UNIVERSITY OF GOTHENBURG

HDK AT STENEBY

CHANGING PARADIGMS

Moving out of the standards of the CNC Machine

Vanessa Fernandez

Essay/Thesis: 30hp

Program and/or course: MFA Wood Oriented Furniture Design / Examwork

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Supervisor: Petra Lilja

Examiner: Torsten Hild

External Tutor: Otto Von Busch

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Abstract

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This work explores new ways of working with CNC (Computer Numerical Control) machines within the field of arts, crafts and design, specifically in relation to woodworking, to increase possibilities of creation according to the current times and resources. The concept behind this work sets its position against systems of power and absolute control, which in a variety of forms numb societies, and diminish capacity of doing and freedom of expression by not showing alternative ways of action. The ultimate objective is to raise awareness about this condition, hoping to increase sense of empowerment in the audience, boosting their courage to take action and change realities for better.

Index

I. **Background**

A. **Introduction**

As part of a society we are affected by external conditions that finally shape us as individuals. In my case, as immigrant from Venezuela, I am aware that the experiences lived there made me the person I am at the moment, and certainly changed the way I look at future.

The interest for understanding the concepts of *power* and *control* started years ago when I was still living in the country. I repeatedly addressed these concepts in projects of architecture and sculpture in different ways, probably as an effort for understanding the context in where I was immerse, or as a way of expressing my concern for what I considered actions taken by the government against progress. The Venezuelan society has been changing dramatically its path in history since 1999 (when Hugo Rafael Chávez Frías took presidency of the country), and it is still undergoing processes of change in politic, economic and social levels as result of erroneous state policies where abuse of power and overcontrol has been present. This social case was an important reference and driving force for the development of this project.

I started the exploration of this work by trying to "decode" those concepts of *power* and *control*, looking for understanding on how they operate in different matters (gender, religion, politics, and so on), hoping to find common elements that compose them and being able to prevent unfavorable conditions in the future regardless the context. The analysis made clear that situations in where those concepts are present (and used in their negative connotation) are difficult to predict due to the diversity of the variables involved, however, those reflections opened path for other areas of interest. I realized that more than trying to foresees unfavorable circumstances (many time out of our control), it is important for me to know how to react and

use those conditions in favor. Now with this project I want to transfer those concepts and analysis from the social context to the field of material work, woodworking and furniture design, by using the highly precise computer controlled “CNC machine” (as a representation of power and absolute control) to create unpredictable results and show other ways of action out of the rules (as I would like to do in reference to social contexts).

I am aiming to prove that possibilities of creation are many if we dare to challenge standards, transforming adversity into non-limiting conditions. This work is not about going against rules, it is about finding alternative ways of working, about changing methods in our practice and the way we look at them as immovable statutes without questioning. It is finally a contribution to opening doors for innovation, freedom of creation and encouragement in personal levels. At the same time, the analogy between craftsmanship and machinery created with this work, comments itself about our role as makers and designers towards the future, questioning paradigms of beauty and modes of production.

In the next chapters I will explain more about the key elements that originated this work and were taken in consideration for its development.

B. **Previous work**

Due to the concept and the method of production applied, the side table CTRL is a relevant piece within the context of this work.

Inspired in the movement of the water and the components of a hydroelectric dam in Dalsland Canal, my focus on this project was directed to the analysis of those elements in an abstract way: the game of forces between power and control.

The water in the place showed itself in diverse conditions: at the beginning calmed, contained and then when passing through the system changing into rough, dynamic and generator of energy. Having these conditions as a reference, the piece was created with the intervention of a 3-axis water jet cutting machine and with it I was able to express my analysis through a concrete object. The technique challenged the programmed and predictable movement of the machine to obtain a more organic result; during the process of cutting a straight line, a prepared block of wood underneath was rotated manually around one axis thus obtaining a random curve in the surface, while in the inside, a set of beautiful and one-off three dimensional shapes were created.

Side table CTRL
External and internal view
Photo: Marie-Louise Velthuijzen

The project was developed taking in consideration two fundamental aspects: in a conceptual level it was framed by the analogy between the concepts of Power and Control presents in the dam and their way of operation in a social context, while from the technical perspective I was able of altering the standards of operation of the machine by making it function as a 5-axis cutter. As a craftsman, it was important to take care of the material during the manual phase: listening and feeling the vibrations of the piece during the cutting to respond back with proper movement.

This project revealed to me the real core of my interest: finding solutions or new ways of approaching restrictive circumstances and transforming them into non-limiting conditions, preparing the ground and direction to the current work.

C. **Defining key terms and concepts**

1. **Power and control**

Many are the shapes that Power can embody to successfully have control over an objective. Those mechanisms are key engines of this project due to their close relation (in opposition) to the idea of freedom; in this case of study the focus will be directed to freedom of creation.

We live in a ruled world, a place where dominant groups have set norms to guide the functioning of societies according to the parameter they have considered appropriated. Having present this idea, seems to be clear the need of constant revision of those norms to verify their validity over time, otherwise we risk giving continuity to obsolete paradigms and become obedient to a system that doesn't work in our favor.

A system that covers all the needs with standardized solutions, where capacities are not challenged or creativity is not promoted, ends up sinking people in a sea of conformism and resignation. The Italian modernist artist and designer Enzo Mari, describes it by saying: “People want easy answers, they don’t want to struggle for things and that is precisely what the system wants, for us to act like zombies”. (as cited Ryan, 1997, p. 35). Moving out of the political context and in relation with other aspects of the work, an example of this condition would be the dependency to computer based systems, virtual spaces where vast amounts of easy-to-reach information are contained, structures that create feelings of satisfaction in the receiver making them unconsciously renounce to challenging realities, therefore giving continuity to the numbness and conformism. However, at this point would be opportune to analyze the responsibility of the parties, since the systems have been created for specific purposes but we as individuals are responsible for taking control over our lives regardless the circumstances.

a.) **Politics.**

Governments respond to particular interests, define rules, and prolong the continuity of these conditions in order to achieve their purposes, sometimes for the nation’s wellness and sometimes driven by personal motivations. I have experienced during the last 18 years the dramatic changes in the course of the history of my home country, Venezuela, due to the ideologies and political leaning of the group in power. Therefore, my work is impregnated with reflections and understanding about this situation.

As a political opponent to the current government in Venezuela, I have formed an opinion about how life can be affected when being under capitalist, socialist or communist contexts, but in

general, as individuals and makers (craftsman, artist and designers) living and working in different societies I am aware of the extend of responsibility I have over my work, however, it is important to keep in mind that the schemes of production and the freedom of creation can be limited and controlled by the mechanisms of the political systems.

In all cases, people should follow rules to preserve the order and prevent chaos, but it is important to identify when those rules are dragging people down and know when and how to resist and defend the liberties if it is needed. The actions of a single individual maybe do not create big changes, but in small scale represent individual revolutions (the most truly political act) that together with the effort of others may boost big moves in society.

b.) **The Venezuelan case**

Without the intention of entering into political depths I want to roughly highlight aspects of the current situation in Venezuela, in order to better understanding of some of the reason that motivate this project; reasons that have made almost 2 million citizens migrate in the last 18 years as the sociologist and researcher Tomás Páez outlined in his book "The voice of the Venezuelan diaspora" (author's translation from Spanish).

Venezuela, being rank in 2015 as the country with the largest oil reserves in the world according to the Organization of the Petroleum Exporting Countries (OPEC), is going through the biggest debacle of its history with total collapse of its productive and economic apparatus as result of the of political change scheme into socialism implemented by Hugo Chavez (president elected 1999 - 2013), and undoubtedly because of wrong decisions and policies of state taken during these years. In 2016, Venezuela was ranked as the second country with the highest annual inflation

(about 800%) according to the International Monetary Fund (IMF), and Caracas, the capital of the country, with 28.479 murders per 100.000 habitants has taken first places as one of the most violent cities of the world, as the independent OVV "Observatory of Venezuelan violence" (author's translation from Spanish) has reported.

These numbers are frightening, so do are the multiple cases of human rights violation, where cases of political prisoners can be highlighted, but in the streets the crisis can be measured based on the reduced quality of life of the citizens. The people suffer the consequences of a system that has failed even providing basic needs, and after years of opposition and protest have almost no hope of change, leaving them alone in an internal battle where those who control the system have no intentions to yield. To the date, end of June 2017, the country has been immerse in its longest protests for about 80 consecutive days, and the official report of 15.000 injured and 75 deaths.

Undoubtedly, the impotence and frustration felt by such situation makes me be more convinced about the importance of taking action to move forward and become better person and professional, and have contributed greatly as engine of this work.

2. **Arts, crafts and technology**

Modern societies are surrounded by technologies and machines that simplify the daily live tasks. Means of transport, ways of communication and products of consumption are some of the elements that have been evolving rapidly, representing a challenge for users in terms of adaptation due to the pace they occur.

Changes bring with them new forms of interaction, new languages. Creatives (artists, craftsman and designers) take them as new resources for expression, making pieces loaded with significance according to the current times.

In that moment where arts, crafts, design and technology meets and influence each other, it is important to consider the circumstances as new possibilities for positive results instead of threats, for what we have to learn how to "play the game" with the new rules, but in our own terms.

a.) **Disconnection and connection between humans and technologies**

We cannot deny that the future tends to depend more on technologies, and it is actually moving forward into more automatize processes. As in times of the Industrial Revolution when much of the labor was replaced by machines, human labor moved to other areas, thus generating over time new requirements and therefore new jobs. Likewise, in the present we have to face the challenges that new technologies bring, but being faithful to our convictions in order to successfully adapt without losing our essence as individuals and criteria for choosing what is worth it, otherwise we risk surrendering upon structures of power that tries to mold the future according to their convenience.

Now a days, computers have a crucial role and participation in the way creative work is generated and produced; therefore it is important to be aware of its extension in different stages and know how we can use them wisely.

In the moment of conceptualization of a piece, reducing the experience to one sense (for instance, only vision) can be risky, in the way that limits the possibilities of communication and perception of messages as a whole. The architect and former professor of architecture and dean at the Helsinki University of Technology, Juhani Pallasmaa (2012), refers to the distance created by computer work and the disconnection between architects and spaces (condition that applies as well to other fields as design, arts or crafts), which is detrimental to the final result: "Computer imaging tends to flatten our magnificent, multi-sensory, simultaneous and synchronic capacities of imagination by turning the design process into a passive visual manipulation, a retinal journey" (p.14).

On the other hand, it is the case of those who have decided to use technology as a tool to express themselves and find encounter points between the human condition and the virtual space. An interesting example of this is the work of the Stockholm-based artist Tove Kjellmark, named "Another Nature" (2016), where using the relatively new technology of 3D scanning and 3D printing, creates pieces based on the artistic research project of bodies in motion and explores "the glitches in transformations between digital and organic, gaps in the experience when you move from one world to another". The interesting result shows sequences of movement incomplete as result of today's limitations of the technology, while taking the advantage of this restriction on her favor, makes us reflect about the current relationship between humans and technology and its boundaries not yet crossed.

Another nature (2016)
Sculptures by Tove Kjellmark

b.) **Losing capabilities**

To develop dexterity of making, training is necessary. Repetition allows us to become skilled, but when it happens within the frame of fixed objectives, we risk losing the opportunity of exploration into other possibilities. Richard Sennett, professor of Sociology and Humanities who has wrote several texts about cities, labor and culture, pointed out: “Developing one’s talents depend on following the rules established by earlier generations; that most modern of words – personal “genius”- had little meaning in this context. To become skilled required, personally, that one be obedient.” (Sennett, 2009, p.22)

When individuals are coupled to the delimiting system, it is difficult to be aware that the individualized progress is controlled. Thereby, only few have the power to make necessary adjustments either to give continuity to the situation or stand against it. In all cases, this monotony in where man is absorbed doesn’t contribute with significant personal and therefore

collective improvements. The textile designer, poet, novelist, and socialist activist William Morris (1884), had a clear and still valid vision about the scene in a big scale, and held the economic structures responsible for using man to achieve their goals saying: “the amount of talent, and even genius, which the present system crushes, and which would be drawn out by such a system, would make our daily work easy and interesting” (as cited Norman Kelvin, 1999, p. 138) and pointing out then: “to compel a man to do day after day the same task, without any hope of escape or change, means nothing short of turning his life into a prison-torment. Nothing but the tyranny of profit-grinding makes this necessary”. (as cited Kelvin, 1999, p. 138).

A direct consequence of these recurrent processes is the distorted understanding of personal power, hence losing capabilities of independent action. In this context the continuity of this condition will make next generations victim and accomplices of the apparent unstoppable system.

3. **Changes.** *Ways of action and resources*

No change can be possible without awareness and action. Most of our daily activities are done and repeated in semi-conscious ways, following regulations and standards set in the past by the society where we live. For this reason, it is not uncommon having a natural resistance to change, but it is in the nature of artists and designers looking for options in pro of real progress for the masses.

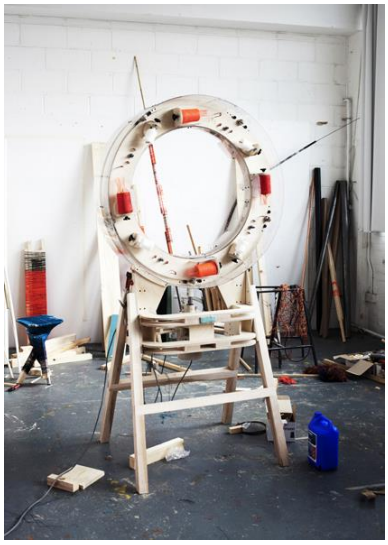
> “Trying to effect change to a system one is within is difficult, but does afford playing with possibilities, or trying to find the ‘play’ within a current system that affords other possibilities. The sustainable designer aiming at structural change must therefore be

> always also trying out different ways of living and working. In addition to the chance that such self-experimentation might light upon structural change pathways, the non-compliance with current structures that such a changing, experimental way of living entails will itself be an irritant to current structures. Sustainable designers should be visibly engaged in creatively critical acts, alerting others by example to the need for radical change. (Tonkinwise , 2017, p. 18)

a.) **Taking action**

The American existential psychologist and writer Rollo May (1975) said: “In human being courage is necessary to make being and becoming possible” (p.13), therefore resides in us the responsibility for this last to occur. In some cases non-conventional moves have to be done if we are aiming to get new results, hence seems to be necessary daring to take action despite the risks of failure, because the value of challenging the standards lies in the awareness gained during the process. It is in this way that potentialities are reveled, allowing innovation, and contributing to the collective.

An example to refer in relation with the mentioned above is the work of Anton Alvarez (2012) and “The thread wrapping machine”. He combines the design and manufacture of a device to achieve the intended result: a machine that solves external joints of all kinds in furniture, while giving new esthetic to the result through the combination of threads around the piece. In this case the existing technology was not enough to fulfill the requirements, but the willing of finding a solution made it possible.



The thread wrapping machine
Photo: Märta Thisner

b.) **Hacking the system.** *Protests and empowerment*

One of the most well-known forces of rebellion in our times against structures of control is the one represented by hackers. This concept that was initially formulated in reference to computer systems and technologies seeks to vindicate individual freedom, as the designer, craftsman, theorist, activist and researcher, and tutor of this work, Otto von Busch (2009) explains:

“Hacking is breaking control - liberating imagination, skills and action, coloring outside the lines

and escaping the paved routes of top-down limitations of manoeuvre" (p. 112). Sharing this ideology, the term has been acquired by other fields and movements that seek to achieve favorable alternatives based on existing conditions, due to this, its relevance when studying how to break down structures of power and control in reference to this work.

The hacking activity is one approach to regain control over dissatisfactory structures: “They liberate potentialities, break open new paths, show possibilities within an established and habitually used infrastructure, pushing the borders and modes of existence beyond the control mechanisms of the main hierarchies or protocols”. (von Busch, 2009, p. 113)

The hacker understands the ruled structures surrounding and knows that in other to get what he or she wants has to work with the existing conditions, dare to apply new methods, find new routes, be aware of possibilities of failure and keep betting for finding alternative procedures to achieve the goal. The social researcher Anne Galloway (2004) describes that “design for hackability means allowing and encouraging people to make technologies be what they want them to be” at the same time that explains and points out the ethical aspects and ultimate goals in hacker activity: “putting power in the hands of users; decentralizing control; protecting privacy; exceeding limitations; creating beauty; and doing no harm to people”. (p. 01)

Once these views are incorporated in regular methods and taken as basic approach to every kind of production, the potentials are obvious. This way of working not only refers to new manual and mechanical procedures, it is also a practice of empowerment, a way of thinking that challenges present structures, engage people with the processes and increase possibilities of creation by liberating creativity and opening new channels of expression.

II. **Purpose**

Key points:

- Create a new way of working with CNC machines
- Stand my position against totalitarian systems of power and control
- Raise awareness about possibilities of change, duty and right to make them happen for better

With this project I want to examine the possibilities of getting the new results in the woodworking field by using CNC machines in non-conventional ways, altering the standard protocols of use and exalting in a contemporary way, the value and importance of craftsmanship. At the same time by making evident the contrast between manual labor and CAM systems (computer assisted machines) I will explore the boundaries and meeting points between manual work and machines, humans and technology, and by challenging the predictable and control power of machines, it will be possible to prove the many possibilities of creation surrounding if we dare to think differently.

I want to produce shapes and textures that cannot be produce with the chosen technology or replicated with any other method. The work attempt to be more artistic oriented than functional (from a furniture industrial design perspective) because in this way I will be more free of exploring into ways of conveying messages through my work and understand better how to carry meanings within the broad furniture design spectrum.

The ultimate purpose of this work is to make people aware of their condition, perhaps inspire someone to change the aspects they don’t like in their lives, raise awareness about the many

hidden possibilities that surround us, and finally in retribution keep pushing myself to explore more into the unknown to find new options for future projects.

III. **Objective**

A. **Challenging the regular uses of CNC machines**

By altering the standard protocol of use of the CNC machine, I will make it work in a non-conventional way thus obtaining a new type of result.

B. **Getting new results out of existing technologies**

As a result of the experimental work with the CNC machine, new results are expected in terms of shapes and surfaces within the woodworking field

C. **Conveying message of empowerment trough a piece of furniture / work of art**

With this work I also want to explore my expression as professional and find way of communicating with an audience.

IV. **Question formulation**

Is it possible to generate new results in the woodworking field by altering the conventional use of the CNC machine?

Can the hacking theory be applied to the woodworking field?

Can I raise awareness and convey the meaning of empowerment through this work?

Is it possible to translate the results of the experimentation into relevant pieces for the field of furniture design where an artistic approach is combined?

V. **Approach**

A. **Selection of the technology to be used**

Due to the nature of the project in relation of working with existing conditions, I have decided working with the CNC machine available in our department because of its location and accessibility.

B. **Experimentation**

For the phase of experimentation it is important to analyze the function and standards of operation of the machine to understand its potentialities and be able of studying possibilities of alterations.

1. **Material and making**

The material base in all the process is wood. As experimental project part of the process of making lacks control and therefore the results cannot be forth see, but the expected outcomes will range from diverse shapes of cuts and surfaces that then can be integrated into a piece of furniture.

2. **Ways of expression**

The work aims to express the clash of forces between the involved elements (material and machine) reveling the impact of the process and convey the sense of empowerment to the audience it reach. In order to do this, it is important to communicate appropriately the message by documenting the process in written and visual forms.

VI. **Process**

Since the research part and conceptualization of the project was done in the previous course, the material work started with a plan to be developed within 12 weeks, where time was assigned to sketching, preparation of material, 3D modeling, work in the CNC machine, documentation and external visits to companies and relevant places to complement the analysis. Each of these elements contributed in the improvement of the next steps and the overall development of the project.

From its conception the project was considered experimental, which made me learn from the expected and unexpected results of every stage. I had to be prepared for adaptation and resilience in order to continue with the exploration, and challenge my own resistance to make pieces with processes out of my control.

A. **Communication and collaboration**

As a very specialized system, the CNC machine works in connection with specific softwares that precisely control its operability. In order to translate the information of the first 3D model

prepared I prepared in SolidWorks, it was highly important having the support and understanding of the people in charge of the machine. In this case, Leevi Laurila as student and technician responsible of operations had a fundamental participation in the project.

In my respect, the first challenge was to expose relevant aspects of the project's concept in early stage, explain the estimated procedure to be followed, and get his trust and approval to continue with my practice. Remaining in our roles, co-dependency occurred when I needed him as intermediary between me and the machine, as well as he needed me to give more specific guidance apart from the details contained in the files. The exchange of information about technicalities of making, and expectations in terms of processes and results were vital, as they have been present in all steps along the development of the project.

B. **First test**

A first test was programed, the most conventional pieces of the collection of experiment. Through it I was able of analyzing the potentialities of the machine, evaluate risks, and study possibilities for the next stages of the project.

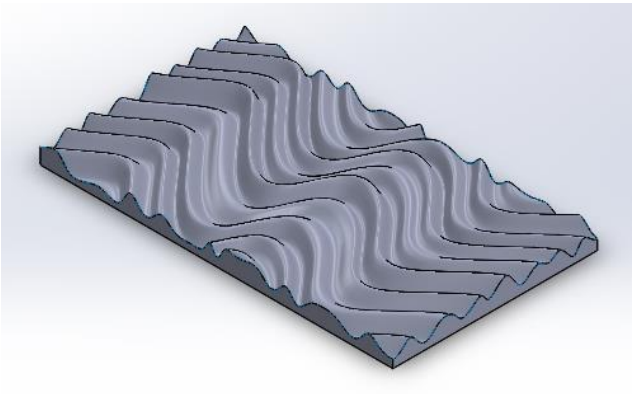
With this first piece I was able of enumerating the following:

- A basic operative standard consist in fixing the work piece (in this case a solid block of Maple wood) to the working table by the integrated suction system. No movement of the piece was allowed during the milling.
- Due to the high speed in which the machine works, safety precautions have to be taken in consideration to avoid personal accidents and risks of damaging the machine.

- Different levels of finishes and detail resolution can be obtained depending on the milling drill bits programmed to be used.
- After preparing the block of wood and the CAD (computer-aided design) file, for the first time I was not in charge of the making of the piece.

First encounter with the machine. Leevi Laurila as technician

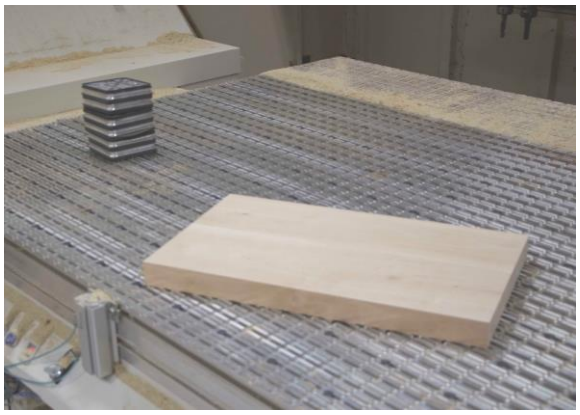
Milling drill bits



CAD file – Experiment 1

The conclusions of this step pointed out:

- Certain distance from the running machine should be taken during the process; therefore the close manual intervention considered at first, should be replaced by an autonomous mechanism of disturbance.
- The applied tools gave different qualities of resolution to original design and offered a catalog of finishes to be implemented in the next pieces. They broader up the spectrum of what aesthetics could mean in this project, by showing alternative possibilities to the ones highly defined and expected from a CNC machine.
- The experience of losing control over the production was classified as a *low level*, since the machine was partially replicating the set design but without my intervention. Higher levels of non-control can be achieved by implementing the randomness of the free-movement of the piece.



Preparation of material in CNC table

Milling process

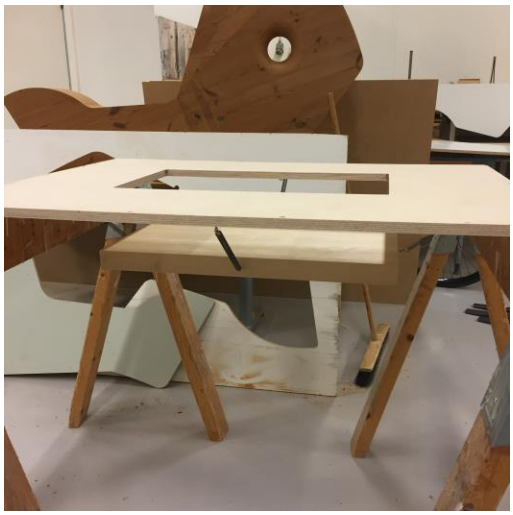
First experiment result

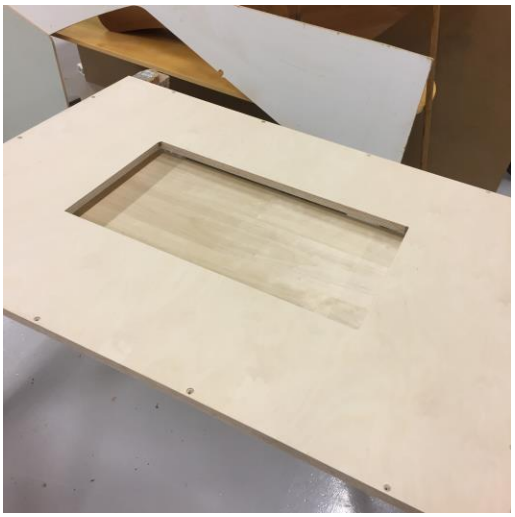
C. **Altering the system.** *The technique*

After the first experience and to continue with the exploration, it was necessary to design the system of disruption for the next experiments.

Since it was clear the necessity of having an autonomous mechanism of disturbance, I started analyzing the elements present in the set. The reflection done around the concepts of power and control pointed out what had to be considered: the machine, as element representative of power couldn't be modified in its function. On the other hand, the oppressed element represented by the material to be milled (a block of wood in this case), has to move and adapt to the condition and find alternatives ways of operation in order to get new results.

The power of speed in the milling drill bit was used as motive, engine and generator of change. The block of wood was place inside a box and from there suspended on the inside with springs allowing the access to it from an open space on the top. This way the box allowed a random movement of the wooden block as result of the contact of it with the spinning milling drill bit, creating unexpected results.





Block of wood suspended with springs from top piece of the box

D. **Sketches, models and subsequent experiments**

The experimentation phase consisted in several pieces in where the designed technique was implemented and adjusted according to the results of each piece.

Time was booked to use the CNC machine, and each piece was prepared as well as its corresponded CAD file, to test possibilities of making.

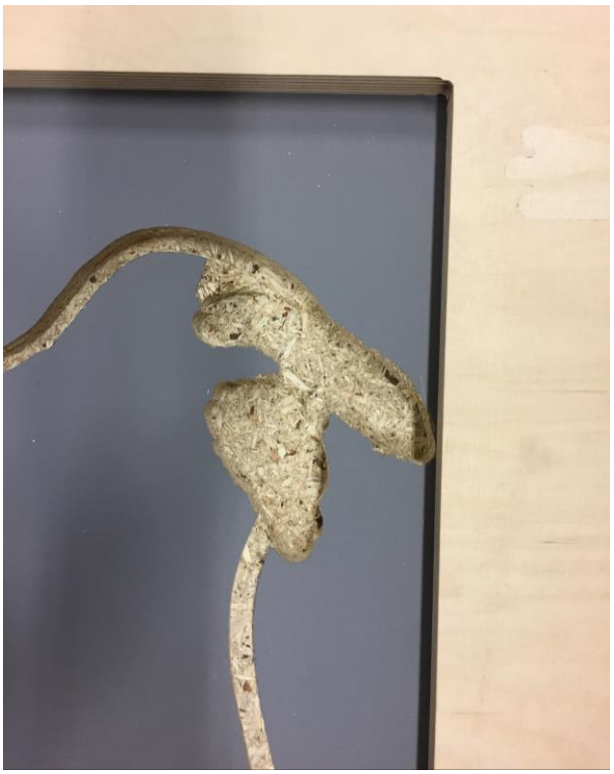
The first piece worked only with the suspension from the springs. In that case, the machine had difficulties to reach and mill the material since the movement in all directions made the contact inconsistent. This movement also suggested difficulties during the milling because the rough shakes of the piece made the springs lose contraction capabilities. As consequence the relative position of the block of wood inside of the box changed constantly, altering the surface and creating obstacles generators of more disturbance, and represented a risk for the operability of the machine.

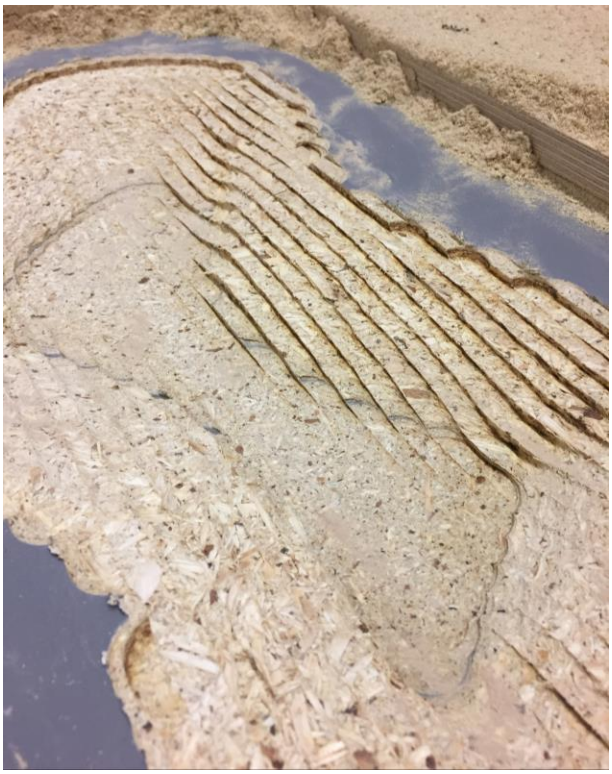
Wooden box for the developed technique

Relief resulted

After this experience, bearings were added to slightly control the movement by allowing it only to happen from side to side but not up and down, avoiding the exposure of the machine to unnecessary risks but without compromising the random component of the process.

With this new element, milling and cuts were tested into blocks of Birch wood and chipboards to challenge the system and material, and to prove possibilities of creation.





Experiments of second stage

E. **Observation and understanding of the process**

One important aspect I noticed during the work was the differences between the results depending on the material used for the milling/cutting process: in this case Maple, Birch wood and Chipboard.

The machine was programmed in all cases to follow precisely the instructions of a CAD file, but the material had also an important role in the definition of the final shapes. The grain of the wood itself directed the path to be followed. As the machine moved, the milling bit got stuck into the fibers, dragging the block and changing the position of the piece, altering completely the reproduction of the original pattern. The movement of the block created chunks of wood in the path of the milling bit, representing obstacles for the machine as long it kept running producing even more disturbance during the following steps of milling and adding randomness to the process.

VII. **Result**

Once all the experiments were done, I had a clear idea about what can be produce with this technique and which are the limitations. The final result was presented as the collection of experiments done with the developed technique in combination with the boxes used during the process, and two extra pieces that add more meaning to the set: a piece mounted on the wall and a pedestal crowned by a broken milling bit resulted from an accident during the experimentation phase.

Arrangement of pieces for the examination

A. **The experiments**

The set of experiments in combination with the boxes where they were made showed the possibilities of the technique. The arrangement included the first experiment, 3 pieces made with the same CAD file to be able of making comparison in between them, and 2 others in where hollowed carving and cutting of an outline was tested (in the making of this last one, a milling bit got broken).

Set of experiments made with the same CAD file.

Set of experiments: cutting of outline, and hollowed carving.

First experiment and box in the background.

B. **The wall**

This piece aimed to complement the collection of experiments by being a new experiment itself in where milling in fix position was combined with others in movement. Different levels of definition were also programmed to show the catalogue of possible finishing.

The block of wood was mounted on the wall through the arrangement of springs that represent how the attachment was done inside the boxes, and to allow interaction between audience and the piece by provoking them to shake the block and be the element of disturbance themselves.

Burns and rough finishing resulting of the milling was showed intact to demonstrate the violence occurred and give a hint to the spectator about the event that produced it.

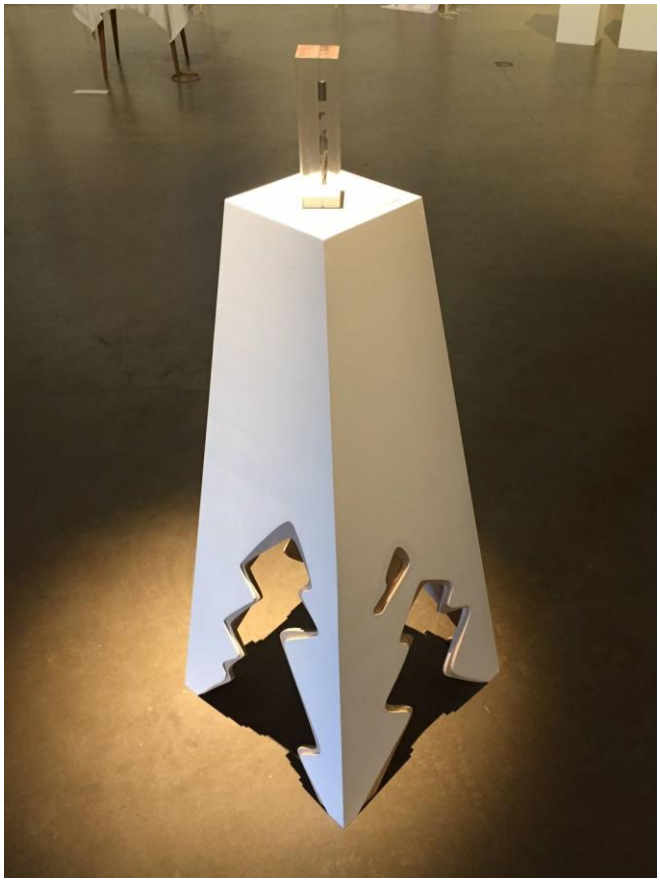
Piece mounted on the wall

C. **The pedestal**

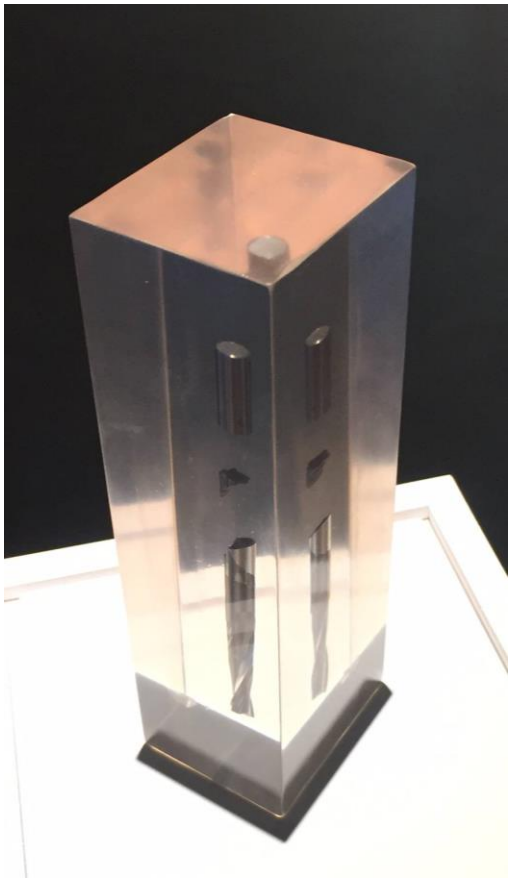
The work was done from the beginning being aware of the potential risk of the making. In all cases, I tried to push the limits according to what the previous experiences had taught me as safe, but in one of the experiments the vibrations were much more than expected, breaking up the milling bit. This opened up a new level of awareness on me, closing the circle of vulnerability of the elements involved in the process, and making a clear reference in connection to my reflections about society and those cases in where rebellion of the oppressed had shaken the structures of systems of power until the point of breaking them down.

Because this experience was significant during the process, the milling bit was included in the set and presented embed in a block of clear polyester resin. In this way the broken tool was showed as the representation of the exact moment of the accident, the breaking moment frozen in time and space.

The resulting block of resin was highlighted by being placed on top of a pedestal. This piece of furniture merged the knowledge acquired in the previous experiments by integrating cuts made in fixed position with others milled on moving panels of birch wood.



Pedestal.



Block of resin with embed broken milling bit.

VIII. **Discussion**

After the presentation, 30 minutes approx. were taken to discuss, comment, and clarify aspects of the project. The overall of criticism was positive, and showed that all the fundamental elements of the project were communicated according to the set goals. The most relevant points can be summarized and grouped as follows:

A. **The process**

The path over the process was the goal, and being critical during the developing was the core of this work. Thereby it was possible transposing the analysis from a social and political context to the making framework. The Venezuelan case as a strong driving force triggered the willing for making a constructive contribution to the woodworking field, and in this direction is was significant the appreciation that being brave and challenging for change it is also a way for innovation.

B. **The making**

An important component in the work was the element of chance. Despite of this, as a designer I was in charge of design, constrict and forth see results, even though they were all out of my control in certain extends, but the more restrictive I was during the process, the less interesting the results were. It was discussed in particular the moment when control was transferred from me to the machine, and then to the block of wood. Through this comment it was possible to point out that my position during the milling was as spectator, and this made itself a comment on our contemporary positions as makers in relation to craftsmanship, and uses of machines as a sort of handicraft.

C. **Expression**

The exploration into the quality of resolution of the milling was valuable in the way of offering new perspectives about levels of details in the finishing of the pieces. It also made reflect about standards of esthetics: what it was in the past, what we consider esthetic at present and the reason why, and our responsibility on shaping these ideas for the future.

The collection of experiments and final pieces also raised an interesting discussion about expectations from makers, viewers and participants of the process, concluding that perhaps the machine cannot be altered, but it is on us changing our own perception of the results.

IX. **Reflection**

The intersection between art, design and technology is highly interesting for me. My work has been developed within this field of study. I consider this area of work full of opportunities, since our development as a societies tends to move forward to more automatized mechanisms (therefore to more restrictions) but at the same time to new possibilities of action show up if we can recognize and learn to deal with them.

The kind of work that was done in this project aims to raise questions about how often our authenticity as individual is relegated to the convenience of others who set rules. These questions can be applied in social contexts or material work.

In direct relation to the developed technique, I learned that all the elements involved had a crucial role in the result and affect each single piece in different ways: length and amount of the springs, position, distance between them, addition of bearings, grain of the wooden block and its

relative position in relation to the machine, were elements responsible for the randomness within the process and constitute relevant elements when working this way.

Finally, *control* is an element that never disappears, it only moves within the involved parts (as well as it happens in society): as designer I was in control of the process until the technician of the machine took place, then out of my hands, the piece underwent the milling process but in difference to a normal case, this time the machine also lost control over the production. Instead, seems to be the material the one in charge and responsible of determining how affected it will be by creating resistance through its fibers and grain. The result, unique pieces in every try despite of the structured efforts of the CNC machine for making equal reproductions.

After this work, I have seen other angles of the phrase: *power is on us*, I have a better understanding of the power we have as individuals of producing change when we are aware of the resources available around us, when we interpret the current conditions and the take actions in response, either approaching the situation with standard methodology or creating new frames had has never seen before. This applies to our work or in events of life.

Hope this work can contribute to others to realize their own potential and inspire proactivity for positive changes when facing totalitarian systems of power and control.

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