Innovationism between Art and Technology

Technological determinism in the controversy around Vantablack

Yuri Gabriel Campagnaro[1]

[1] Collaborating Professor, School of Music and Fine Arts of Paraná, State University of Paraná, Brazil.
yuri.gabriel@gmail.com

ABSTRACT

This article investigates how innovationism—the neoliberal paradigm framing technological innovation as a profit-driven imperative—structures the sociotechnical controversy surrounding Vantablack. Through an STS lens, we analyze how Surrey NanoSystems, Anish Kapoor, and Stuart Semple mobilize contradictory narratives that simultaneously critique and reproduce innovationist ideologies. While the material's development as a nanotechnology-based "superblack" pigment exemplifies technological determinism (treating Vantablack's emergence as an autonomous scientific breakthrough), its artistic appropriation reveals co-produced tensions between market logics and cultural production. The actors' practices demonstrate innovationism's paradoxes: Surrey NanoSystems oscillates between high-tech branding and low-end commercialization; Kapoor leverages exclusivity despite achieving similar aesthetic effects through conventional means; Semple's democratizing rhetoric relies on the same novelty-seeking mechanisms he condemns. These contradictions emerge from a shared ideological framework that naturalizes innovation as both economically necessary and socially neutral, obscuring its role in reinforcing asymmetries of access and power. We argue that the Vantablack controversy crystallizes broader tensions in technoscientific governance, where innovationism mediates between art, technology, and politics. Rather than resolving these tensions, the case exposes how even competing positions remain constrained by market-centric epistemologies that privilege short-term profitability over collective benefit. The study advances critical perspectives on innovation by unpacking its material, discursive, and ideological dimensions in contested cultural domains.

Keywords: Innovationism; Technological Determinism; Art and Technology; Vantablack; Nanotechnology.

Proposal Submitted 8 February 2024, Article Received 17 October 2024, Reviews Delivered 28 April 2025, Revised 30 May 2025, Accepted 6 October 2025, Available online 17 December 2025.

INTRODUCTION

In 2016, when the controversy surrounding Vantablack entered the art world, the various positions of the actors involved, along with media commentary, highlighted a significant observation: artists do not have access to all colors. This observation challenges assumptions about the chromatic phenomenon that are often taken for granted. Typically, colors are viewed as immaterial and readily available, aided by commercial color charts[1] and digital tools. However, this controversy reveals the materiality and limitations of color.

Despite the widespread opinions and research on the issue, there has been a lack of necessary connections between the multidisciplinary debates surrounding the subject. It is crucial to draw upon insights from Science and Technology Studies (STS), a critical perspective on technoscience, color theory, and social theory, particularly focusing on the intricate relationships between art, economics, politics, and policy.

With these perspectives in mind, our research frames the debate around a specific issue: the role of innovationism in the Vantablack controversy. This neoliberal model of invention, which prioritizes short-term profit as the primary goal of scientific and technological development, plays a pivotal role in the interactions we have studied. Our overarching aim is to understand its impact on the primary actors involved: Surrey NanoSystems, Anish Kapoor, and Stuart Semple.

We identify innovationism as a driving force behind nanotechnology inventions like Vantablack. The uncertainty surrounding its commercial viability creates a connection with mass audiences, relying on the spectacular presentation of futuristic promises. The invention of Vantablack is self-justified by its emphasis on novelty and short-term profit. This innovationist logic extends into the contemporary elite art world, where production is similarly driven by novelty and profit. As we will present, Kapoor's use of a challenging and expensive material like Vantablack to achieve an aesthetic result he had previously attained is justified by the values of exclusivity, luxury, and innovation associated with the material. Meanwhile, Stuart Semple's reaction, while also aiming to create a superblack material, frames the controversy differently, emphasizing innovation without the luxury and exclusivity of Vantablack. In conclusion, innovationism plays a central role in shaping how Vantablack is contested and enacted by these competing actors and their associated values. These practices and narratives are rooted in a deterministic view of technology, seeing it as separate from society and as the key driver of social transformation.

[1] Color charts are systematic visual representation of colors, often used to aid in color selection, identification, or understanding of color relationships.

To study this subject, we build on the sociotechnical controversy surrounding Vantablack, which we previously mapped in our doctoral research using the frameworks proposed by Bruno Latour and Tommaso Venturini (Venturini, 2010). Drawing on news reports, catalogs, scientific surveys, interviews, and statements from key stakeholders, this study examines the sociotechnical network underpinning the controversy surrounding Vantablack. The primary actors in this dispute include Surrey NanoSystems—the creators and owners of Vantablack—along with lead scientist Ben Jensen, as well as artist Anish Kapoor, who holds exclusive rights to its artistic use. Opposing this arrangement is Stuart Semple and his company Culture Hustle, which has developed alternative pigments such as Pinkest Pink and the Black 1.0–4.0 paint series in explicit protest against Kapoor's monopoly. We draw upon STS definitions of innovationism, particularly the critical perspectives offered by Oliveira (2011), Bagattolli (2013), Serafim and Dias (2015). Additionally, contributions from Cupani (2011) enable us to connect the themes of innovationism with technological determinism, the neutrality of technology, and neoliberalism.

In this text, we provide a brief overview of the Vantablack controversy, its main topics, and key actors. We then present some theoretical assumptions and concepts that underpin our analysis. Subsequently, we explore how innovationism influences the framing of each of the three primary actors—Surrey NanoSystems, Anish Kapoor, and Stuart Semple. Finally, we offer our concluding remarks.

1. CONTROVERSIES AROUND VANTABLACK

In 2014, British nanotechnology company Surrey NanoSystems developed a novel pro-duct intended for use in telescopes and with potential military applications. Composed of carbon nanotubes, this material has the unique ability to absorb light, rendering any object coated with it nearly invisible, akin to a void. 'Vertically Aligned Nanotubes Array Black', or Vantablack, is a superblack material that absorbs almost all light, with a reflec-tion rate of just 0.036% (Michael, 2018).

The product's debut got significant media attention, with commentators using metaphors such as "You must not see it to believe it" (Cascone, 2014) to emphasize its seemingly otherworldly properties. Its appearance as a black void evoked comparisons to phenomena like black holes. From the outset, Surrey NanoSystems anticipated the material's potential applications beyond its optical and military uses, suggesting that it could be employed in luxury goods, cinematography, and architecture (Michael, 2018). However, despite its striking visual qualities, the company did not initially foresee its use

in the art world. It was only after the British-Indian artist Anish Kapoor contacted them in 2015 that a version of Vantablack was adapted for artistic purposes.

The collaboration between Surrey NanoSystems and Kapoor unexpectedly stirred controversy within the artistic community. Their agreement granted Kapoor exclusive rights to use Vantablack for artistic purposes, a decision that outraged many other artists who were eager to work with the material but were barred from doing so, regardless of their willingness to pay for it. Painter Christian Furr stated that he had never heard of an artist monopolizing a material, while watercolorist Shanti Panchal described such behavior as "absurd" (Renard, 2016). These reactions prompted British artist Stuart Semple to formulate a response that extended beyond mere discourse. In 2016, Semple became the first to take concrete action by developing his own ultra-black paint. His product, Black (now in its Black 4.0 version), is made from acrylics, making it non-toxic and affordable. However, Semple's paint is sold with a unique condition: purchasers must confirm online that they are not Anish Kapoor, as Semple's products are available to everyone except his artistic rival.

Following Semple's intervention in the debate, Surrey NanoSystems and Kapoor recalibrated their strategic framing of Vantablack. In a statement posted on their official Twitter account, Surrey NanoSystems asserted that "Vantablack is not a colour, it's the complete absence of colour" (Breitenbach, 2016). This declaration introduced fundamental ambiguities regarding Vantablack's ontological status: was it truly a color, or rather a material phenomenon? Such questions precipitated deeper theoretical inquiries into the very nature of color—what constitutes a color, whether color can be proprietary, and by what criteria such determinations should be made. Surrey NanoSystems' position effectively reframed the discourse, arguing that because Vantablack represented the absence rather than presence of color, its exclusive control was justifiable across moral, political, technical and legal dimensions. Thus, what began as a dispute over artistic access escalated into a significant epistemological debate challenging conventional understandings of color theory and material production.

The controversies surrounding Vantablack are sociotechnical in nature. Debates in scientific knowledge always relate to broader social and political issues. These disagreements have historical trajectories that intertwine with the development of modern scientific method, becoming an inevitable part of relations between science, politics and society (Turnhout; Tuinstra; Halffman, 2019). Controversies usually reveal aspects that normally stay hidden, leaking beyond the scientific field and involving other social actors (Venturini, 2010).

Actors that perform a mediation role in the controversy, that are responsible for transformations and influence over the key elements of the sociotechnical network, we consider as primary (Lourenço; Tomaél, 2018). We identify them as Surrey NanoSystems, Anish Kapoor and Stuart Semple, as well as Vantablack itself.

To make Vantablack commercially viable, Surrey NanoSystems positioned it as a sophisticated technology, a professional-grade art material, and an innovative perception device. At the same time, however, the company formed connections with industries as diverse as deodorants, video games, the automotive sector (e.g., BMW), and luxury watchmakers like H. Moser (Surrey NanoSystems, 2021). These varied applications required technical modifications, resulting in multiple versions of Vantablack. For satellites, the Vantablack S-IR is used in infrared instrumentation (3µm to 25µm) for space and terrestrial applications. For telescopes, the Vantablack S-VIS superblack is optimized for space use. In the automotive industry, the VBx2.3 version of Vantablack, designed for Automotive ADAS Stray Light Suppression, reduces diffuse light in vehicle sensors. This version, which is applied via spray and absorbs 0.9% of visible light, is also the one used by Anish Kapoor.

In response to public backlash and the actions of other stakeholders, Surrey NanoSystems adjusted its communication strategy and production processes. Kapoor also had to adapt his artistic intentions, as Vantablack proved to be more technically challenging than he had anticipated, and his use of it was subject to scrutiny from a critical artistic community. Meanwhile, Semple's involvement in the controversy brought him considerable attention, allowing him to found his own color company, Culture Hustle, in 2016. This development shifted his career trajectory, increasing his success and positioning him as a figure who combines artistic practice with entrepreneurship, social media engagement, and polemical self-promotion, an interesting career strategy for an independent artist in the competitive art market.

The controversies surrounding Vantablack reveal deeper connections to a broader process of invention-driven scientific and technological development, oriented toward short-term profit. These issues intersect with technological determinism, neoliberal ideology, and the assumption of technology's neutrality. After outlining our methodological approach and theoretical assumptions in the next section, we explore how innovationism has influenced the actions and relationships of the primary actors in this controversy.

2. VANTABLACK'S CREATION AND KEY CONCEPTS OF ANALYSIS

Innovation narratives play a significant role in shaping how the actors involved with Vantablack frame the material. According to the Surrey NanoSystems website, "Vantablack is the name of a brand for a new class of superblack coatings" (About Vantablack, 2023). In an interview, Anish Kapoor discussed his use of "the newly developed pigment Vantablack" (Bronner, 2015), while reports describe how "Anish Kapoor Adds New 'Super Black' to His Palette" (Cascone, 2014). Whether referred to as a coating, pigment, or color, Vantablack is consistently associated with the concept of 'newness.' It is described as a new application of carbon nanotubes, a new technology, an unprecedented optical property, and a new kind of black.

The concept of technological innovation is often shrouded in mystification. Histories of technology tend to emphasize breakthroughs and inventions, often overlooking pre-existing techniques, which are treated as unquestioned elements of progress. These dominant narratives present technological development as linear and cumulative, embedded in the notion of continuous progress. Such a conception is problematic because it fails to distinguish between innovation and usage, ignoring the specific historical and spatial contexts of invention processes (Edgerton, 2004).

This kind of mystification can be challenged by examining the development of Vantablack more closely. Scientific research on superblack coatings began as early as 2007 (Dury *et al.*, 2007), and studies on the spatial applications of superblack coatings were published in 2013 (Hagopian, 2013). Investigations into the optical uses of carbon nanotubes followed in 2015 (Azoubel *et al.*, 2015). After Vantablack's release, other companies developed similar products. In 2017, Nanolab, a U.S. laboratory associated with NASA, produced a carbon nanotube-based superblack coating called AdVANTA Black. In 2019, MIT created its own nanotechnology-based superblack, known as Ultrablack CNT.

The production of Vantablack requires complex and expensive infrastructure. The process involves a specialized reactor that chemically induces the growth of millions of tiny carbon filaments, known as carbon nanotubes, which are responsible for the material's light-trapping properties (Threewitt, 2021). Vantablack is a fragile material that cannot withstand open environments or direct contact with mechanical abrasion. Like many nanotechnologies, it is also potentially toxic (Michael, 2018).

Vantablack's primary appeal lies in its visual effect—its total opacity and flat, texture-masking blackness. However, carbon nanotubes are not a new discovery. They were first created in 1991 by Japanese physicist Sumio Iijima, who identified their extraordinary tensile strength (Real Engineering, 2021). The novelty of Vantablack lies in the use of carbon nanotubes in optics and the exploration of their ability to absorb electromagnetic energy, including visible light.

In addition to its discursive importance, innovation has become a policy model (Bagattolli, 2013) and a central concept within neoliberal technoscientific frameworks (Oliveira, 2014). According to Langdon Winner (2018), the term innovation functions as a "god term"—a concept perceived as inherently positive and a driving force of development. Although historically linked to the modern ideology of progress, today's dominant discourse frames innovation primarily in market-centered terms.

The criteria for evaluating innovation no longer hinge on social benefit but rather on profitability. Consequently, this form of progress does not guarantee collective advancement but instead benefits a select few—namely, those with capital to invest. Winner (2018, p. 67) argues that innovation has thus become the "jewel in the crown of neoliberalism," reflecting a shift from earlier ideals of universal betterment toward a model that privileges privatization, deregulation, and private-sector solutions over public welfare. Within this framework, improvement is presumed to emerge incrementally through market-driven innovations, supplanting collective efforts toward the common good in favor of individual and corporate gains.

Following these notions, scientific activity is now primarily oriented toward producing technological innovations, which are defined as inventions that reach the market and generate short-term profit. This phenomenon, known as innovationism, promotes the commercialization of science in line with neoliberal agendas (Oliveira, 2011). Innovationist policies focus on creating the infrastructure necessary for companies and scientific institutions to innovate, dynamically reorganizing connections between social and market actors in a systemic approach (Bagattolli, 2013).

The innovationist model positions technological innovation as the engine of economic growth and views new technologies as the primary drivers of social change, aligning with the concept of technological determinism. This concept suggests that technological development is the determining factor in social transformation, following a linear model in which more innovation automatically leads to greater social progress. In this framework, technology is seen as autonomous, operating independently of human

influence. According to technological determinism, technological progress is inevitable, continuous, and self-directed, driven solely by efficiency and divorced from political or moral considerations (Cupani, 2011).

The emphasis on innovation in policy leads to institutional arrangements that link scientific institutions, such as universities, with market-oriented stakeholders, such as companies in the productive sector. This interaction fosters an entrepreneurial culture that naturalizes innovation as the primary objective of research, shifting the goals of non-market organizations toward commercialization (Serafim and Dias, 2015). Alternative criteria for scientific and technological development, including ethical considerations, are marginalized, consolidating a view of science and technology as neutral and inherently beneficial.

Thus, key concepts such as innovation, innovationism, technological determinism, the neutrality of technoscience, and neoliberalism are interconnected within a system of scientific and technological practices and narratives. As a result, scientific and technical agendas are increasingly directed toward short-term, profit-driven innovations. In line with neoliberal theory, market processes become the primary forces shaping social activities.

To explore the role of innovationism in the Vantablack controversy, we analyze how each actor frames the product. These framings involve decisions about what aspects of the product's representation—its images, metaphors, and narratives—are included or excluded. Framings are also articulated through objects and actions, such as measurement equipment, research practices, political issues, and long-term institutional structures (Turnhout, Tuinstra, and Halffman, 2019). The controversy surrounding Vantablack's nature reflects different framings by various actors, including their treatment of its nature, partnerships, and agency. Analyzing these framings allows us to better understand the role of innovationism in the Vantablack controversy as a whole.

3. SURREY NANOSYSTEMS, INNOVATIONISM AND NANOTECHNOLOGY

In 2016, two years after its creation, Vantablack was featured on BBC's The One Show, where it was likened to a black hole. Presenter Marty Jopson demonstrated its non-reflective properties by shining a flashlight on it, remarking that Vantablack "has the potential to revolutionize our understanding of the universe" (Onetruechannel, 2016). In both verbal and visual representations, Vantablack was portrayed by its creators as a highly sophisticated, futuristic innovation developed using advanced tools, such as a

specialized reactor, in a pristine laboratory environment evocative of settings seen in science fiction movies.

These representations frame Vantablack as a refined and exclusive technological object. However, subsequent partnerships formed by Surrey NanoSystems introduced actors from diverse, and often contrasting, sectors. Some of these partners are linked to the luxury market, such as the Swiss watch brands MCT and H-Moser, which produced luxury watches featuring Vantablack in 2016 (Fenner, 2016), and BMW, which produced a single model entirely coated in Vantablack for the 2019 Frankfurt Auto Show (Koenig, 2019). On the other hand, partnerships with more mainstream and mass-market actors also emerged, including the popular deodorant brand Lynx, which covered a bottle in Vantablack for exhibition in 2016, a pavilion built for the Winter Olympic Games in South Korea (Surrey NanoSystems, 2022), a promotional event for the video game Call of Duty: Black Ops 4 in 2018 (Kelly, 2018), and stage designs for French DJ Gesaffelstein in 2019 (Deahl, 2019).

These seemingly disparate collaborations can be better understood by examining Vantablack's relationship to innovationism. Vantablack is not merely a technology but a nanotechnology, which carries significant implications. The primary criterion for defining nanotechnology is its scale. According to the U.S. National Nanotechnology Initiative, nanotechnology involves the manipulation and control of matter at dimensions of approximately 1 to 100 nanometers[2] (Barben *et al.*, 2008).

Over the past thirty years, research and applications in nanotechnology have made significant advances in fields such as pharmaceuticals, electronics, materials engineering, and optics. Nanotechnology has grown alongside biotechnology, information technology, and cognitive science. Despite these advancements, nanotechnology is not a well-defined field, as it is not approached in a linear or disciplinary manner. This lack of clarity underscores the importance of promoting public acceptance and the feasibility of nanotechnology by propagating positive images of its development. As nanotechnology enters into public discourse, often politically charged, a strong polarization has emerged. There are optimistic interpretations, which herald nanotechnology as revolutionary, and pessimistic ones, which raise concerns about its potential risks (Mattedi *et al.*, 2011).

[2] For comparison, the average thickness of a human hair is 80,000–100,000 nm (0.08–0.1 mm), making nanomaterials at least 800 times smaller than a hair's cross-section.

These opposing perspectives are evident in the controversies surrounding Vantablack. Just as nanotechnology is hailed by its proponents as revolutionary, Vantablack is presented as capable of creating a new color and a novel visual experience, often described as "the blackest material in the universe" (Batycka, 2022). Conversely, critics, such as Stuart Semple, emphasize the risks associated with nanotechnology and highlight that, in contrast, his own black paint is non-toxic and does not require state approval for purchase.

Innovation in nanotechnology often focuses on future possibilities, with significant emphasis placed on the representations of its potential. As Mike Michael (2018, p. 1107) notes, in the case of Vantablack, "its full aesthetic potential is not necessarily self-evident but must be mediated through artistic practice." The various demonstrations conducted by Surrey NanoSystems with partners such as Lynx, BMW, and Anish Kapoor serve to show us what Vantablack looks like more than what Vantablack is able to do (Michael, 2008).

> The main point to draw out here is the uses (or viability) that are associated with VANTAblack largely do not exist in the present (cf. Collins's case study where the demonstration aimed to establish the current safety of the flasks) but in the future (i.e., prospective applications). Aesthetic experience thus serves in the assessment of potentiality or promise: it is another means of enacting expectations (see Borup *et al.*, 2006). (Michael, 2008, p. 1112)

The uncertainties surrounding the product's initial applications, coupled with its high cost and complex production process, prompted Surrey NanoSystems to seek short-term profitability. In addition to building an audience based on future promises, as explained by Michael, the diversity of partnerships also helped the company identify immediate commercial opportunities.

The partnerships cultivated around Vantablack strategically harness both the product's novelty and the cultural authority of nanotechnology, capitalizing on the pervasive assumption that technological innovation represents inevitable progress. Through carefully crafted media presentations that emphasize technical achievement over social context, Surrey NanoSystems reinforces a worldview that frames Vantablack's development as an autonomous, unavoidable outcome of scientific advancement rather than as a contingent product of corporate strategy.

For public audiences, this framing reduces complex innovation processes to spectacular demonstrations of technical inevitability. By presenting Vantablack's existence as simply the next logical step in material science, all sociopolitical considerations regarding its development costs, accessibility, and social utility become obscured behind an apparently predetermined trajectory of technological progress.

Nanotechnology's significance in the paint and color industry stems from its ability to produce structural or physical colors. Unlike chemical colors, which result from molecular bonds, structural colors arise from the architectural structure of molecules that filter light in specific ways (Assis, 2013). This phenomenon is observed in nature, such as in the blue wings of butterflies. The discovery that some colors derive from the physical structure of materials at the microscopic level inspired the development of optical nanotechnology (Paleja, 2023).

While Vantablack is not the only structural color produced through nanotechnology, it was one of the earliest. NanoLab introduced AdVANTA in 2017 (Optical Black Coatings, 2023), and MIT developed Ultrablack CNT in 2019 (Chu, 2019). In 2021, Purdue University created a superwhite color, which, while not made with nanotechnology, is often compared to Vantablack (Wiles, 2021). In 2022, Singaporean researchers developed a red pigment using nanotechnology (Site Inovação Tecnológica, 2022).

The controversy sparked in the art and color industries by Vantablack opened new avenues for exploration. Before its collaboration with Anish Kapoor, Surrey NanoSystems had not anticipated Vantablack's application in these domains. The controversies surrounding it established Vantablack as a potential new method for producing structural colors for art purposes using nanotechnology, encouraging competition and the entrance of other companies and products into this emerging field.

Following Vantablack, developments in superblack materials initially intended for telescopes and military applications, such as AdVANTA and Ultrablack CNT, were soon joined by products designed for the art world. NanoLab, for instance, created a black oil paint called Gravity Black Oil Paint, as well as a soluble paint using nanotubes called Singularity Black. It also made a partnership with artist Jason Chase to demonstrate its artistic potential (Optical Black Coatings, 2023). MIT also promoted the artistic application of its superblack by collaborating with artist Diemut Strebe, who used the nanotechnology coating in his artwork 'Redemption of Vanity' (Chu, 2019).

As explained above, the development of Vantablack and similar ultra-black materials originally served only technical applications. For the scientists and engineers behind these innovations, artistic use constituted an afterthought at best, an accidental byproduct of research targeting functional rather than aesthetic purposes.

This stands in stark contrast to the artistic perspective that fueled Stuart Semple's opposition and the subsequent creation of alternative pigments. Where scientists see

precise light absorption measurements, artists recognize a medium for human expression. Where technologists develop materials to solve engineering problems, creative practices engage with color as cultural communication.

The ongoing controversy ultimately reveals two irreconcilable frameworks: one that evaluates Vantablack through metrics of technical performance, and another that interrogates its cultural meaning and accessibility. This fundamental tension—between color as quantifiable phenomenon and color as lived experience—persists throughout every stage of the debate.

Innovationism, characterized by the pursuit of novelty as the primary focus of research and technological development, is embedded in a deterministic view of technology as a linear and cumulative process that prioritizes efficiency and short-term profit. In the case of nanotechnology, the uncertainty surrounding its present-day viability underscores the need to connect with mass audiences through demonstrations and aesthetic experiences, grounded in promises of future potential. The seemingly contradictory partnerships formed by Surrey NanoSystems, which blend an aura of sophisticated technology with purely commercial actors across both high- and low-end markets, can be understood within the framework of innovationist processes. Novelty itself serves as a justification for its development in a type of framing that is not familiar to an artistic and sensible perspective of color.

4. ANISH KAPOOR AND INNOVATIONISM IN THE ART WORLD

In the previous section, we explored how Surrey NanoSystem's public demonstrations of Vantablack align with narratives of nanotechnology and innovationism. In this section, we will examine the nature of these demonstrations, identifying the aesthetic values and mechanisms at play to better understand their presentation. Several common characteristics are evident across Vantablack's exhibitions. First, these displays are never permanent; they are transient, typically lasting only a few days or, at most, a few months. Opportunities to see Vantablack are rare and limited. For instance, after its appearance on The One Show in 2016, it was publicly displayed for approximately one month, and less so by Lynx deodorant. In 2019, Vantablack was featured only at the Frankfurt Auto Show and as part of Gesaffelstein's stage design at the Coachella Festival, both short-lived events. In 2022, it was displayed in Kapoor's works at the Venice Biennale, with some of his pieces continuing to circulate in temporary exhibitions worldwide.

A significant aspect of these presentations is the cultivation of an image of exclusivity and luxury. These events are often not fully open to the public. In the more accessible displays, such as those organized by Lynx and BBC, attendance requires registration, and spots are limited. The other venues, such as art galleries or car shows, are restricted spaces that either require paid entry or special invitations. Apart from public exhibitions, the other means of experiencing Vantablack is through the purchase of products incorporating the material, most notably luxury watches, which can cost nearly $100,000 (Fenner, 2016).

Surrey NanoSystems effectively associates Vantablack with values of rarity, exclusivity, luxury, and sophistication. When viewed alongside the marketing strategies, media reports, and social media activity surrounding the material, the importance of spectacle becomes clear. Vantablack, often referred to as the "blackest material in the universe" and compared to a black hole, is portrayed as capable of transforming not only science and technology but also our perception of reality. These narratives are crafted to inspire awe and admiration.

In the realm of art, Vantablack's allure can be attributed to its unique optical property: complete opaque blackness. From the perspective of optical physics, color is an electromagnetic wave with a specific wavelength perceived by humans, and its properties can be quantitatively measured. In this context, black is the absence of light, occurring when no such waves are present. Black is thus associated with darkness[3]. This perspective is useful when discussing light as color. However, color is also experienced in a different dimension. Light rays interact with objects, which absorb and reflect certain wavelengths, depending on their properties. This interaction is the basis of color-pigments, defined by the chromatic elements present in molecules[4] (Pedrosa, 2009). In this context, a black object absorbs all incident light, yet in reality, even black objects reflect some light, allowing us to perceive their three-dimensional form.

Thus, color-light and color-pigment are two distinct dimensions of color perception, operating according to different principles. In color-light, the primary colors are red, green, and blue, and combining green and red light results in yellow. Conversely, in color-pigment, the primary colors are cyan, magenta, and yellow, and combining red and green pigments results in a neutral gray. Each dimension operates under different color

[3] This understanding of color originates from Isaac Newton's prism experiments, which demonstrated that visible colors (the rainbow of the color spectrum) are components derived from white light.

[4] This dimension of color (as material pigment mixtures) is the one most commonly employed by artists in their practical work with paints and pigments.

systems, requiring distinct color wheels (Silveira, 2015). Vantablack bridges these two realms, producing a black pigment in physical objects that mimics the blackness of color-light. Its exceptionally low reflection rate makes the black pigment appear as it does in the absence of light. This is why Vantablack can be considered a new color, and why its experience is so captivating, as it challenges our usual perception of objects.

However, other manipulations of pigments have previously achieved similarly opaque black effects in physical materials. Many artists have already explored these effects in their works, with Anish Kapoor being one of the most notable. In fact, Kapoor's extensive history with the use of black pigments legitimized his exclusive control of Vantablack. His use of black is rooted in a quest to translate darkness into physical form, resonating with internal emotional states. Kapoor himself has stated, "A work will only have that deep resonance that I try to indicate if the kind of darkness that I can generate, let's say in a block of stone with a cavity in it that's very dark, if the resonance that's in that stone is something that is resident in you already." (Vidal, 2014, p. 54).

Our aim here is not to conduct a poetic analysis of Kapoor's works but to highlight that he had already succeeded in achieving total blackness before using Vantablack. For example, Adam (1989) features a block of stone carved and painted with dark blue pigment, creating a squared form that contrasts with the organic nature of the limestone. In Descent into Limbo (1992), a black hole in the ground confuses the viewer's sense of two- and three-dimensional space, to the extent that in 2018, a visitor to the installation fell into the hole, resulting in hospitalization (Block, 2018). By contrast, works made with Vantablack, like Non-object Black (2022), must be enclosed in glass boxes due to the material's fragility and toxicity. The reflective glass, however, diminishes the sense of infinite depth that Vantablack is meant to evoke, having less impact than Kapoor's previous works.

If Kapoor had already mastered the use of black to evoke darkness, why adopt Vantablack? Despite its remarkable properties, Vantablack is costly and difficult to produce. Moreover, after the negative backlash surrounding Kapoor's exclusive rights to the material, there was heightened anticipation and scrutiny surrounding his work with the nanotechnology. To understand this, we must consider how contemporary art engages with technology.

According to Paulo Laurentiz (1991), in the shift from modernism to postmodernism, materials are no longer viewed as passive and malleable in art-making. Instead, their resistance is acknowledged as an agency in itself. In contemporary art, the interaction between materials and the artist's subjectivity co-produces the artwork. Thus, materiality

—rather than the material itself—becomes the focus. As Gompertz (2013) observes, post-modern art fundamentally engages with critical questions of authenticity, authorship, reproduction, and identity. Contemporary artistic practice particularly emphasizes experiential and entertainment values, while reconceptualizing materials as active agents capable of their own expressive potential (Gompertz, 2020).

Therefore, for Kapoor in particular, it is not just the optical effect of Vantablack that matters, but the process by which it is made, including its technical and material challenges. Poetic narratives actively incorporate and explore all elements inherent to the materiality we have previously discussed. Vantablack's rarity, its high cost, it all creates poetic meaning, that changes the way spectators relate to the artwork, as well as the interaction between artist and material. The difficulty of production, the rarity and the high cost are not obstacles but integral to his artistic choice. Kapoor uses Vantablack because it is expensive, exclusive, and innovative.

This approach is consistent with Kapoor's career and artistic philosophy. Many of his works employ advanced technology and command high prices. In his pursuit of illusionism, Kapoor manipulates monetary value as a mythological element, attributing emotional significance to the symbolic power of high prices. His artistic endeavors frequently require substantial financial backing to achieve the desired results (Vidal, 2014). Kapoor's exclusivity in using Vantablack can be seen as part of his broader artistic practice —an artistic performance in its own right. At this point, technology, market forces, and poetics converge, with the latter becoming intertwined with issues of private property, commerce, and the creation of myths.

Innovation is a central theme in contemporary art, often linked to the intersection of art, market and technology. While art movements like Dada and Pop Art have questioned notions of originality and individuality in art creation, art historian Will Gompertz (2013) notes that in the more established realms of the art world, values of originality, authenticity, and rarity remain fundamental. These values are crucial for the art market and influence the pricing of artworks.

We cannot incur in an apocalyptical view of technology. Evidently, not all forms of novelty constitute the "innovationism" we critique here. As Winner (2013, p. 65) observes, some innovations are benign—those whose creative processes respect traditions while opening new, fruitful possibilities. What defines the innovationism we critique is its ideology of abrupt rupture with the past and its primary focus on market-driven profit through privatized processes.

Therefore, in analyzing Kapoor's engagement with Vantablack, we must recognize that the mere presence of material agency—that understanding of artistic media as co-creators central to much poetic practice—does not itself constitute innovationism. The decisive factor lies rather in the particular terms of this relationship. Kapoor's valuation of Vantablack foregrounds its most ideologically charged aspects: its presentation as a self-evident technological breakthrough that demands acceptance (a stance echoing technological determinism's fiction of context-free invention), coupled with its feature of an exclusive commodity (embodying neoliberal strategies of value extraction through artificial scarcity and market capture).

The connection between Kapoor's framing and these problematic innovation paradigms emerges not from any general poetic impulse, but from the specific values these representations carry—namely, the naturalization of innovation as private property and technological change as an autonomous force.

5. STUART SEMPLE AND THE RACE TO A NEW SUPERBLACK

The role of invention as a driving force in the development of science, technology, and art is particularly evident in exclusive spaces like nanotechnology laboratories and the Venice Biennale, as previously discussed. It is precisely against these spaces and their exclusivity that Stuart Semple frames his actions. Both his products and declarations challenges the values of exclusivity, rarity, luxury, and sophistication associated with Vantablack, as established by Surrey NanoSystems and Anish Kapoor, and rooted in an innovationist framework.

We emphasize Semple's response not merely for the critical stance he claims to uphold, but fundamentally for its mode of intervention. Rather than limiting himself to discursive critique or symbolic protest, his opposition operates within the productive sphere—becoming the first to develop an alternative material to rival Anish Kapoor and Surrey NanoSystems.

Denied the opportunity to act as a consumer, Semple adopts the role of a manufacturer. Since Vantablack is not available for purchase, Semple creates his own "superblack" that is accessible to the public. However, there is an inherent asymmetry between Semple's enterprise and that of Surrey NanoSystems. While Semple's company, Culture Hustle, specializes in producing paints and pigments for artistic purposes, Vantablack's application in art is the result of a negotiated arrangement with Kapoor—it was not originally

intended for such use. Vantablack is produced using complex and costly nanotechnology processes, whereas Semple employs acrylics and pigments in a nearly artisanal manner. In this way, by positioning his product as a counterpart to Vantablack, Semple is also questioning its fundamental nature, challenging Surrey NanoSystems' assertion that Vantablack is not a color, but a material.

According to Semple (2021), inks, paints, and pigments can be categorized along two axes: ordinary/extraordinary and accessible/inaccessible. Ordinary, affordable paints are those commonly used by artists in their daily work, widely available in art supply stores, and often of lower quality. In contrast, products like Vantablack are extraordinary, both difficult to produce and rare. They possess unique optical effects and are inaccessible to the general public. Therefore, according to Semple's narrative, Culture Hustle's goal is to make extraordinary materials affordable and available to all.

His framing represents a stark contrast to the framing of Surrey NanoSystems and Kapoor. Culture Hustle is positioned as providing materials that are not expensive, toxic, or exclusive. Semple's discourse centers on "sharing the world's flattest, mattest, blackest art material," and offering a "better black," one that is superior not because it is less reflective, but because it is accessible (Semple, 2017). Semple's activism in other color disputes—against Tiffany's and Barbie's color trademarks or Pantone's paid digital color packages—further reinforces this democratic approach. As a result, he has been labeled the "Robin Hood of the art world" by some journalists (Leffler and Shannon, 2023).

This type of qualification is symptomatic of a significant contradiction in Semple's practice and narrative. The artists' own statements often contain self-promotional distortions, particularly in the competitive art market, and no matter how democratic or critical Semple's interventions may appear, they are not free from contradictions. While Kapoor is already one of the most prominent figures in the international art scene, Semple was virtually unknown until the Vantablack controversy. His activism enabled him to build an international career. This contradiction is consistently evident in his behavior: on one hand, a democratic hero; on the other, an opportunist who leverages political debate to profit from his paint company and gain visibility in the art world.

Despite their disagreement, Semple's enterprise shares common ground with the very actors he opposes. To compete or create a narrative of competition, he must engage in the same market space. Ultimately, Semple also seeks to produce a superblack, which explains his initial sense of exclusion from Kapoor's monopoly over Vantablack. He too is captivated by the allure of total opacity, and though he does not frame it as exclusive, he emphasizes its fascination.

On the other hand, Semple's framing of colors encompasses not only their intrinsic optical properties but also the ideological, economic, and cultural values associated with art and technology. In the case of Culture Hustle, extraordinary colors are not only those that behave uniquely—shining, changing, highly saturated, or opaque—but also those that are somehow forbidden. At times, the extraordinary resides more in the narrative surrounding the color than in the color itself. Semple frames his products as art performances, integrating poetic, technological, and political dimensions into a unified whole. In aesthetic terms, Semple does not reject the fetishistic or sublime experiences associated with superblacks, nor their role in spectacle—all of which are central to Kapoor's use of Vantablack.

It is also important to recognize that while Semple contests the meanings surrounding Vantablack, highlighting its exclusive associations and offering an alternative, Vantablack profoundly influences him. His artistic practice increasingly engages with issues surrounding color controversies, making them central to his career.

His discourse, however, can sometimes be violent. In a behavior typical of social media dynamics, he tends to amplify his voice by diminishing the opponent, often creating caricatures that simplify and exaggerate their positions. As art historian John Gage cautions, artists' public statements should not be taken at face value, as they are often mediated by self-promotion (Gage, 1999). In Semple's case, some of his rhetoric can border on incitement, including personal attacks on Kapoor, whom he has compared to murderers and labeled a "smelly rotter" (Semple, 2015).

Moreover, while Semple promotes accessibility, the prices of his products are not necessarily inclusive, especially outside the UK. Additionally, there are significant differences in how he and Surrey NanoSystems protect their innovations. Legal mechanisms, such as patents, are designed to strike a balance between rewarding inventors and preventing monopolies (Morales *et al.*, 2022). Patents offer protection while also making the invention's details public. In contrast, Semple's superblacks are protected through trade secrets, which keep their production methods hidden from the public. From this perspective, Vantablack's patent system is arguably more transparent than Semple's informal protection methods.

Beyond the legal and policy issues, the ethical and political debate surrounding access and common use remains crucial. Despite Semple's contradictions, his activism has succeeded in disrupting what was previously a monopoly. It is a fact that before his intervention Vantablack was the only superblack available and was exclusively reserved for

Kapoor. Semple not only created an alternative superblack but also inspired other companies to develop their own versions, many of which are now used in artistic representations.

At the same time, Semple's actions align with the innovationist paradigm at some degree, as he competes to develop the blackest black and other novel pigments—framed as groundbreaking advancements in color production—while reinforcing an economic enterprise that bolsters his own career. However, his framing diverges from the neoliberal market, which prioritizes profit as the main objective of invention. Semple emphasizes political concerns of access as the central focus. While we might question whether his political narrative serves more as a marketing strategy to promote his products and enhance his personal brand, these shifts remain important in challenging the innovationist model.

6. FINAL REMARKS

In this study, we examine the role of innovationism in the sociotechnical controversy surrounding Vantablack—a dispute that intersects science, technology, color, art, politics, law, and economics. We begin by outlining the key events, identifying the primary actors and their interactions. After presenting the main theoretical frameworks, we analyze how innovationism influences the actions and narratives of those involved in the controversy.

Our findings reveal that the actions of the actors involved in the controversy continually frame, disrupt and contest the materialities, meanings, and applications of Vantablack—all in constant interplay with innovationism. This innovationist drive is, at certain points, shared among the actors, while at others, it is contested; yet it remains an ever-present force in their practices. We demonstrate how the notion of groundbreaking inventions, driven by corporate profit motives, permeates the contemporary art world, intersecting with both aesthetic and ethical values. Simultaneously, we observe that even within these contradictions, there are ongoing disputes over which ethical principles should guide innovation—whether market-oriented scopes or democratic values rooted in accessibility.

Further, our research identifies key connections between innovation, technological determinism, and neoliberalism, which manifest in the contradictory stances of all primary actors. Surrey NanoSystems, for instance, promotes Vantablack as a sophisticated technology while forming partnerships with low-end commercial sectors, resulting in discursive incoherence. Kapoor, despite his pursuit of technological novelty, had already achieved similar aesthetic effects prior to Vantablack, exposing the complexities of

artistic processes and their entanglement with market dynamics. Semple, though framing his practice as democratic, engages in controversial and Manichean rhetoric for self-promotion. Beyond these individual contradictions, we also highlight the irreconcilable perspectives on color—whether as a byproduct of nanotechnology or as a medium for artistic expression.

Despite the centrality of innovationism in these debates, we argue that while it exerts a strong influence, extending into the artistic sphere, it is still possible to challenge this paradigm through actions that integrate artistic, technological, scientific, and industrial dimensions within a single agency. Although Stuart Semple's many contradictions, his emphasis on accessibility as the ultimate objective of technical and artistic production points at a good direction, because it makes us think of ethical implications of technical choices. Based on this type of concern, we can imagine an alternative approach for considering the kinds of innovation public policy might support and invest in.

The neoliberal claim that the profitability of innovation leads to social development rests on the assumption that technology is neutral and exists outside of politics and ethics. Its autonomous growth is presumed to result in greater efficiency and, consequently, enhanced productive capacity. This notion believes that market economies are inherently rational and that their autonomy ensures sustainable development when left unregulated (Harvey, 2004). Innovationist policies are grounded in these concepts. As we find in this research, such concepts are also present in art, culture and technology.

A way to challenge this doctrine is to develop innovation with alternative foundations and outcomes in mind. The key to opposing the idea that both technology and the economy are neutral, apolitical entities lies in incorporating ethical and political values into the innovation process, thereby redefining its primary objectives beyond mere technical efficiency. Maybe this controversy can help us question why do we need superblack colors and how we want them to be made, shared and used.

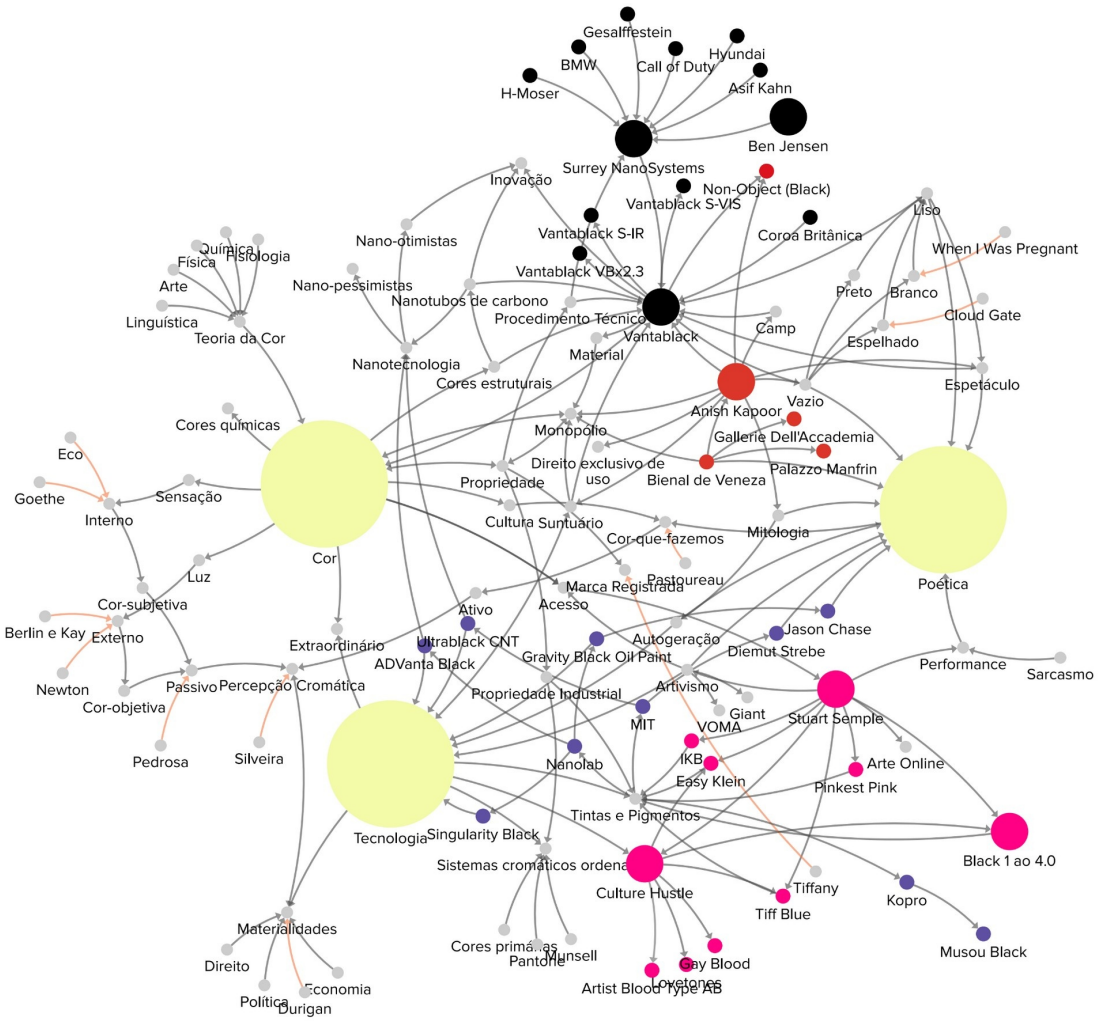

Figure 1. Sociotechnical map of the Vantablack controversy: actors, products and relations.
Source: elaborated by the author.

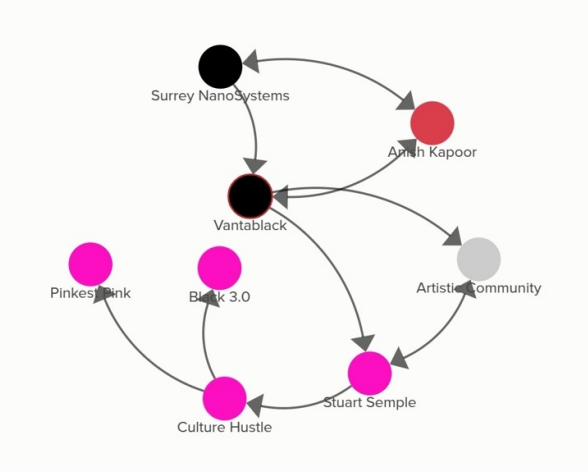

Figure 2. Network of Key Actors in the Vantablack Controversy.
Source: elaborated by the author.

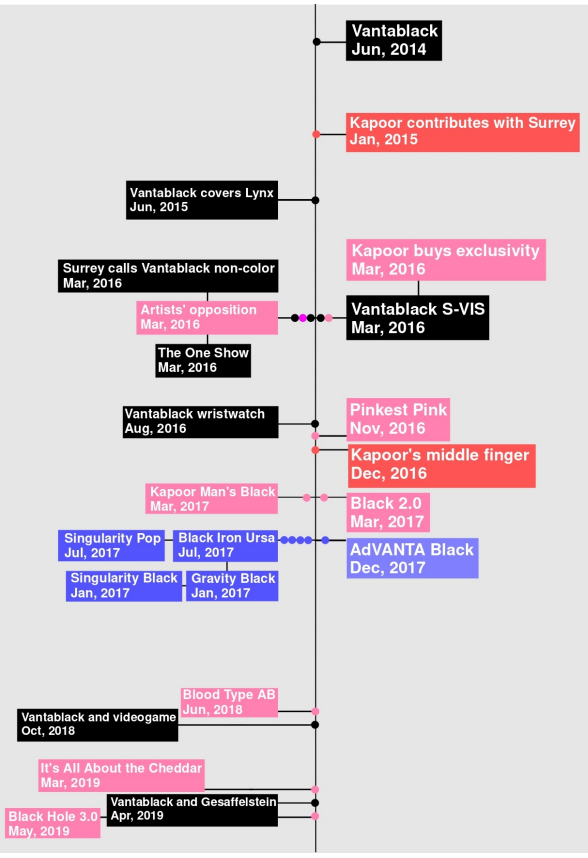

Figure 3. Timeline of the Vantablack Controversy and Related Developments.
Source: elaborated by the author.

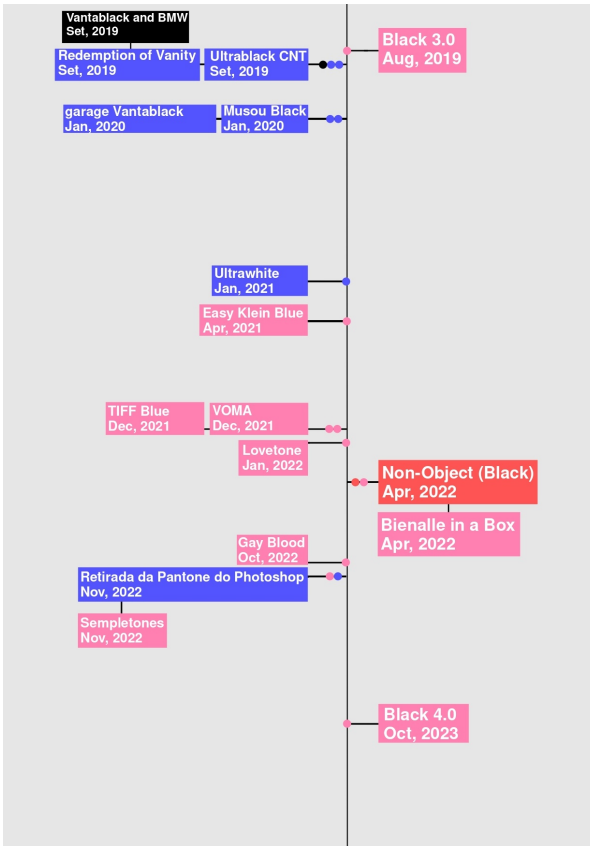

Figure 4. Timeline of the Vantablack Controversy and the Ultra-Black Color Race (2019–2023).
Source: elaborated by the author.

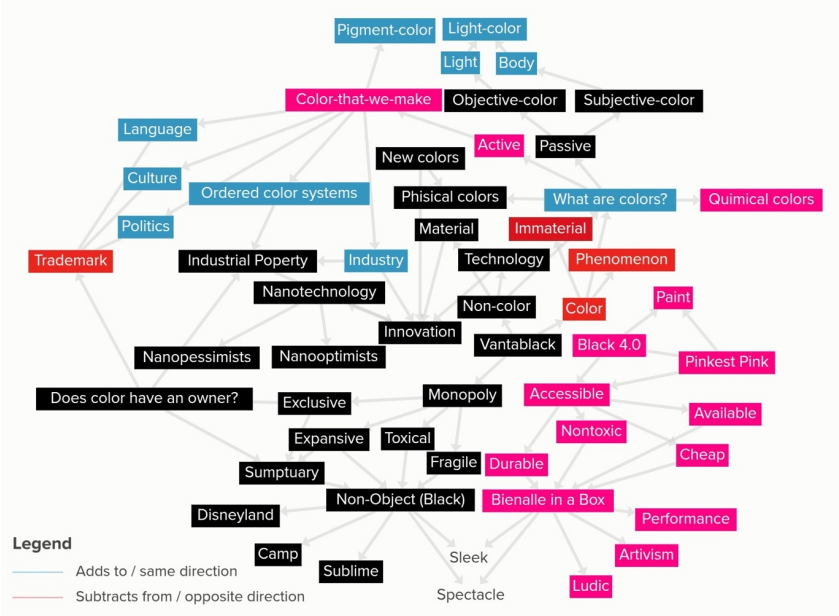

Figure 5. Mind Map of Color: Perception, Innovation, and Ownership.
Source: elaborated by the author.

REFERENCES

About Vantablack (2023). Surrey NanoSystems, 2023. https://www.vantablack.co.uk/

Assis, O. B. G (2013). A asa da borboleta e a nanotecnologia: cor estrutural. *Revista Brasileira de Ensino de Física*, v. 35, n. 2, 2301-2310. https://doi.org/10.1590/S1806-11172013000200001

Azoubel, S., Cohen, R., & Magdassi, S. (2015). Wet deposition of carbon nanotube black coatings for stray light reduction in optical systems. *Surface and Coatings Technology*, 262. https://doi.org/10.1016/j.surfcoat.2014.11.063

Bagattolli, C. (2013). *Política científica e tecnológica no Brasil: Mitos e modelos em um país periférico* [Doctoral thesis, Universidade Estadual de Campinas]. Repositório da Produção Científica e Intelectual da Unicamp. https://repositorio.unicamp.br/acervo/detalhe/910539

Barben, D., Fisher, E., Selin, C., & Guston, D. H. (2008). Antecipatory Governance of Nanotechnology: Foresight, Engagement, and Integration. *In:* HACKETT, Amsterdamska; LYNCH, Wajcman (eds.). The Handbook of Science and Technology Studies. Cambridge: MIT Press. https://cspo.org/library/anticipatory-governance-of-nanotechnology-foresight-engagement-and-integration/?utm_source.com

Batycka, D. (2022). *Into the void: Anish Kapoor reveals his first works using Vantablack, the world's darkest color, in Venice*. Artnet. https://news.artnet.com/art-world/anish-kapoor-unveils-vantablack-in-venice-2102896

Block, I. (2018). *Man injured in Anish Kapoor art accident at Serralves museum*. Dezeen. https://www.dezeen.com/2018/08/20/anish-kapoor-art-accident-descent-into-limbo-serralves-museum/

Breitenbach, D. (2016). *Black is the new black and artist Anish Kapoor claims to own it*. Deutsche Welle. https://www.dw.com/en/black-is-the-new-black-and-artist-anish-kapoor-claims-to-own-it/a-19093827

Bronner, J. E. (2015) *Anish Kapoor talks about his work with the newly developed pigment Vantablack*. Art Forum. https://www.artforum.com/interviews/anish-kapoor-talks-about-his-work-with-the-newly-developed-pigment-vantablack-51395

Cascone, S. (2014) *Anish Kapoor Adds New 'Super Black' to His Palette*. ARTNET https://news.artnet.com/art-world/anish-kapoor-adds-new-super-black-to-his-palette-111382

Cupani, A. (2011) *Filosofia da Tecnologia: um convite* (3a edição). Editora da UFSC.

Chu, J. (2019) *MIT engineers develop "blackest black" material to date*. MIT News. https://news.mit.edu/2019/blackest-black-material-cnt-0913

Deahl, D. (2019) *How Gesaffelstein's Coachella set tricked minds with the world's blackest black*. The Verge https://www.theverge.com/2019/4/24/18512555/gesaffelstein-coachella-performance-vantablack-monolith

Dury, M.R., Theocharus T., Harrison, N., Fox, N., Hilton, M. (2007) Common black coatings – reflectance and ageing characteristics in the 0.32 – 14.3 μm wavelength range. *Optics Communications*, v. 270, issue 2. https://doi.org/10.1016/j.optcom.2006.08.038

Edgerton, D. (2004) De la Innovacion al uso: Diez tesis ecléticas sobre la historiografia de las técnicas. *Quaderns d'història de l'enginyeria*, v. 6. http://www.fing.edu.uy/catedras/disi/ctysociedad/Materiales%202009/innovacion_uso.pdf

Fenner, J. (2016) *The Blackest Watch in the World Can Be Yours For $95,000*. GQ Magazine. https://www.gq.com/story/mct-vantablack-watch

Gage, J. (1999) *Color and meaning: art, science and symbolism*. Berkeley: University of California Press.

Gompertz, W. (2013) *"Isso é Arte?: 150 anos de arte moderna do impressionismo até hoje"*; tradução Maria Luiza X. de A. Borges; [revisão técnica: Bruno Moreschi]. - 1.ª Ed. - Rio de Janeiro: Zahar.

Hagopian, J. G. (2013, September). Super-black nanotechnology coating for aerospace applications. *Advanced Coatings & Surface Technology, 26*(9). https://go.gale.com/ps/i.do?p=AONE&u=anon~88d5f5cd&id=GALE%7CA348998212&v=2.1&it=r&sid=googleScholar&asid=a57896e4

Harvey, D. (2004) *O Novo Imperialismo*. 1.ª ed. São Paulo: Edições Loyola.

Kelly, K. (2018) *Playing Call of Duty: Black Ops 4 in Total Blackout*. Activision. https://blog.activision.com/content/atvi/activision/atvi-touchui/web/en/blog/call-of-duty/archives/playing-call-of-duty-black-ops-4-in-total-blackout

Koenig, C. (2019) *New BMW X6 as a spectacular show car: world's first vehicle in Vantablack®*. BMW Press. https://www.press.bmwgroup.com/global/article/detail/T0300081EN/new-bmw-x6-as-a-spectacular-show-car:-world%E2%80%99s-first-vehicle-in-vantablack%C2%AE?language=en

Laurentiz, P (1991). *A holarquia do pensamento artístico*. Campinas: Unicamp.

Leffler, B.; Shannon, R. (2023) *Colour Crusader: How the "Robin Hood" of the art world is liberating colour for everyone*. Global News. https://globalnews.ca/news/9581118/colour-crusader-how-the-robin-hood-of-the-art-world-is-liberating-colour-for-everyone/?goal=0_9f8af92ae1-648839df25-1210607237&mc_cid=648839df25&mc_eid=89a847f199

Lourenço, R. F., & Tomaél, M. I. (2018). Actor-network theory and cartography of controversies in information science. *Transinformação, 30*(1), 121–140. https://doi.org/10.1590/2318-08892018000100010

Mattedi, M. A., Martins, P. R., & Premebida, A. (2011) A nanotecnologia como tecnociência: contribuições da abordagem sociológico para o entendimento das relações entre nanotecnologia, sociedade e ambiente. *Pensamento Plural, Pelotas* [09]. http://pensamentoplural.ufpel.edu.br/edicoes/09/6.pdf

Michael, M. (2018) On "Aesthetic Publics": The Case of VANTAblack®. *Science, Technology & Human Values*, v. 43, n. 6, pp. 1098-1121. https://doi.org/10.1177/0162243918775217

Morales, P., Flikkema, M., Castaldi, C., & de Man, A.-P. (2022). The effectiveness of appropriation mechanisms for sustainable innovations from small and medium-sized enterprises. *Journal of Cleaner Production, 374*, 133921. https://doi.org/10.1016/j.jclepro.2022.133921

Oliveira, M. B. (2011). O inovacionismo em questão. *Scientiae Studia: São Paulo*, v. 9, n. 3, p. 669-75, 2011. https://doi.org/10.1590/S1678-31662011000300011

Oliveira, M. B. (2014). Texto publicado em Roseli Salete Caldart & Paulo Alentejano (orgs.) *MST, Universidade e Pesquisa*. São Paulo: Expressão Popular, 2014, p. 39-59. https://expressaopopular.com.br/livraria/9788577432509mst-universidade-e-pesquisa/

Onetruechannel (2016). *Vantablack, the darkest black invented—BBC*. Youtube. 07 mar. 2016. https://www.youtube.com/watch?v=t5c2DUqE2v0

Optical Black Coatings (2023) *Nanolab*. https://www.nano-lab.com/optical-black-coatings.html.

Paleja, A. (2023) Inspired by butterflies, researcher invents new paint that has no pigments. *Interesting Engineering*. 10 mar. https://interestingengineering.com/science/researcher-invents-paint-without-pigments

Pedrosa, I. (2009). *Da cor à cor inexistente*. 10 ed. Rio de Janeiro: Senac Nacional.

Real Engineering (2021). *How Carbon Nanotubes Will Change the World*. Youtube. 08 mai. 2021. https://www.youtube.com/watch?v=SIif11QOsRI

Renard, M. (2016, 2 de março). *En achetant l'exclusivité du Vantablack, Anish Kapoor crée la polémique*. Connaissance des Arts. https://www.connaissancedesarts.com/arts-expositions/en-achetant-lexlusivite-du-vantablack-anish-kapoor-cree-la-polemique-1137426/

Serafim, M., & Dias, R. (2015) Comentários sobre as transformações recentes na universidade pública brasileira. Avaliação, Campinas; *Sorocaba*, v. 20, n. 2, p. 335-351, jul. 2015. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1414-40772015000200335&lang=pt

Semple, S. (2015). *Art School*. 2015. Disponível em: https://www.youtube.com/watch?v=X_B8JOfO7ig

Semple, S. [@stuartsemple]. (2017, March 28). *The blackest unicorn in the whole wide world is real! Resin sculpture is actually 3D - he's coated in my Black 2.0 and it makes him look almost flat - not #vantablack - no filters - share the love - share your colours! #shareTheBlack ✌️❤️🎨* [Photograph]. Instagram. https://www.instagram.com/p/BSMfvNwFgPA/

Semple, S. [@stuartsemple]. (2017, March 28). *The blackest unicorn in the whole wide world is real! Resin sculpture is actually 3D—he's coated in my Black 2.0 and it makes him look almost flat—not #vantablack—no filters—share the love—share your colours! #shareTheBlack ✌️❤️🎨* [Photograph]. Instagram. https://www.instagram.com/p/BSMfvNwFgPA/

Semple, S. (2021). *The world's brightest white paint is here! White 2.0!* Youtube. 2 nov. 2021. https://www.youtube.com/watch?v=wTb-gBU4EFQ&t=98s

Silveira, L. (2015) *Introdução à teoria da cor*. 2.ª ed. Curitiba: Ed. UTFPR.

Site Inovação Tecnológica (2022). *Vermelho mais vermelho do mundo é obtido depois de 102 anos*. www.inovacaotecnologica.com.br/noticias/noticia.php?artigo=vermelho-mais-vermelho-mundo

Surrey Nanosystems. (2021) *Technical Data*. https://www.surreynanosystems.com/resources

Surrey Nanosystems. (2022) *O Vantablack*. https://www.surreynanosystems.com/assets/media/32267-80-2_galleryNormal.jpg.

Threewitt, C. (2021) *Is Vantablack really the blackest black?* https://science.howstuffworks.com/vantablack.htm

Turnhout, E., Tuinstra, W., & Halffman, W. (2019). *Environmental expertise: Connecting science, policy and society*. Cambridge University Press. https://doi.org/10.1017/9781316162514

Vidal, D. (2014) *The Return of the Aura: Anish Kapoor: The Studio and the World*. In: KAUR, Raminder; Dave-Mukherji, Parul (ed.). Arts and Aesthetics in a Globalizing World. ASA Monographs Book 15. Londres : Bloomsbury Academic https://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers17-07/010067076.pdf

Venturini, T. (2010) Diving in magma: how to explore controversies with actor-network theory. *Public Understand. Sci.* v. 19, n. 3, p. 58–273 https://doi.org/10.1177/0963662509102694

Wiles, K. (2021) *The whitest paint is here – and it's the coolest. Literally*. Purdue University. https://www.purdue.edu/newsroom/releases/2021/Q2/the-whitest-paint-is-here-and-its-the-coolest.-literally..html.

Winner, L. (2018). *The Cult of Innovation: Its Myths and Rituals*. In E. Subrahmanian, T. Odumosu, & J. Y. Tsao (Eds.), Engineering a Better Future: Interplay between Engineering, Social Sciences, and Innovation (pp. 61-73). Springer.