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# Generative Design For Creators – The Impact Of Data Driven Visualization And Processing In The Field Of Creative Business

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## Abstract

***In how far can algorithms take care of your creative work?***

*Generative design is currently changing our conventional understanding of design in its basic principles. For decades, design was a handmade issue and postproduction a job for highly specialized professionals. Generative Design nowadays has become a popular instrument for creating artwork, models and animations with programmed algorithms. By using simple languages such as JavaScript's p5.js and Processing based on Java, artists and makers can create everything from interactive typography and textiles to 3D-printed products to complex infographics.*

*Computers are not only able to provide images, but also generate variations and templates in a professional quality. Pictures are being pre-optimized, processed and issued by algorithms. The profession of a designers will become more and more that of a director or conductor at the human-computer-interface. What effects does generative design have on the future creative field of designers?*

*To find an answer to this complex field we analyze several examples of projects from a range of international designers and fine arts as well as commercial projects. In an exercise I will guide you step-by-step through a tutorial for creating your own visual experiments that explore possibilities in color, form and images.*

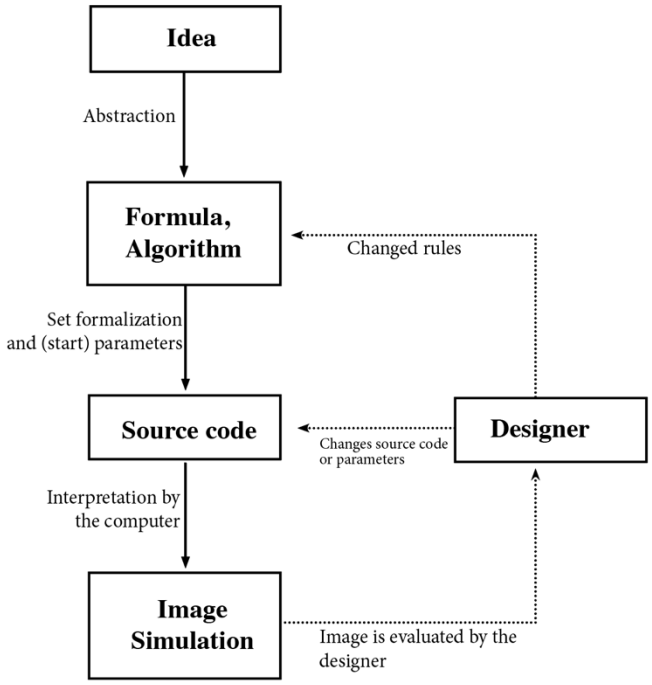


***Figure 1:*** *Model of flow of Generative Design*

## Introduction

The present work deals with three different fields of application of algorithms in the field of creative business. There are a variety of definitions of what generative design is. Originally the term refers to a design method especially in the field of Industrial Design where certain parameters (stress, material, humidity etc.) create variations of a single draft. Nowadays, Generative Design is a technology in which 2D- or 3D models are created and optimized by an algorithm. A user sets up requirements for the model, such as manufacturing processes, loads, and constraints, and then the software offers designs that meet those requirements.

This paper addresses the question of the extent in how far can algorithms create better results as an artist / designer / architect and in how far can an algorithm meet a designer's and client's high expectations? The current situation can be divided into four sections:

## 1. Algorithm as a co-creator

This chapter deals with the question about the definition of human creativity and wants to find out in how far an algorithm can support daily challenges of a creative job examining several examples.

To understand the sense of creativity we first have to look at typical human skills to be able to get a deeper understanding of the complexity of creativity. Which human skills are needed for creativity and will not be replaced by Artificial Intelligence in

Future? What characteristics differentiate humans from other forms of life and in addition to artificial intelligence?

Besides that, human ideas are not only generated by electric nerve activity but with a combination of several body activity it is clear that creativity cannot only be substituted by mathematical issues.

Human skills needed for creativity for example are:

- Empathy
- Responsibility
- Experience
- Ethics
- Systematic thinking
- Believe

First, we have to consider, that the term intelligence is a collective term for cognitive or mental performance. Creativity describes the ability to create something that is new or original while being useful or usable. Or as described by Prof. Robert E. Franken:

*„Creativity is defined as the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others."* [1]

Intelligence is kind of a superordinate, neutral term whereby in comparison creativity is performance.

Artificial Intelligence can be categorized into strong and weak KI and there are four types to be named [2]:

1. Reactive machines (f. e. a chess computer program). They were developed for limited purposes and cannot be easily applied to another situation.

2. Limited memory (f.e. in autonomous driving cars). Observations that happen in the not-too-distant future, for example, a car changing lanes. These observations are not stored permanently.

3. Native theory. In this category, AI systems have self-awareness or consciousness. Machines with self-awareness understand their current state and can use the information to infer what others are feeling. This type of AI does not yet exist.

4. Self-Awareness. In this category, AI systems have self-awareness or consciousness. Machines with self-awareness understand their current state and can use the information to infer what others are feeling. This type of AI does not yet exist.

Creativity would be a mixture of all four types. So let's consider as a first raw conclusion: Artificial intelligence is able to substitute human creativity *in some fields.* What makes it so special?

Let us next have a look at a convenient creative workflow to achieve more insights: Clients expect from creative people (artist, designer, architect) to be unique, artistically (measured in winning competitions), trendsetting (get articles in relevant newspapers) and technically firm. It mostly starts with a client's briefing and a request for a price offer. The client expects us to develop a viable and sustainable idea. We create drafts and if we like what we see, bring it to a professional level by vectorizing and finalizing it to a professional level. A feedback from the client mostly lets us draw variations in form, color, structure, layout position, shape and so on. We have a test-run and final draft / production going. But a lot of the time budget we spend for variations and finding the best / suitable design from a basic idea. The following image shows how conventional workflow is structured and where there is a lot of time investigation necessary for a successful result.

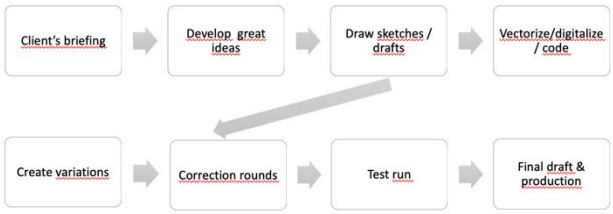


***Figure 2:*** *Flowchart of a convenient creative workflow*

the next graphic visualizes the conventional workflow in comparison to a *logarithm*-assisted creative process:

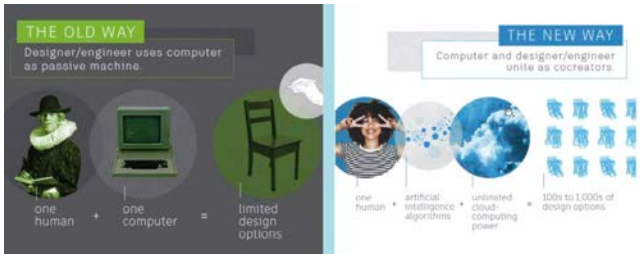


***Figure 3:*** *Flowchart of comparison of a conventional and logarithm-assisted creative process * [3]*

As can be seen from the figure, the algorithm in this example can be particularly helpful where variants and design options are involved.

Let's have a look at an illustrating example: The aircraft manufacturer Airbus relies on generative design in the further development of the A320. The Bionic Partition Wall, developed in collaboration with US software company Autodesk and created using the 3D-printing process, weights 30 kg and is therefore 45% lighter than previous components. [4]

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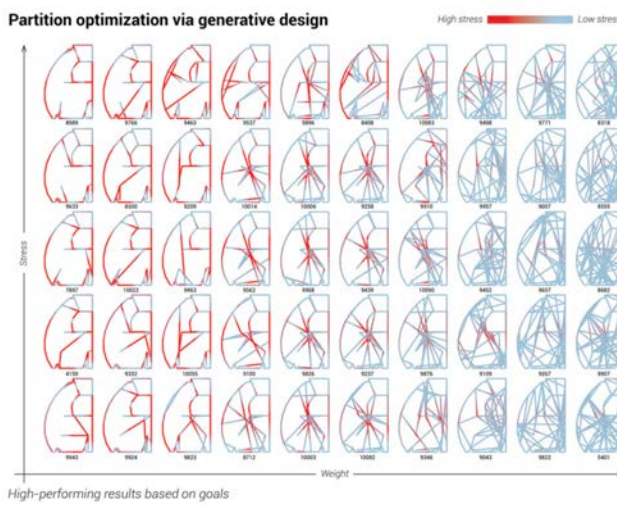


***Figure 4:*** *Optimization result of the Airbus A320 partition wall. [4]*

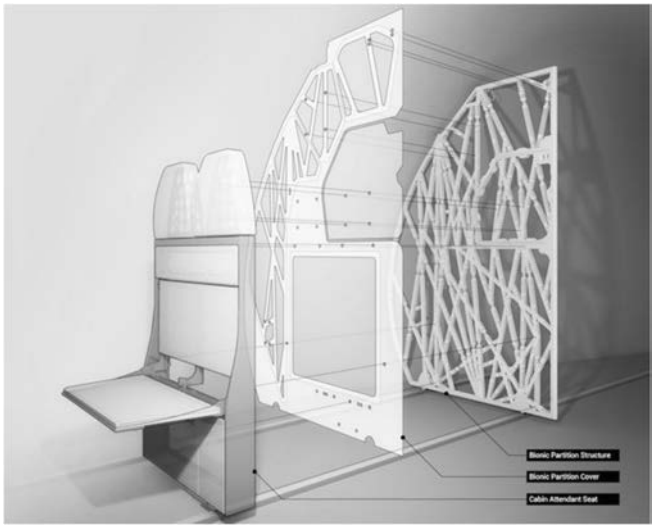


***Figure 5:*** *Assembling construction view Bionic Partition Wall Airbus A320 [4]*

**Interim summary**

An algorithm supports a creative process in the following fields as listed:

- Large range of parameter-driven variations of optimized design-drafts with little effort
- Shortens design and production process
- Creates better performing results (in the shown example lighter or more stress-resistant samples)
- Lower material costs
- Less model building (clay models) or less assembling or welding work (also thanks 3D-printing possibilities)

## 2. Algorithm as a creator

This chapter deals with the question about the impact of Generative Design in the field of art and how an algorithm can create art.

**Example 01:** The example shows the very famous series of "Campbell soup cans" 1962 by of Andy Warhol at Ferous Gallery in New York.

***Figure 6:*** *Andy Warhol Campbell Soup Cans 1962 [5]*

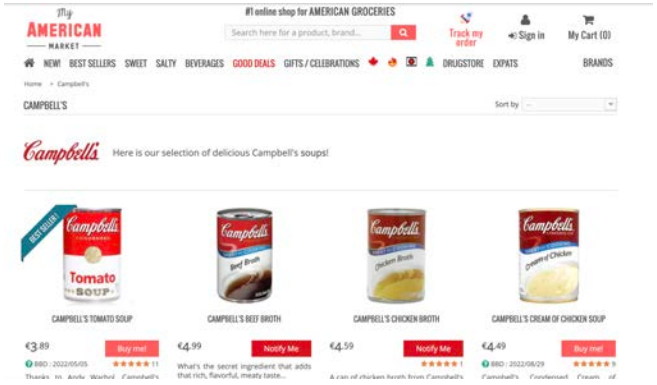


***Figure 7:*** *Campbell Soup Can for $ 3,89 in MyAmerican Market Online-Shop [6]*

There are a lot of existing namely articles about the fact that Andy Warhol's Campbell Soup Can Serie, also as a pile-up artwork of originals, is art but it's sisters and brothers sold in a simple supermarket are not. One of the most important definitions and the explanation about why Andy Warhol's soup cans are considered art, but also a common definition is made by Arthur Danto in "What art is"[7]. He explains as follows: *"What in the end makes the difference between a Campbell's soup can and a work of art consisting of a Campbell soup can is a certain theory of art... without the theory, one is unlikely to see it as art, and in order to see it as part of the artworld, one must have mastered a good deal of artistic theory as*

*well as a considerable amount of the history of recent New York painting. It could not have been art fifty years ago."* [8] Both intention and perception, then are integral to Danto's definition of art. If somebody creates something as art and that thing is perceived as art, then it is art. The importance of Danto's definition of art is that its basis is philosophical or conceptual rather than a question of the aesthetics of a piece. The reason that the *Campbell's Soup Cans* could not have been art 50 years previous to Danto's essay is because definitions of art in the early twentieth century still concentrated on the aesthetics of a piece rather than the idea behind it. Danto's definition does, however, present its own set of problems. Could art exist in a vacuum? But Art generated by a computer would still be considered art because it's about a concept.

The question exposed here, however, is not what art is, but to what extent an algorithm can generate art. To illustrate this, I would like to give two further examples.

Example 02: Bosporus Data Sculpture. Refik Anadol is a contemporary media artist based in Los Angeles. His artwork is special for that the artist is creating the idea of his artwork but the illustration itself is generated by an algorithm. This example shows that the act of art doesn't compulsory mean be bound to its result. It is enough to create a vision, the main idea and to construct an engine. The output is generated by the computer and image quality meets the audience's high expectations. The result shows that an algorithm as can be a creator as long as it is built by an artist.

***Figure 8:*** *Bosporus Data Scupture by Refik Anadol, Istanbul, 2019 [9]*

But let us look even further:

Example 03: „Elements of disruption – the noise inside learning machines" by Runway Flash Residency. Runway ML is a software that promises to create digital art by Machin Learning, and you do not need any coding skills to use it. The company gives scholarships within the Runway Flash Residency. This project called "Elements of disruption – the noise inside learning machines" was written by a runway scholarship holder. Since Friedrich Kittler [10] we know that noise is not only disturbing our messages, rather it is the message itself — that wants to be decrypted. "Let's tell a little more about the concept behind because it is really challenging and forward-looking: noise is not only disturbing our messages, rather it is the message itself that wants to be decrypted. When looking at images of machine learning, one common pattern is noise. Instead of suppressing this noise, I want to take a close look in this visual exploration. When you look at these machines generated images, what you commonly see, are very distinct artefacts. Moments of distortion, that so many engineers are probably trying to fight right now. But instead of fighting it, I want to take a closer look at the noise produced by these machines learning algorithms" [11]

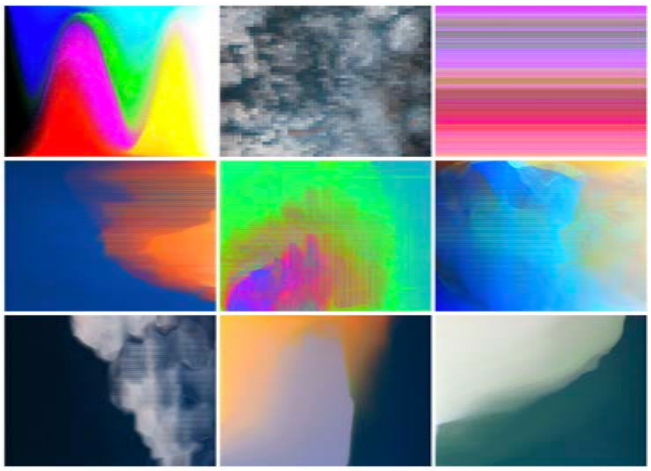

***Figure 9****: Images from Element of Disruption – the noise inside learning machines [11]*

These examples show that the question "what is art?" depends on the artists idea, who is executing it is unimportant, it can be a team of people or a machine. But yet the spark cannot be given by an algorithm. They only execute and generate. The output result is remarkable aesthetic.

*Example 04: Artwork from Sougwen Chung, "when I draw with robots", co-active drawings with AI-robots.* Soungwen's work is an exploration into machine learning of the drawing style of the artist's hand. The robotic arm's behavior is generated from neural nets trained on the artist's drawing gestures. In a sense, the robotic arm has learned from the visual style of the artists previous drawings and outputs a machine interpretation during the human / robot drawing duet.

***Figure 10:*** *Artwork from Sougwen Chung, "when I draw with robots", co-active drawings with AI-robots. [12]*

**Interim summary**

An algorithm supports an artistic process as:

- The (digital)artist creates the concept
- Artist / coder writes an algorithm which is fed by data (input)
- The visual output (animation, graphics etc.) is created by the algorithm / robot
- Algorithms change from passive to active /co-active production
- Not only reaction but also decisions are made by the algorithms.

## 3. Algorithm generating brand identity

In contrast to art, design defines itself as linked to function. "Form follows function" is the most common and easy to understand definition of Design by Louis Sullivan [13]. This guiding principle also works for Generative Design, as demonstrated later. But let us start with a convenient example showing that also this definition is interpreted broadly:

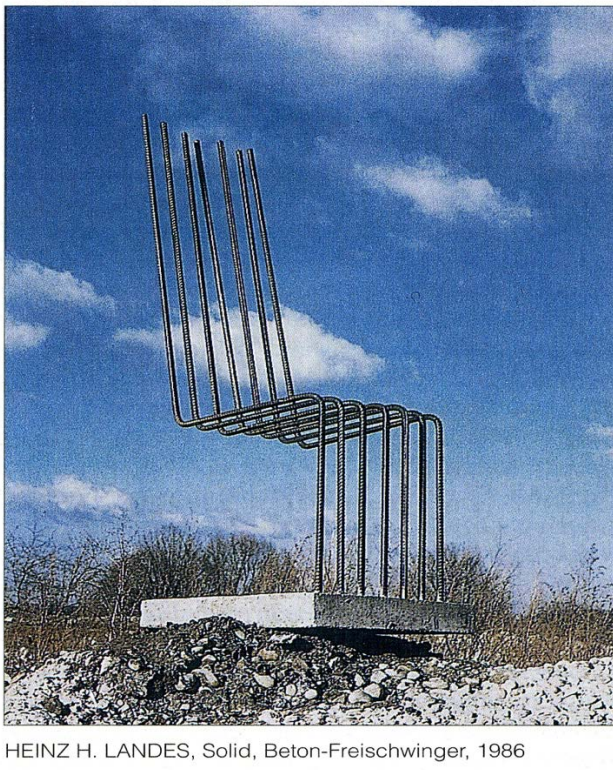


***Figure 11:*** *Heinz H. Landes, Solid, Beton-Freischwinger 1986 [14]*

Example 02: Corporate Design for Hamburg-based wine yard "Brut Wine". The idea behind using Generative Design for the product packaging and label design of their wine and sparkling wine products is that the character of every vintage is generated by weather conditions like rain, wind, sunshine and temperature. The algorithm is fed by daily weather data. if there is a lot of rain, the design becomes more tighter, using stripes and larger dots. If there is wind, there is more dynamic in the picture. At the end of the season a unique pattern is generated and printed for each single collection.


***Figure 12:*** *Corporate- and Packaging Design BRUTE Wine. [15]*

**Interim summary**

An algorithm supports a corporate design as:

- Suitable for corporate designs which have movement, progress or change within their brand values
- Algorithm creates variations, creator can choose
- Basic design has to be drawn by creative person
- High quality aesthetics

## 4. Final conclusion

Code and design are increasingly intertwined and interdependent. Meanwhile it's outdated to think that artists work with paint only or create a design by making sketches of furniture or drawing book-cover illustration only. Art universities offer more and more digital skills and media classes, because creators become code engineers of their own work. This changes the conventional education of artists and designers fundamentally. The Job description of creative people has changed rapidly.

**Away from the cliché of who is primarily responsible for the beautiful shell / optics, towards an interdisciplinary team player who is involved in the development process from the start.**

**Generative design** leverages **artificial intelligence** and machine learning to turn tedious engineering **design** processes into a sophisticated yet natural interaction between computer and engineer. The main part of the topology optimization and simulation is automatically conducted by the computing unit.

And yes it has a phantastic impact on our creative jobs whether **we use it to complement traditional techniques or to head on for a totally different understanding of art and design:**

Generative design therefore helps us to find the most efficient form in the production of three-dimensional objects and it helps us to conserve resources. In contrast to generative design as it exists in art, generative design pursues very specific intentions geared towards economic goals. In this environment, the designer is no longer necessarily the one responsible for creation. Rather, with the computer, the designer gets a “co-creator” who puts him in the role of curator himself. As such, the designer can draw on the full and in close coordination and on an equal footing with engineers, developers and other decision-makers, make the selection of the ideal design. There is no need to push through and “defend” your own design, because ultimately all designs were created using algorithms.

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This paper was especially edited for imaging.org taking place in January 2021.

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## Author Biography

*Born in Vienna, Austria. Julia Schnitzer is a Professor for Digital Media (research area: Interaction Design) at Faculty of Informatics and Media at Technische Hochschule Brandenburg. Program coordinator Master-course Digital Media M.A.. Courses: Designing Interfaces for Internet-, Mixed Reality-, BCI -, Machine Learning- & AI-applications. Frontend Development and Processing, Human Centered Design. Research in Brain Computer Interface and Mixed Reality.*

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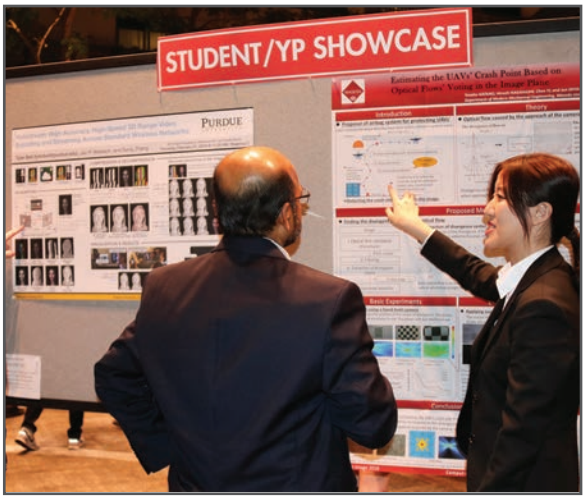


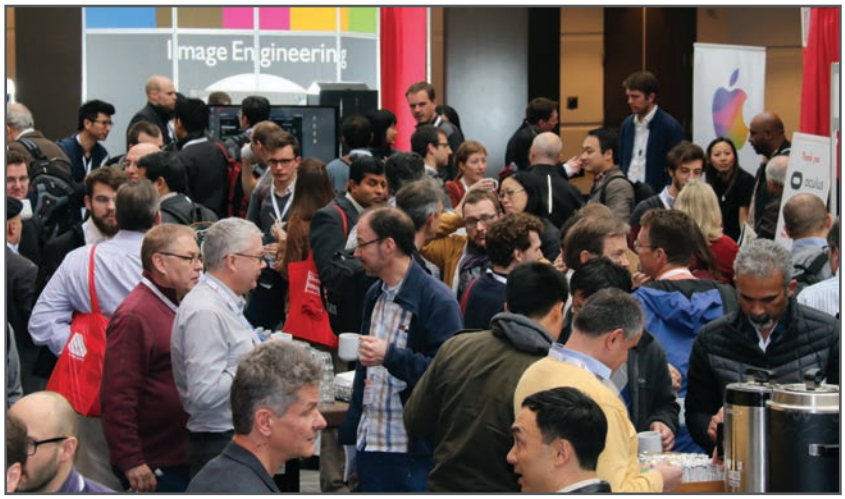



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