Degree Project in Architectural Lighting Design
Second Cycle 15.0 hp

One Light to fit them all
Rethinking Luminaire Design, Reusability - Re•adjustability

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Reusability - Re•adjustability
Abstract

A luminaire’s primary purpose is to provide visibility into a space, but also to serve as an aesthetic object for it. When switched off, luminaires maintain their presence as forms and when switched on they transform places by creating or vanishing different shadows.

For years luminaire designers are trying to tame the light emitted from the light bulb, an archetypal component of a great literal and metaphorical significance for the human history. The era of LED’s sets no limits of light source forms, intensity, color temperature, lighting color or color rendering index. Space is now the primal factor and the luminaire forms and adjusts around it.

By examining the connection between luminaires and space, functionalism and how great designers approached the topic, a luminaire design tool will be explored connecting past, present and possible future technology advancement. With the above tool, a prototype model will be created with the intention to experiment with adjustability and adaptability into space. The main goal will be the research of a primal form for the design tool that serves as a multipurpose solution while retaining high quality levels. Well-being and creativity as well as responsible consumption and production are connected with the design process.

Keywords

Design tool, Functionalism, Geometry, Adjustability, Adaptability
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1. Introduction

Personal experience and Motivation

During my time working in a lighting retail company, I had the opportunity to see a vast number of lighting fixtures through exhibitions, catalogues, showrooms and industries. The experience I gained from the Architectural Lighting Design program until now made me understand the need of balance between the aesthetic design of a luminaire and its lighting qualities. Nowadays, a huge range of fixtures are focusing mostly on the first aspect and ignoring lighting distribution, glare, flicker, visual comfort and other lighting qualities. What if there was a tool to guide and help luminaire designers create products with higher lighting quality levels adapting to the demands of different spaces? **How can a luminaire serve as a multipurpose solution while retaining high quality levels?**

1.1 The three basic approaches

In the next chapter a general luminaire and space analysis will help us understand the bond between those two, as well as the changes that occurred due to the technology advancement. A retrospect into the past especially after modernism, looking at how great designers approached and worked with a luminaire as an object, as well as their established fundamentals and basic principles will be the link between the past and the present. Lastly, analyzing ways of improving sustainability matters related with the luminaire design field will help us understand why I chose to go into a specific direction trying to efficiently connect the past, present and the possible future.

1.1.1 Luminaire and Space

Everything starts with the light source. The archetype of this source, the very first thing that comes to our mind when we imagine emitted light is the light bulb. But the light bulb is not sufficient to light a room by itself. At the very least, a bulb needs a holder and a connection to an electricity supply. (Sudjic, 1985) Even if the above can be considered a light fitting, it still feels incomplete. A luminaire has to perform an additional function of directing and controlling the light. We need to have light where is needed. In that way we shape the character of the room according to our needs.

“I cant stand a naked light bulb any more”

“To shade a lamp seems only polite”

Blanche Dubois
‘A Streetcar Named Desire’
(Williams, 2004)
The primary function of a luminaire is to provide illumination within a space while also serving as an aesthetic object within it. Even when switched off, luminaires maintain their presence as tangible forms, but when switched on, they emanate energy, transforming both the environment and the faces within it, and either creating or dispelling shadows (Pavitt, 2004).

This study aims to analyze and deconstruct the fundamental aspects of the luminaire design process, while also applying various principles to develop a potential design tool for adjustable and adaptable light fixtures. The three essential key elements are the light source, the components of the fixture, and, of course, the space itself (refer to Figure 1). In the past, light sources were limited in terms of shape and function. Luminaire designers endeavored to control the light emitted by bulbs using elements like shades, reflectors, and diverse materials. However, with advancements in technology and the advent of LED lighting, the light source now offers limitless possibilities in terms of shape, intensity, color temperature, lighting color, and color rendering index. The use of materials has also expanded, leading to the creation of new lighting approaches. Today, space plays a pivotal role, defining the requirements and shaping the form of the luminaire around it (Pavitt, 2004). To be adaptable in various spaces, a luminaire must meet multiple criteria. The design tool aims to overcome limitations in the aforementioned elements and serve as a fundamental blueprint, enabling the creation of versatile solutions that maintain high-quality standards.

Light fixtures can be classified into numerous categories based on specific attributes or functions. However, this study will focus solely on two distinct groups that are relevant to both the spatial context and the direction of light within that space. The first group pertains to domestic lighting and is widely recognized by the general public. Luminaires within this group are categorized based on their spatial positioning. The five most prevalent categories include Pendant lamps, Ceiling lamps, Wall lamps, Table lamps, and Floor lamps (refer to Figure 2). Although there are additional subcategories, they are primarily associated with these five main categories. For instance, recessed lighting can be considered a subcategory of ceiling lights. The design tool will aim to create fixtures that can adapt to these categories and fulfill a majority of their requirements.
The study also examines how luminaires illuminate a space. Jørstian & Nielsen (1994) have categorized fixtures into six distinct categories based on the distribution of light they provide within a space (refer to Figure 3). These six primary categories are: Uniform lighting, Direct downward lighting, Direct upward lighting, Mainly downward lighting, Mainly upward lighting, and Up and downward lighting. A classic example of uniform lighting is the opal glass globe, which evenly diffuses light. A luminaire with a half-sphere metal shade facing downwards represents direct downward lighting, while flipping it upside down results in mainly upward lighting. By using a semi-transparent material like frosted glass, the luminaire falls into the next two categories. Lastly, up and downward lighting emits a balanced amount of light in both the upward and downward directions. An example of this category would be an up and down wall lamp. Similar to the previous group, there are additional subcategories. For instance, a cylinder fabric shade emits almost equal amounts of light upward and downward, along with some diffused light through the material, thereby belonging to both the uniform and up and downward lighting categories. Each category corresponds to a specific ambiance or mood within a space. For example, a bell shade fixture is more suitable for technical rooms, while a glass fixture emitting light in all directions signifies a beautiful, elegant, and celebratory lighting atmosphere (Jørstian & Nielsen, 1994). The forms of these six subdivisions will be explored and analyzed to develop a design tool that enables the creation of fixtures capable of emitting light in any direction as required.
1.1.2 Luminaire and Functionalism

Functionalism plays a vital and inspirational role in this study, closely linking to the preceding chapter. Striving to simplify a product by removing unnecessary details until no further alterations are possible leads to achieving the perfect minimalism. While aesthetics undoubtedly hold significance in the design process, it begs the question: What truly defines aesthetics? Poul Henningsen, for instance, did not prioritize the visually appealing design of his PH lamp. Instead, he placed great emphasis on the aesthetic quality of the light emitted by the luminaire and its contribution to the overall ambiance of a room. However, without his artistic sensibility, the lamp would never have attained its status as a cultural classic (Jørstian & Nielsen, 1994).

In this study, the relationship between form and function, where form follows function and function follows form, assumes a different role. Neither variable is constrained or fixed, but through their flexibility, I aim to create a design tool capable of adapting and adjusting in any given situation, altering both form and function. Poul Henningsen aspired to create the ultimate lamp that would surpass all others. Considering that his designs are still utilized today with minimal variations, it can be said that he succeeded. However, had he not faced technological limitations during his time, such as constraints on light source form, intensity, and color temperature, his designs would likely have taken a markedly different shape.

“Form follows function—that has been misunderstood. Form and function should be one, joined in a spiritual union.”
Frank Lloyd Wright
1.1.3 Luminaire and Sustainability

Lastly, sustainability is the primary driving force behind this study. When considering luminaires and sustainability, several factors come to mind. These include energy efficiency, the use of recyclable and eco-friendly materials, and addressing the luminaire’s life cycle by exploring options for reusing and repairing components or the entire product. The two key aspects related to luminaires and sustainability are energy and materials.

Energy efficiency has significantly improved in recent years, largely due to the adoption of light-emitting diode (LED) technology. Through the implementation of light management systems, we have greater control over lighting, enabling us to reduce energy consumption by balancing artificial light with freely available daylight. However, the unregulated production and installation of new artificial lighting is a concern that warrants attention. Despite using more energy-efficient light sources, we must question whether we truly need the increasing amount of artificial light being introduced each year. Fagerhult Group’s sustainability report (2022) indicates that the usage phase of a lighting product contributes the most to its overall environmental footprint (refer to Figure 4).

Material selection and the quantity of materials used in each luminaire are crucial considerations for sustainability. Many contemporary luminaires prioritize the use of recyclable or biodegradable materials to minimize environmental impact. Additionally, packaging plays a significant role. Designing luminaires that can be adjusted, disassembled, or packaged in smaller volumes helps reduce CO₂ emissions.

Figure 4.
Footprint from products sold by Fagerhult Group 2021 (baseline year for SBTi).


Notes: It is noticeable that the use phase completely out ranges the others, with the materials getting the second place with only 8%. Of course we will have to consider many factors, such as the type of the energy source. If it is renewable it completely changes the approach in luminaire design making the focus on materials and other elements more valuable.
The primary focus of this study is the life cycle of luminaires, specifically analyzing their reusability and adaptability in different spaces. There exists a common misconception that when we replace a faulty driver in an LED luminaire with a new one, we are making a significant contribution to sustainability by prolonging the product’s life cycle. While there is some truth to this, Sebastian Knoche, in a podcast by Villar & Shalaby on Circularity in lighting design (2021), highlights the ecological importance of the drivers and optics within a luminaire. He refers to the Abiotic Resource Depletion Potentials (ADPs), which is a ranking of elements based on their preciousness. For instance, phosphor, a key component of an LED chip, holds a high position on this list, whereas aluminum, commonly used in light fixtures, ranks lower. Therefore, simply replacing an LED chip in a luminaire does not contribute to sustainability as much as initially thought. Sebastian emphasizes that the control gear of the luminaire is responsible for 75% of failures. Consequently, the logical conclusion is that we need to maintain high-quality standards and produce luminaires that have longer lifespans without the need for frequent interventions.

Taking all of the above into consideration, we must acknowledge the reality that a light fixture may no longer be desirable in a space after a certain period. Technological advancements and changing aesthetics and trends often lead to renovations, putting the life cycle of a luminaire at stake. What happens to a set of fixtures once they are no longer wanted? Is it financially feasible and environmentally sustainable to recycle them? What if these luminaires possessed adjustable and adaptable properties that would allow them to be reused in new spaces, even with different functions? The design tool aims to serve as a guide for creating adaptable luminaires, products that can stand the test of time. In an era of “timeless design,” where we prioritize stripping away excessive form to focus on light qualities, such a tool would be a valuable addition to the world of lighting design. We must also emphasize the importance of lighting quality, as contributing to responsible consumption and production should not come at the expense of neglecting good health and well-being (Agbedahin, 2019).

Figure 5.
Sustainability Goals relation. Personal drawing. (Photoshop)
Figure 6. Mind Map
Personal drawing (Photoshop)
2. Methodology

Having analyzed the Luminaire Fundamentals, Functionalism and Sustainability, I will explore the form and possibilities of a design tool by focusing in lighting quality, adaptability and adjustability into space. Materials will be totally excluded from the study and geometry will play a very important role in forming a possible archetypal form for the design tool.

“It is not recycling the material or the ready-made aspect that interests me. What does is the reuse of the archetype, the recycling of the idea.”

Ingo Maurer
(Pavitt, 2004)

2.1 Exploring the Form

To attain an archetypal form for the design tool, the examination of light distribution within a room serves as the starting point. Drawing upon Figure 3 and analyzing the six categories, it becomes apparent that the Uniform Lighting category encompasses the other lighting qualities to some extent. By commencing with the sphere as the foundational shape and systematically deconstructing it, various geometries and lighting qualities can be explored. The light source also assumes a significant role in bridging the past, present, and potential future through technology.

A prime example of a sphere luminaire that emits uniform lighting is the conventional milky glass globe. This semi-transparent glass envelops an E27 bulb, effectively serving as the conduit between the bulb and the space. Considering the abundance of limitless technology, the initial focus will deliberately disregard the light bulb as a form, leaving only the sphere and the space as the two variables (refer to Figure 7). By geometrically decomposing the sphere, its surface can be divided in two ways. The first approach entails a vertical analysis, wherein a vertical half curve is employed to divide the sphere from top to bottom. This curved line, referred to as “Γενέτειρα” in Greek, derives its name from the word “birth,” signifying that this specific line gives rise to a sphere when rotated 360 degrees around the vertical axis (refer to the first shape of Figure 8).

Figure 7.
Eliminating the light bulb as a form while exploring the design tool possibilities. Personal drawing. (Photoshop)
The second is the horizontal analysis where the sphere is divided by many horizontal circles, with the middle one having the higher radius and the ones closer at the top and bottom having the lowest (refer to the second shape of Figure 8). Now imagine endless geometrical possibilities emerging from the sphere. Relating them to luminaire design and lighting, everything could start from a sphere. The most archetypal fixtures that come into our mind are related to that very basic form. By further analyzing different geometries I will connect the design tool with lighting.

Figure 8.
Sphere Geometrical Analysis.

Figure 9.
A tool where at the hands of the designer can help them create magic. Personal drawing. (Photoshop)
2.2 Luminaire Adjustability

When thinking about an adjustable luminaire, we usually have in our mind a fixture which we can tweak and change its height or shade through a handheld mechanism. But adjustability does not limit there. A luminaire could be adjustable without having to change form, but by changing its lighting attributes. A smart light source for example could change intensity, colour temperature, color or even light distribution. A conflict between technology and design and the question of luminaire accessibility surfaces. Ken Appleman (2022) talked about responsive lighting in his lecture and raised the question about what is responsiveness. I will raise the same question about adjustability. Which luminaire is considered more adjustable? One that uses all the technology of the world to change multiple lighting attributes through the push of some buttons, or one that has a movable shade that can be adjusted manually by the user?

In the upcoming case study I will analyze some selected luminaires and evaluate adjustability among other attributes.

The study will only focus on the manual adjustment of a fixture. A correlation between the design tool and adjustable components will be analyzed to investigate how useful the guiding tool can be when designing an adjustable luminaire. In Figure 10, we can observe personal findings of four basic adjustable geometrical mechanisms related with the lighting design tool around the sphere analysis. The four mechanisms are no more than a personal investigated result of the decomposing sphere analysis in different surfaces and axis and correlating it with lighting components and terms. The surface adjustment is mostly referred to shading components around a light source to change the direction of light, concentrate it, or cover it while keeping the light source intact. The second one is mostly related with the light source. A simple movable spotlight for example that can be adjusted and direct the light where it is needed. The axis adjustment could be either the height adjustment of a luminaire which is a very important element to space adaptability, or the adjustment of lenses, reflectors or even vertical shades. It is important to note here that when referring to this category I do not consider only one single axis orientation for example axis X, but other axis such as Y and Z. The last one has a similar approach as the previous one but this time the components or light sources are adjusted 360 degrees around the axis. A good example would be the adjustment

![Geometrical adjustable mechanisms.](image)

Notes:
1. Surface adjustment.
2. Center gyroscopic adjustment.
3. Single axis up and down adjustment.
of a cover “lid” in a wall lamp or a 360 degrees adjustment of a linear light source. The four mechanisms are not restricting, but indicating the possibilities of a spherical lighting design tool. Depending on the designer’s perspective the sphere as an entity can transform and the emerging components, surfaces and materials can vary. One simple example would be the leap from a perfect circle to an ellipse.

2.3 Space Adaptability

Adjustability and adaptability are two correlated terms. I depicted some of the design tool capabilities related to the creation of an adjustable luminaire. A fixture changing its form and lighting qualities has adapting and reusing attributes. In this chapter I will correlate the above mentioned capabilities with space and explore adaptability. A great inspiration for me was the MULTILAMPE design by Miriam van der Lubbe (refer to Figure 11).

Figure 11.
MULTILAMPE or Multifunctional Lamp. Design by Miriam van der Lubbe, the Netherlands 1997. Granted permission for use by Miriam van der Lubbe. (Pavitt, 2004, Page 58.)
An archetypal form of a table lamp used in different surfaces and spaces and comically enough as a car light. The design intends to be the exploration of form (Pavitt, 2004), but in my opinion also poses the question of compatibility and adaptability of an object and in this case a luminaire. What is normal and right? Is the designer always setting the rules for the user when creating an object? If the rules are broken has the design failed? In Figure 12. inspired by Miriam van der Lubbe I am exploring form and space from the eyes of a spherical entity and trying to relate with compatibility and adaptability. The form is either attached, hanged, recessed, standing, or not even there. Recalling Figure 2. and 3. I am connecting one single form with space. A single entity trying to adjust and adapt producing as many light distributions as possible.

“In search for the lamp to end all lamps”

Poul Henningsen

(Jørstian & Nielsen, 1994)
3. Results

3.1 Exploring adjustable forms and possibilities

Having analyzed and decomposed the sphere I explored different geometries and forms around it, while integrating combinations of the four found adjustable mechanisms. The first part of the results is more conceptual and tends to discover how capable the design tool can be. I am discovering connections between the sphere, the light source, the luminaire components and the space around it (refer to Figure 13). Following an additive process starting from a simple spherical geometry, I build on different shapes, lines and geometries, trying to reach a level where an adjustable luminaire form can be imagined. In this process basic luminaire archetypal components are being revealed or hinted, such as metal and fabric shades, typical LED light sources or filtered surfaces.

In figure 14 and the Appendix, we can see how many of these shapes can resemble luminaire designs or be the beginning and the cornerstone for a complete lighting product. Surfaces, lines, curves and more complex geometric shapes are being composed together to serve and translate into different luminaire elements such as shades and light sources. Of course light fixtures do not only consist of these elements and components. For a luminaire to be functional into space there have to be considered other factors such as the electricity connection but for the purpose of this study I am completely ignoring these limitations.

Figure 13.
Design tool key elements connection diagram
Personal drawing. (In Design)
Figure 14. Luminaire design geometry analysis and exploration with the sphere as the primal element using Autocad. More explorative shapes can be found in the Appendix page 36. Personal drawing. (Autocad)
3.2 “Reversed” Case Study

A series of specially selected adjustable in their own way luminaires will be examined, analyzed and evaluated. The Case Study aims to connect the Design Tool with different fixtures and relate it with adjustability, adaptability, technology as well as lighting quality. The evaluation is personal and on a scale from 1 to 5. I will also refer to Figure 10, analyzing the relation of the fixtures with the four geometrical adjustable mechanisms. Another purpose of this study is to influence and inspire some of the prototype’s design decisions, since it is also going to be analyzed and evaluated in the end in a similar way. Hence the word “Reversed”.

**CASE STUDY - DESIGN TOOL - PROTOTYPE**

**Geometrical Adjustable Mechanisms**

![Figure 15. TITANIA](image)

Design Alberto Meda
Paolo Rizzatto, 1989

**Personal Evaluation:**

- **Adjustability:**  
  ![Adjustability](image)
- **Adaptability:**  
  ![Adaptability](image)
- **Technology:**  
  ![Technology](image)
- **Lighting Quality:**  
  ![Lighting Quality](image)

**Design Tool Analysis:**

A lightweight pendant lamp that can change color with the use of polycarbonate filters. The user can manually place the filters left and right from the light bulb, as well as adjusting the height of the luminaire using the spherical counterweight.

In terms of technology TITANIA uses the bare minimum. A simple E27 socket surrounded by different elliptic shapes. Nevertheless the fixture smartly uses colored filters to adjust the color of light, as well as having the sweet touch of the spherical counterweight for further adjustability and adaptability.
Design Tool Analysis:

Geometrical adjustable mechanisms
Approximate percentage analysis:

-Adjustable height using spherical counterweight.
-Manually changeable colored filters.

Notes:

One of the most related to the study fixtures, the Multi-Lite Pendant embraces the golden era of Danish design and explores different lighting distributions, as mentioned in Figure 2., with the ability to manually adjust its shades by the user. Again another fixture that uses the baseline technology for luminaire design but smartly combines function and aesthetics.

Geometrical adjustable mechanisms
Approximate percentage analysis:

-Manually adjustable rotating shades.
A book turning into a lamp or a lamp being a book. Lito is a quite unique product that owes its success due to the sensory feeling and surprise of the user. Being able to touch the product, carry it, control and transform it, creates a deep connection between the user and the lamp. A diffused material functioning as an accordion but also resembling as book pages emits cozy warm light. The whole product functions as a book and can take any preferred angle, thus making it extremely adaptable into space. What also makes Lito extremely adaptable is its portability. The power source is rechargeable and the volume of the product is quite small. You can carry it with you as a flashlight and create a cozy environment wherever you want. Another smart feature is the implemented strong magnets on the cover making it able to attach any metal surface. Simplicity, aesthetics and utility are combined together forming a nice portable lamp.

Geometrical adjustable mechanisms
Approximate percentage analysis:

- Manually adjustable rotating shades.
Another similar portable product the Lantern Lamp can be transformed and function differently according to the user's needs. When fully open it can function as a lantern carried around emitting diffused light and when closed it can be used a focused torchlight. The handle can also be used as a base transforming the lamp into a task light for reading or as a hanging accessory for a cozy pendant light where electricity is unavailable. The main part of the luminaire can be rotated 360° and the light is functioning with batteries. The Lantern Lamp might not be as elegant as the previous example, but has more functions, can create more lighting distributions and can be carried while functioning much more easily.

Notes:

Geometrical adjustable mechanisms
Approximate percentage analysis:

- Adjustable height using spherical counterweight.
- Manually changeable colored filters.
3.3 Prototype Series

After conducting a thorough analysis and developing a design tool based on the examination of luminaire fundamentals, functionalism, and sustainability, the next step is to utilize this tool to construct a prototype model. The prototype will prioritize adjustability and adaptability, enabling it to generate various light distributions and qualities. The study will delve into the practical applications and scenarios for the prototype, examining how a solution derived from the design tool aligns with sustainability and functionalism principles. Due to limitations in construction, both digital and physical examples will be presented in the study.

3.3.1 Digital Prototype

Early concepts
Having analyzed the sphere and the four adjustable mechanisms, I was trying through sketches and drawings (refer to Figure 19 & 20) to find the best possible way to maximize adaptability through adjustability into space while retaining high quality levels. Balancing all the above mentioned even while ignoring some limitations is still something quite challenging. The prototype completely focuses on the above using mostly geometry as a tool completely ignoring technology limitations among others.

Figure 19.
Early stage prototype sketching and thoughts. Personal drawing. (Sketch)
Design Process

Functionalism, as a design approach, emphasizes the removal of superfluous elements from objects and architecture to achieve their optimal form for proper functionality. Taking inspiration from this design philosophy, I set out on a quest to create something that possesses a timeless quality and the ability to seamlessly adapt to any space or surface. The prototype I developed employs a dynamic interplay of adding and removing geometric elements, allowing it to adjust and align with its environment while producing diverse lighting qualities. Therefore, I have chosen to name it the Prototype Series, as it embodies a fluid and flexible nature, devoid of rigid predefined forms for each specific function.

Starting with the basic axis, I divided the sphere into four spaces using two ellipsis on the axis Y and X. Afterwards, I utilized completely the fourth adjustable mechanism (refer to Figure 10) to relate the surfaces with the sphere and introduce the first steps to adjustability. After this point comes the game of removing, adding or dividing elements in order to create different scenarios and forms for different uses and spaces (refer to Figure 21).

I want to note that at this point the digital prototype has no limitations or considerations about technology and real life realization. The light source and the electrical connection are not considered for this prototype. I mostly focus on the geometry and the most possible flexible outcome of a timeless design that could fit anywhere at any time and space.
Figure 21.
Digital prototype showcasing the form flexibility.
Personal drawing (Autocad)

Notes:
1. Starting from the sphere creating the first basic geometries of the prototype.
2. Further analysis and adjustability of the prototype functioning in space.
3. Removing elements to adapt as a surface luminaire.
4. Further removing elements to adapt in more than one surface.
5. Splitting further the original form, creating enhanced adjustability as well as lighting distributions.
3.3.2 Physical Prototype

Materials and Light source

For the physical model I had many limitations but tried to realize as many scenarios as I could. The used light source is a 405mm linear led profile from LUMINO at 4.8Watt and 2700k (See Figure 22) and was chosen due to its thin 15x15mm profile which was very compatible with the model’s scale. The three basic materials used for the model are thick grey and thin white and black carton, as well as flat headed pins and transparent tape (See Figure 23). The grey carton is mostly used for the main structure of the prototype as well as the completely opaque covers and shades redirecting and blocking the light from the linear LED source. The white and black thin cartons were used for contrast adjustments as well as semi transparent shades creating multiple lighting atmospheres. Flat headed pins and transparent tape is used to stabilize and readjust the prototype for possible multiple scenarios.

Figure 22.
Light source used for the physical prototype model.
Manufacturer: LUMINO. Model: V12S - 0405 mm

Figure 23.
Materials used for the physical prototype model.
In displaying order: Grey, black and white carton / Flat headed pins / Transparent tape.
Additive process

Converting from the digital to the physical prototype had its limitations. By using the grey carton as a surface I started building a hemisphere prototype by creating a circle and adding the light source as well as the rest of the adjustable components. The light source and the two half circle components can be adjusted 180° giving more possibilities for different scenarios (See Figure 26). Another twist is the readjustment and replacement of the two half circle components if the user needs another light distribution. Finally, different surfaces (See Figure 24) will be used to reflect light, change its color and create different distributions. In figure 25 we can see the step by step adding process of the basic components for the physical prototype.

Figure 24.
Different shading scenarios for the physical prototype. Personal drawing. (Autocad)

Figure 25.
Physical prototype adding component process. Personal images.
Final results

By harnessing the adjustable axis and incorporating various shades, I successfully achieved a range of diverse lighting qualities and distributions. The physical model proved invaluable in assessing lighting aspects, as it provided a clearer understanding of the levels of quality involved. Figure 28 showcases some of the outcomes. I experimented with two different light source orientations, vertical and horizontal, and then made adjustments to the shades, axis, and textures to attain varying light distributions, intensities, and contrasts.

3.3.3 Space scenarios

The prototype, although not a final polished product, holds immense potential for generating numerous refined luminaires. In Figure 27, I presented a visual representation of a space showcasing the luminaire’s placement in various configurations. Taking the concept further, I developed lighting sections that illustrate different light qualities and possibilities within a contemporary setting. These scenarios are organized and categorized based on two of the four adjustable mechanisms closely associated with the prototype (refer to Figures 29 & 30).
Figure 28.
Testing different scenarios and distributions and discovering possibilities on the physical prototype. Personal images.
Figure 29.
Conceptual lighting section scenarios. (Autocad)
The 360 degrees adjustment tool is used to change the lighting angle.

Scenarios depicted from left to right:
1. Wall lamp adjustable lighting.
2. Retail/Museum concentrated lighting.
3. Cozy atmospheric wall lighting.
4. Corner adjustable lighting.
5. Downwards adjustable lighting.
6. Up and down wall lighting.
7. Corner floor upwards lighting.
8. Table lamp adjustable lighting.
9. Wall and downwards adjustable lighting.
Figure 30.
Conceptual lighting section scenarios. (Autocad)
The surface adjustment tool combined with a diffused filter is used to create different lighting scenarios.

Scenarios depicted from left to right:
1. Pendant mostly downwards lighting.
2. Retail/Museum concentrated lighting.
3. Cozy atmospheric upwards pendant light.
4. Corner adjustable diffused and concentrated lighting.
5. Downwards adjustable diffused and concentrated lighting.
6. Up and down wall lighting.
7. Corner floor adjustable diffused and concentrated lighting.
8. Table lamp adjustable diffused and concentrated lighting.
9. Ceiling adjustable diffused and concentrated lighting.
4. Discussion

Thoughts and Concerns

I believe that the luminaire design industry is currently facing a challenge in terms of innovation. There seems to be a repetition of similar products with minor variations, leading to a lack of true innovation. The focus on professional lighting has resulted in standardized luminaires, making it difficult to navigate through the specifications and select the right fixture for a specific project.

While the concept of “timeless” design may have found its form, it has yet to find its true essence. Initially, my intention was to create something innovative and unique, but I soon realized that someone else may have already had a similar idea. This realization prompted me to approach luminaire design from a different perspective. By exploring the principles of functionalism, luminaire fundamentals, and sustainable practices, I developed a design tool that serves as a guide for creating sustainable and adaptable products. The aim of this tool is to promote well-being, circularity, and to reshape the way we think about luminaire design.

Correlations

Through the case study, we have observed how the design tool relates to a wide range of products, showcasing its applicability in various scenarios by effectively utilizing the four adjustable mechanisms (refer to Figures 29 & 30). Figure 12, featuring the MULTILAMPE design by Miriam van der Lubbe, demonstrates a notable correlation between the results obtained from the design tool and how the same luminaire can adapt to different surfaces and spaces. Furthermore, we can draw a strong connection to the work of Michael Anastasiades, a renowned lighting designer who has extensively explored the use of high-end materials and simple geometrical shapes to express and enhance minimalistic forms and structures. His product range often features opal spherical luminaires and unconventional installations that combine technology, materials, function, and form in a poetic manner, resulting in elegant and sophisticated products. These examples highlight the profound influence of technology, materials, and design on the creation of visually appealing and functionally efficient luminaires.

Sustainability

By exploring different scenarios within the limitations of the model, it becomes evident that a spherical or subdivided sphere luminaire with adjustability promotes spatial flexibility and adaptability. Imagining a real-life final product with interchangeable components, we not only achieve the creation of high-quality luminaires capable of effectively controlling light, but also have the potential to foster circularity in product design. This means that even if a luminaire is no longer needed in one space, it can be transformed and readjusted for use elsewhere.
Creating a connection between the user and the product forms the foundation for sustainability. However, it is important to consider that too much freedom and flexibility can lead to negative outcomes if users are not knowledgeable or mindful of the product’s capabilities. For instance, in public spaces, users who are unfamiliar with the installed lighting may resort to simply switching the lights on or off throughout the day, neglecting the full range of adjustability.

It is crucial to educate and raise awareness among users regarding the potential and benefits of adjustable luminaires. This way, they can make the most of the product’s flexibility, optimizing lighting conditions while minimizing energy waste. By striking a balance between user empowerment and informed usage, we can maximize the sustainability potential of adaptable luminaires in various settings.

5. Future Application

The study had its limitations, primarily focusing on exploring the geometric aspects and providing limited analysis of material contrasts. The design tool, while rooted in geometry as its fundamental principle for luminaire creation, has boundless potential for expansion and exploration. The research has been centered around a single shape of the design tool, without combining multiple shapes, which suggests the possibility of incorporating additional light sources and diverse lighting qualities. In fact, the tool can effectively be employed to design chandeliers and extend beyond geometrical shapes. By incorporating various textures and materials, the design possibilities within the luminaire design realm can be further expanded.

Similar to the use of a circle guide in teaching people how to sketch faces, the design tool can serve as a foundational step for luminaire designers. It can be employed as a starting point to visualize and conceptualize the desired product they aim to create. The design tool acts as a guiding framework, facilitating the design process and stimulating creativity in luminaire design.
6. Disclaimer

All product and company names are trademarks or registered trademarks of their respective holders. Use of them does not imply any affiliation with or endorsement by them.

Any scheme or shape that resembles or have similarities with any design does not intend to copy, promote or undermine the original creator and product.

The design tool is not considered innovative at its own, but it intends to be used as a guiding tool helping to answer questions throughout a luminaire design progress.
7. References


8. Appendix

Design tool further geometrical analysis and first rought conceptual ideas (Autocad):