously emotional bound to the circumstances of the times.

The impression of this scene invoked some ideas about the object as a final result. No matter how a society evolves or decays, eating behavior is an intrinsic human pleasure and consolation that should be respected. This is because this time is significant in cultural and ceremonial contexts; the significance of eating goes beyond physical ingestion. Therefore, tableware was considered as an experimental medium to demonstrate issues relating to eating and machinery and to examine ideas.

2.2 CONCEPT CONSTRUCTION

Design Phase

  : Idea developments using design tools

> **Free-hand sketching**
> **3d test modeling**
> **Quick rendering**

  Concept construction is a process that involves examining collected and verified information and reaching the step of idea representation; in the present project, this focused on a subjective point of reinterpretation in relation to the theme. This included interpretations that came into being from the examination of forms and values, and the extracted fragmentary thoughts were clarified by certain key concepts. The following stage was conducted prior to the idea visualizing process to follow the initial aim of arousing new perspectives rather than meeting the user's needs.
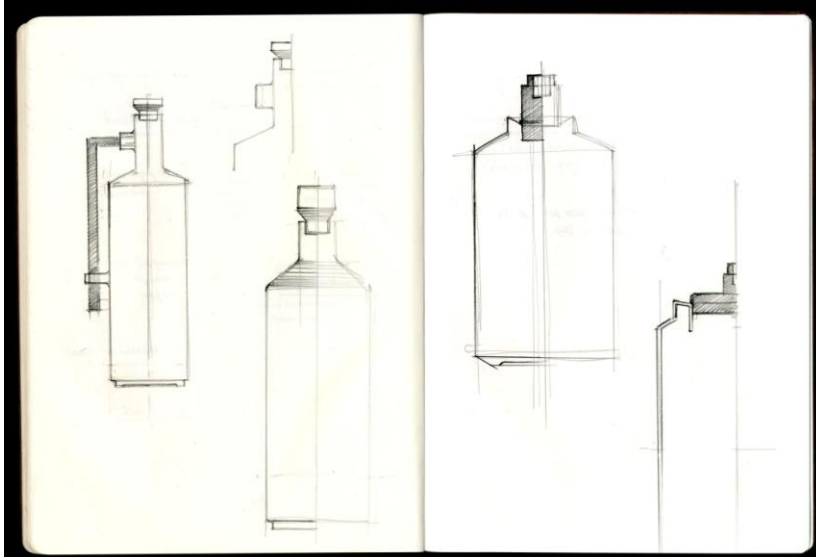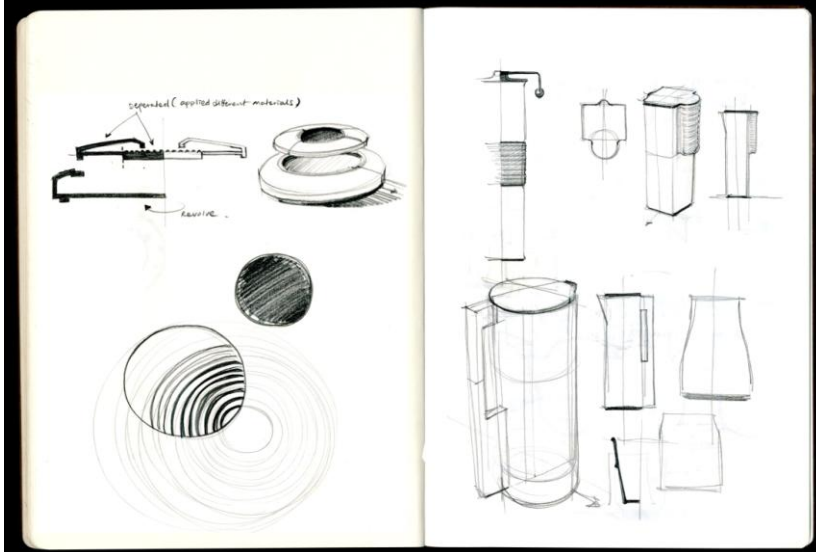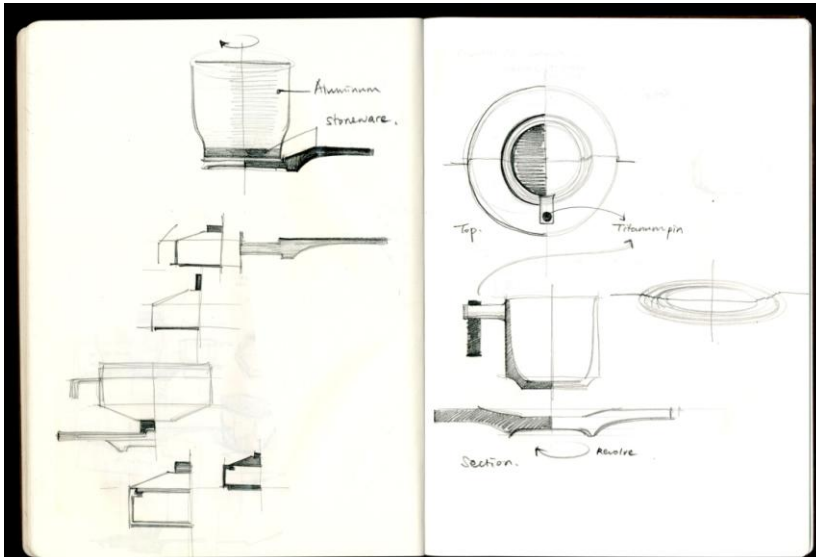
2.2.1 ASSEMBLY AND DISASSEMBLY

Stacked, Assembled.

Each piece, as a component of one dominant mechanical assemblage
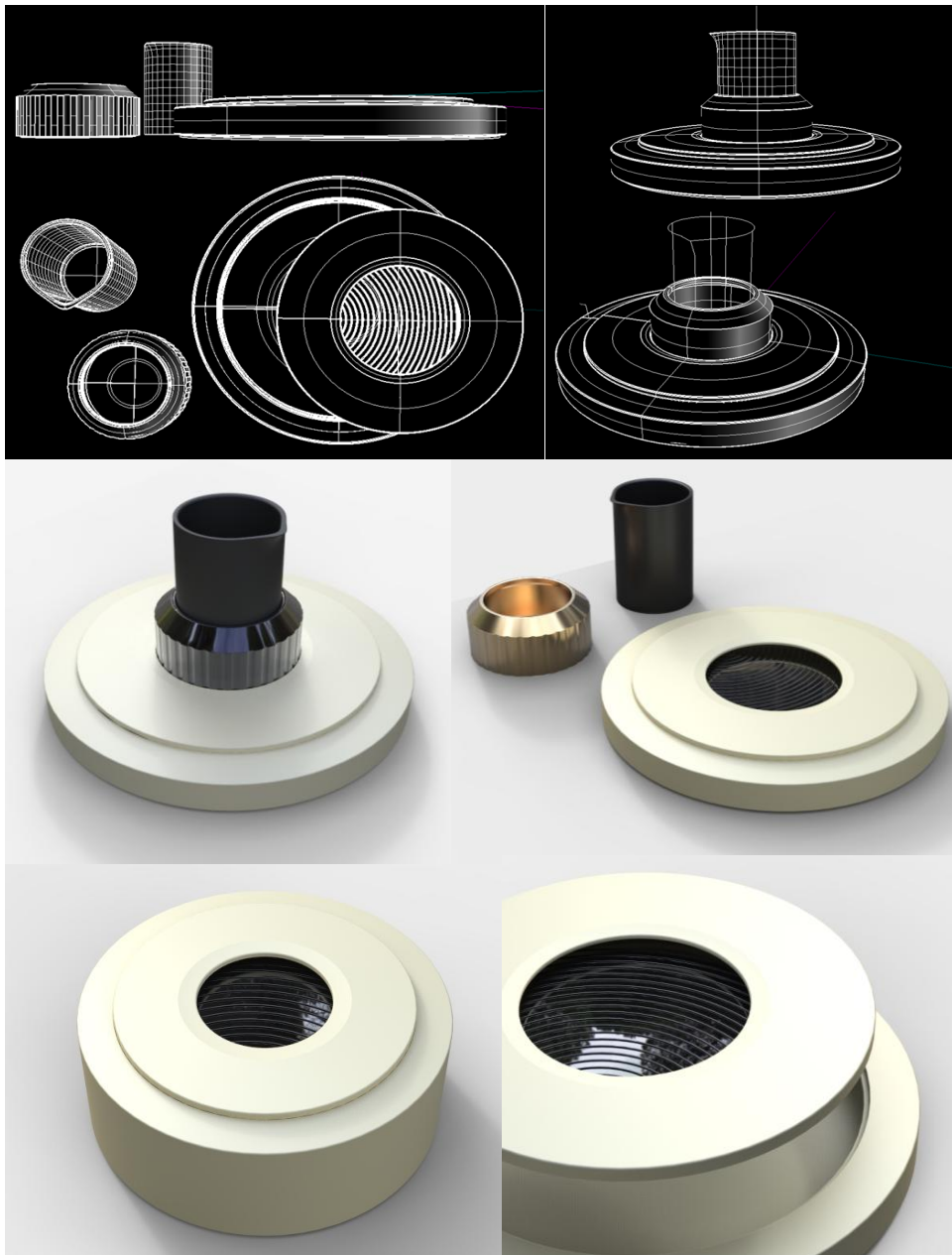
Storage (multifunctional), **Sugar & cream bowl**

Soft touch French Vanilla (stone wear)
Glossy Charcoal-black (unconfirmed)
Champaign Gold (unconfirmed)

Tea cup
Coaster
Desert serving dish

The initial design explorations were focused on the structures and definition of each object in a wide frame. I demonstrated them through applications using functional objects. Individual pieces worked as components of the whole, with their functions maintained. Jars and sugar and cream bowls were meant to support the structure and create an assembling image. Thus, lids-which are generally exposed-were hidden inside and functioned as both a lid and a component for the inserting operation. Other pieces (the sugar bowl and cream cup) were inserted over, and finally every object came into being as an element by building up an assemblage.

In the same way, a series of teacups, coasters, and dessert serving dishes were developed as one another's assemblage. These were differentiated from the existing notions of stacking cups and dishes-where one thing is placed on another-and were intended to be combined more intimately.

Each element had an assigned role and proper position for placement, functioning as a kind of tool. The logic was embodied as a form, so that the objects could be special to each other and for the whole composition. To realize a perfect image, the elements needed to contribute to the whole in the right place. Thus, the set as it came together resembled the parts of a mechanism.

Water bottle

Main body - Soft touch (stone wear)
Deco ring - Glossy separate piece(unconfirmed)
Lid - Aluminum

One feature extracted from the external approaches-the form, static, and kinetic rhythms-was applied in group scene simulations. The stacked images had widely been verified in terms of the manufacturing case as a possible further development. The repeating outlines made a certain pattern and when things were rearranged in a different way, new images were created. Each element became a more anonymous mechanical component in a bigger frame, evoking a mood of a united and machine-like world.

2.2.2 HIDDEN ELEGANCE

Drinking tea, an aesthetic of relationships

- Expecting result(object) - Tools for expressing ideas --- Tableware(Tea service)
- Ceremonial Approach

Definition of Aesthetic of Drinking tea

Storytelling
Affection for human
Building relationships
Exploration of beauty

Physical intake

Tea drinking means more than satisfying one's thirst. It has taken root in our daily life, varying through cultural diversity and regional characteristics over a long period of time. Drinking tea is a more conscious process than having a meal, and sometimes requires a more emotional attitude. When we sit around and have a conversation, tea works as a medium that leads to more intimate and significant interrelationships. The time people spend drinking tea reciprocally reveals their beauty, along with various factors embraced by the five senses. Beyond forms, from the atmosphere varied by the tea flavor, the rattling sounds of dishes, the whole image of movements of being piled up and spread out, and textures on a fingertip, hidden elegance is exposed. This is an aesthetic created by a pure coincidence that transcends its function or purpose.
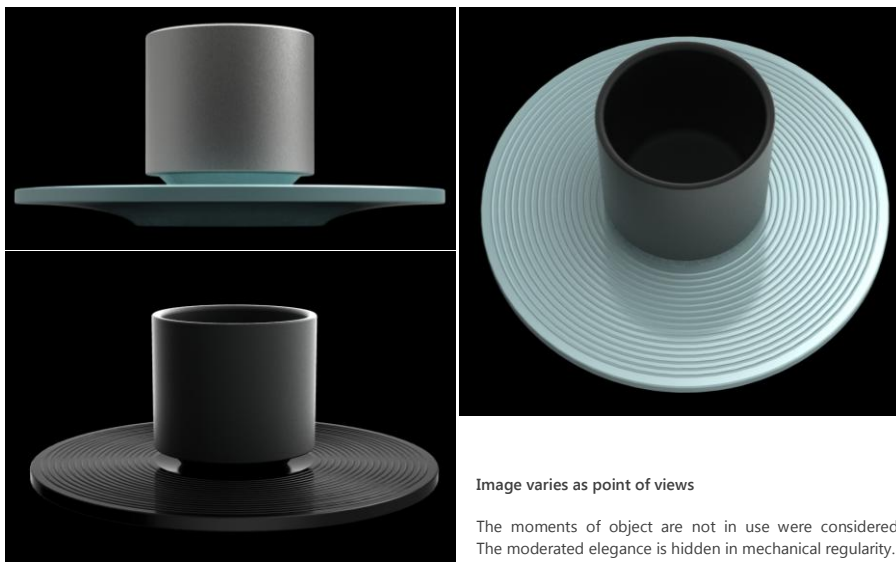

Image varies as point of views

The moments of object are not in use were considered. The moderated elegance is hidden in mechanical regularity.

2.2.3 SILENT MASSIVENESS

Mechanical form and structure were designed following for functions so that user can convince the working operations and principles. A mechanical assembly is generated by a mathematical clarity and exact combination between two parts. A single union of pure form creates mechanical complexity in the end. Machines not only generate dynamic movements and sounds but also evoke the massive and dignified moods in silence.

2.2.4 EVANESCENCE (몰 沒)

The loss of industrial artifacts

An idea of Beauty, according to Francis Hutcheson (1694-1746), is intimately connected to individual experiences. In other words, Beauty is in the Eye (or at least, in the Mind) of the beholder. The aesthetic perception toward machines based on my experiences and taste. Especially it related to the passing of time which remains machines as industrial artifacts. No longer alive, no longer remarkable but the machine-age machines have stories which make them more beautiful than they were.

3. RESULTS

3.1 SILENT MACHINE (A TEA SERVICE SERIES)

A tea service set, Silent Machine, is composed by functional products reflecting aesthetic interpretations on function-focused forms. Every single object can be identified when it is utilized as a part of the whole. Mathematically formulated silhouettes and details contribute to creating an image of mechanical regularity rather than being emphasized on their ornamentation. While individual objects are stressed by their forms in the disassembled status, they change to the practical products by assembling by their usage. The Silent machine is classified by 5 types of combination in terms of assembling methods, and by 7 types as its function. Specifically, a water bottle for serving hot water, a milk bottle considering the western style of tea serving, a short wide and high narrow jars usable for cookies or tea leaves storages, tiny jar for sugar cubes, and a cup set which has a tea cup, a coaster, and a desert serving dish as its elements.

Assemblage
Jar_SW01/Jar_SW02
A multi-functional jar combination

Bottom
Body (stoneware)/ Cover (stoneware)

Top
Body (stoneware)/ Cover (aluminum)

Assemblage
Bottle_M01
A milk bottle

Body stoneware)/ Cap (stoneware)

Assemblage
Bottle_W01
A water bottle

Body (stoneware)/ Cap (aluminum)

Assemblage
Cupset_01
A tea cup/A coaster/A desert serving dish

Cup/coaster/dish (stoneware)
Stirring stick (aluminum)

Assemblage
Jar_HN01
A multi-functional jar combination

Body/cover (stoneware)
Deco ring (aluminum)

3.1.1 OPEN DIALOGUE WITH CRAFTSMEN

Throughout a prototype mock-up phase I developed ideas by technical supports from ceramic specialists to demonstrate a possible further production. This process was done by investigating the viable methodological approaches, by exploring the material dispositions, and by delimitating technical problems. And based on the results I visualized ideas in the virtual interfaces to review developed designs.

After the practical method verifying step done I concluded that a ceramic injection molding method is the best for my design. It is a relatively new manufacturing process that combines the shape complexity and productivity of plastic injection molding with performance attribute of ceramics, metals, and carbides. It is capable of producing a wide range of component sizes and shapes, and it is well suited to the production of complex-shaped ceramics. Regarding it several ways were argued and technical supports from experts were referenced through this phase.

Nevertheless, given the circumstances related to the cost and time frame, I decided to use a manual modeling by a collaborative works with a ceramist.

3.1.2 PROTOTYPING

Manual modeling by a wheel throwing method

Thought enough conversations I delivered the design points and expressional intention and got prompt feedbacks from the ceramist. These direct communications and actions led to the idea developments and the quick modifications of forms.

Due to the nature of a manual work, I had to face on a lot of unexpected problems while I reproduced the machine-like designed forms. Especially in cases of forming inserting parts and the calculating the percentage of contraction during drying and firing process, it needed an accurate and elaborate process.

Surface finished objects after the first firing

Colored and glazed with black and cobalt and waiting for the final firing

Ceramic objects after all the process done

3.2 DISCUSSION-RESULT IN A USER CONTEXT

The Silent Machine series was not designed focusing on functionality or usability from the beginning. Though I approached it conceptually placing emphasis on the physical beauty of machines and on their changed values based upon the passing of time, the objects were still expected to follow their functional roles. Here, I faced on controvertible issues. It was about whether the Silent Machine is only accepted as a sculptural object in a same context of an installation art, or utilized enough as one of practical products. The prototype that I made is close to the former case. I expect the Silent Machine to be a matter of discussions through exhibitions or online journals rather than being as a commodity in market places.

I intend every single element faces on the public as individuals prior to being perceived as a functional product such as a 'tea service'. Moreover I expect it provides the public to think and remind of some facts and values that they left behind. The experience of mechanism-the assembling and the disassembling-on their fingertips will attribute to lead us into the valuable machine age stories.

3.3 POSSIBLE FURTHER DEVELOPMENTS

I still have lots of tasks to investigate as long as I consider a mass-production for my design. Most of all, it is required to precede some researches about the target users and their possible experiences which can be produced by the Silent machine. In addition, the surface finishing should be reviewed on to improve usability and practicality within a boundary of an aesthetic point.

Given the circumstance of manual modeling process, the initial plans in terms of the prototype reproduction in a large amount were not implemented but I still consider a possibility of strengthening the my concepts to try a machine manufacture. The precise and detailed forming by the manufacture will enable the core idea of mechanism-the assembling and the disassembling- more explicitly.

3.4 MORE ACTIONS
### (TEXTILES-table linen/napkin)

Pattern design works were done as further developments. The main purpose was to extend a boundary of trials using different materials and methods. It included a table linen and napkins and I applied the same idea as that of ceramic works.

I extracted mechanical drawing lines from test modeling interfaces that I worked with. And rearranged them with graphical point emphasized on. The point was finding a way to transit a functionally useful tool as aesthetic one.
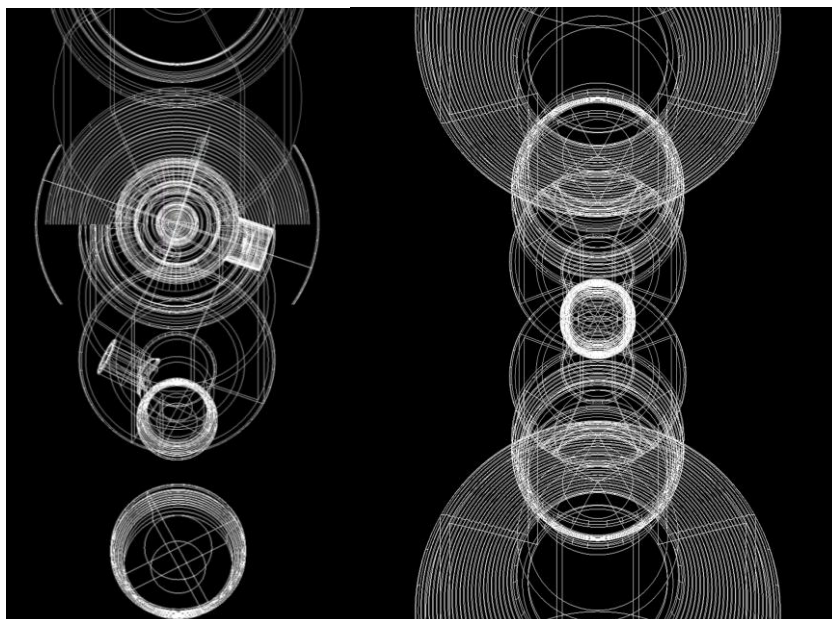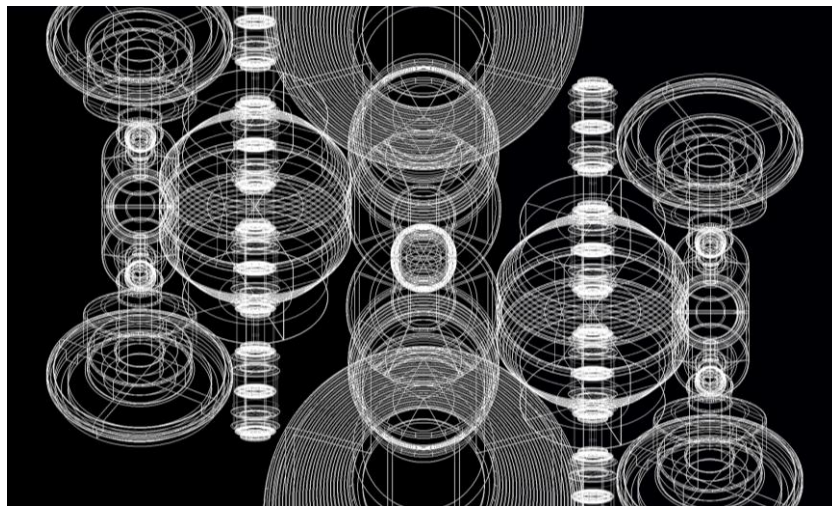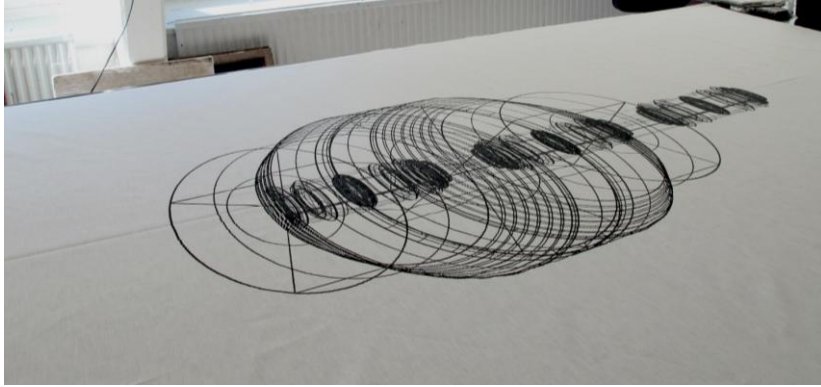
Graphics were printed on fabrics and the pixelated lines were shown as the way they were seen in technical drawings. Pattern arranging was tried in several ways with different color coordination.
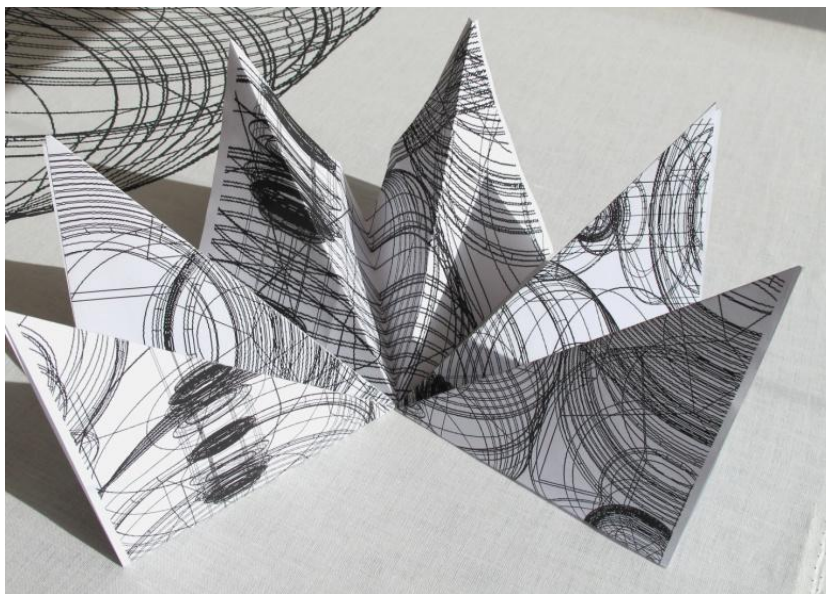
4. REFLECTIONS

THE PROCESS-TWO DIFFERENT APPROACHES

The process was divided into 2 phases. One was a concept construction basing on a storytelling method, and the other one was a figuration by projecting the established concepts. It was to follow a basic design process and 2 phases had been demanded to be well balanced during the whole process. The thing preceded the most in the first phase was trying to approach to some obvious and ordinary facts from new angles rather than problems-solving aspects. Questions originated from a personal curiosity and doubts were extended the scope of the exploration and connected to the attempts to find clues from the historical backgrounds. The efforts of background setting as if making a film scenario worked well in the process offering the abundant inspirational source. The historical happenings and stories were beyond the factual meaning and were re-illuminated from creative viewpoints with the distance away from the present kept.

The biggest crisis came out during prototype making. I had to compromise with reality several times because of my lack of skills in handling materials and techniques. The collaborative works were determined as an indispensable process and I would dare to say the trial was successful. The enough discussions between a designer and a craftsman and the complementary role play made it feasible. It also enabled quick communication concerning materials and manufacture, and the amplified synergy from it lessened mistakes. Moreover the participation in the actual making process provided me to have a broader point of view one step further from that of designer's. Considering further development related to the mass-production, the process above was a big accomplishment as its start.

THE EXAMINATION AND DISCUSSIONS

The presentation was done by a sequence of the research processes and described with development-focused. Discussions were mainly on the user experience and the possibility of mass-production.

This project was planned under a consideration of machine manufacturing in the beginning. The aim was due to a conceptual intention which was to express the anonymity of an individual object in a group, a morphologic intention which was to realize the machine aesthetics, and to approach to public with reasonable price. Nevertheless, its expressional tendency caused a problem of usability on the other hand. The modification of forms and textures must be tried carefully as much as the core concepts are being maintained. It is still needed to review further contemplations such as the prototype modifying, market researches, usability as an industrial product and so on, but I delimited its scope by the demonstration of a prototype design.

One another interesting issue was about the user experience, which was discussed on our reactions during perceiving process with individual elements of the Silent machine, and on personal interpretations influenced by cultural diversity. Most of all, the emotional storytelling and tacit communications that the Silent machine is likely to bring up were emphasized and positively discussed.

5. REFERENCES

- J.P. Tellote (1999). "A distant technology." Hanover and London: University Press of New England.
- W.H. Mayall. (1968). "Machines and Perception in Industrial Design." London: Studio Vista/Reinhold.
- The Museum of Modern Art. (1934). "Machine Art" New York: The Museum of Modern Art, New York.
- Stephens Gregory (2009). Biting Back at the Machine: Charlie Chaplin's Modern Times. "Sense of Cinema(Issue 60)".
- Beebhas, C. Mutsuddy and Renee G. Ford (1995). "Ceramic Injection Molding." London: Chapman & Hall.