Potential Digital Transformation of the Art Market: The Application of AI Machine Learning to Art Authentication

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Abstract

Titel: Potential Digital Transformation of the Art Market: The Application of AI Machine Learning to Art Authentication

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This thesis explores Machine Learning (ML) for authenticating art. Interpol treats art forgery as a serious crime with the number of forgeries threatening the growing field of art as an investment asset class. Present authentication methods appear to lack efficacy, reducing their ability to address this challenge.

The literature review outlines the current state of art authentication, ML and digital transformation. A questionnaire explored the current state of authentication, the diffusion status of AI art authentication as per Rogers (2003), its disruptive potential according Si & Chen (2020), and its potential acceptance according to Venkatesh and Bala (2008). Responses from 65 participants were collected.

The findings revealed a growing demand for AI art authentication, with the art market showing awareness and preliminary adoption but not full implementation. Although currently not a disruptive technology, ML has the potential to complement traditional authentication methods but will face acceptance resistance that can be mitigated through strategic interventions. According Hanelt et al's (2020) framework, AI art authentication has the potential to digitally transform the artworld.

Conflict of interest: The author is associated with ARTTRD, a company involved in AI art authentication. Despite this, efforts have been made to maintain academic integrity and prevent bias in the research due to this affiliation.

Keywords: art authentication, AI art authentication, AI (artificial intelligence), machine learning, digital transformation, art forgeries, art market transparency, art analytic, CNN

Sumário

Título: Potencial Transformação Digital do Mercado de Arte: A Aplicação da Autenticação da Máquina de Aprendizagem de Arte

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Esta tese investiga Aprendizado de Máquina (ML) em autenticação de arte. A Interpol vê a falsificação de arte como crime grave, afetando o investimento em arte. Métodos atuais de autenticação são ineficazes neste desafio.

A revisão de literatura aborda o estado da autenticação de arte, ML e transformação digital. Um questionário avaliou a autenticação atual, a difusão da autenticação de arte por IA (Rogers, 2003), seu potencial disruptivo (Si & Chen, 2020) e aceitação (Venkatesh e Bala, 2008). Respostas de 65 participantes foram coletadas.

Descobertas indicam crescente demanda por autenticação de arte por IA, com adoção inicial no mercado de arte, mas sem implementação total. ML, ainda não disruptivo, pode complementar métodos tradicionais, enfrentando resistência à aceitação, mitigável por intervenções estratégicas. Segundo Hanelt et al. (2020), a autenticação de arte por IA pode transformar digitalmente o mundo da arte.

Conflito de interesse: O autor está vinculado à ARTTRD, empresa em autenticação de arte por IA. Esforços foram feitos para manter integridade acadêmica e evitar viés.

Palavras-chave: autenticação de arte, autenticação por IA, inteligência artificial, aprendizado de máquina, transformação digital, falsificações de arte, mercado de arte, analítica de arte, CNN.

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1. Introduction

Art authentication is a key aspect of the massive art market. The latter was valued at approximately $ 67.81 billion in 2022. Despite the challenges of COVID-19 and the energy crisis, the art market has continue growing with auction records being broken and new artists and works of art emerging (McAndrew, 2023).

The contemporary art market is also presently plagued by forgeries. Art forgers have gained considerable notoriety, and in some instances, even attained celebrity status. Society and the media often revel in Schadenfreude derived from the belief that such acts only harm affluent collectors, avaricious dealers, or corrupt experts. Beyond immediate financial losses, forgery constitutes a highly pertinent problem, with far-reaching implications for the integrity of the market and the potential to distort historical records (Butin, 2020). Expert estimate that as much as 50% of artworks circulating in the European market are counterfeit (Tschirren, 2022). The Geneva Fine Arts Expert Institute states that between 70% to 90% of all tested artworks are forgeries, and the actual number of non-authentic pieces might be even higher (Bambic (2014)

Authentication processes are needed, particularly as 96% of wealth managers in 2021 viewed art and collectables as a key component of wealth management, up from 55% in 2014 (Deloitte et al., 2021). Despite no clear definition of the determinants of authenticity, written reports by art experts are commonly based on three criteria: comparative stylistic and motivational analysis within an oeuvre, provenance, and technical aspects of the work (Authentifizierungen vom Kunstinstitut, n.d.)

COVID-19 accelerated digital transformation in various industries. This also affected the art world which is traditionally based on personal encounters with original works, while the industry has historically been slow in adapting digital methods (Kuntnjak, 2021) (Boll, 2020). The ML team at Sotheby's engaged in a research effort to automate art pricing, dedicating particular attention to producing contemporary appraisals all works of art sold by Sotheby's. This initiative exemplifies the potential of ML applications within the art market (Bailey, 2020).

Recently, Art Recognition or Art Eye-D Associates is using ML to authenticate art. Art Eye-D Associates trains their systems with high-resolution digital images. Depending on the artist, architecture of the convolutional neural network (CCN) and the training-validation-testing-

split, the system achieves accuracy rates between 85% and 90%, but up to 100% (Frank & Frank, n.d) (Frank & Frank, 2022) (Frank & Frank, 2023).

This study interrogates how ML can solve the problem of art authentication. It begins by discussing the academic and managerial significance of the subject and then review the relevant literature, categorized into four sections. These are the art world, artificial intelligence, digital transformation and its interconnectivity. By drawing upon the literature review, the research gap will be identified, and the Research Question will be derived. The third chapter dedicated to the research design presents the hypotheses and data collection methods. The fourth chapter discusses findings and the final chapter summarizes the conclusion and addresses limitations, and suggestions for future research.

1.1 Problem Statement and scope of the study

The large number of art forgeries and lack of transparency and clear mechanisms for authentication in the art market can be thought of as a form of market failure. This thesis analyses the potential of ML applications for authenticating works of art and will conclude whether this technology is likely to achieve broader adoption.

Art can take many forms including painting, sculpture, music, literature, or dance. This study is limited to artworks on canvas or drawings as opposed to prints, sculptures and digital works of art. Although ML has achieved high accuracy in differentiating drawings by Raffaello Sanzio da Urbino from works created by admirers, imitators, and forgers, further research is needed in the field of drawings to improve accuracy and account for the wide range of styles and techniques (Frank & Frank, 2023). Paintings are the central theme here and the experts interviewed mainly operate in European and American art markets.

1.2 Academic and managerial relevance

The managerial and academic relevance is evident considering current trends. The art market is a significant economic force, demonstrating substantial economic strength as an asset class that is relatively non-correlated (Boyer, 2011). Notably, art is increasingly seen as a financial asset class, with wealth managers suggesting that it make up approximately five to ten percent of a diversified investment portfolio (Butin, 2020). Additionally, art-secured lending reached a market size of 31,1 billion USD in 2022, with an average growth rate of 10.7% compared to 2021 (Deloitte, 2021). The Hazan et al., (2022) estimate the global luxury market to grow

annually by 6 percent from 2022 to 2026 which is bullish for art. Mcandrew's (2022) study of high net worth (HNW) collectors revealed that 74 percent were optimistic regarding performance of the art market and 53 percent intended to buy art within the next 12 months. In 2021, the median expenditure of HNW collectors reached $274,000, twice as much as 2020. Furthermore, this rose approximately 280% compared to the pre-pandemic average of $72,000. This can partly be attributed to increased wealth of HNWs (2022).

Although appraisals by art experts do not provide absolute certainty, lack of interest among market participants to expose forgeries, are among the reasons Interpol has classified the phenomenon as one of the most significant contemporary crimes. A substantial number of undetected art forgeries is a distinct possibility (Butin, 2020).

Furthermore, the case of New York's oldest art gallery, Knoedler, compromised even a well-established institution. Here, Dominico De Sole, the former chairman of Sotheby's, was deceived by a forgery. Publicity about the Knoedler scandal, in which over $80 million of fakes were sold, called attention to lack of transparency in the art market which was portrayed in the Netflix documentary "Made you Look" (“Knoedler Gallery’s Scandal Becomes a Netflix Documentary,” n.d.)

The relevance of ML is evident in the fact that 20 percent of C-level executives report using it as a core part of their business. Additionally, current trends such as unsupervised ML and no-code/low-code ML development further demonstrate the practical applications and potential of this technology (Shalamanov, 2021).

In 2017, Leonardo da Vinci's "Salvator Mundi" became the most expensive painting ever auctioned (Friedlander, 2017). Ever since the work resurfaced and was displayed at the National Gallery in London in 2011, there was controversy about its authenticity among scholars ((Leonardo Da Vinci: Painter at the Court of Milan, 2011). In 2020, Steven and Andrea Frank from Art Eye-D Associates employed CNNs to authenticate Leonardo pieces. Despite challenges, including the limited number of 17 attributed paintings, the data-intensive nature of CNNs, Leonardo's use of assistants and apprentices, extensive restoration of pieces, etc., the effort successfully conducted ground breaking work in art history. They were able to provide quantitative evidence supporting the academic consensus viewpoints that the authorship of the painting's background and the blessing hand was debatable and most likely not Leonardo. The

most significant elements, such as the head, however, could indeed be attributed to renowned master (Frank & Frank, 2020).

This research demonstrated the potential of advanced ML applications, when integrated with in-depth qualitative art historical analysis, to revolutionize the authentication process and introduce greater trust into a $450.3 million market.

2. Review of selected literature

Chapter two presents a review of relevant material on the artworld, machine learning, digital transformation and their connection.

2.1 Artworld

The concept of art and the definitions surrounding it have been debated by scholars, philosophers, and artists over many years. This ongoing debate discussion highlights complexities concerning the concept of art along with lack of consensus on “what is art.” According to a leading authority, Arthur Danto (2013), art began after centuries of processes, “to reveal its inner truth” in the late twenty century (P.23). Joseph Beuy`s “erweiterter Kunstbegriff“, or “extended art concept“ and Marcel Duchamp`s readymade art are examples of expanding and challenging the boundaries of art. Duchamp is known for appropriating everyday objects (such as a urinal) that he presented as works of art. Thus, Duchamp subverted the idea that an artwork must be a wholly original creation by the artist and also that it must deal with lofty subject matter (“The Readymade - Modern Art Terms and Concepts,” n.d.). One might consider Richard Rorty´s maxime “truth is what your contemporaries let you get away with saying” when considering the ongoing debate (Haven, 2017).

The attempts to define art led to the rise of anti-definitonalist theories. Weitz argues that theories of art should be “open” as its nature is so creative and ever-changing that no closed and final definition can be created (1956). Danto (1964) however pleads for a “closed” concept of art following a relational definition. The context in which works acquire the ontological status of being considered art is via what he refers to as the "Artworld". George Dickie built on Danto`s theoretical framework by stating that "a work of art in the classificatory sense is (1) an artifact (2) a set of the aspects of which has had conferred upon it the status of candidate for

appreciation by some person or persons acting on behalf of a certain social institution (the art-world)" (1974, p. 34). Scholars such as Khatchadourian (1979) have criticised Dickie`s conception. However, the several attempts to define art have reshaped the understanding of its nature and highlighted the importance of the system surrounding a work of art – the artworld.

To gain a comprehensive understanding of the **most relevant players** and how they are interconnected, one may refer to Dossi (2007): "The artist must believe in his art, the gallery owner must market it, the critic must make it known, the museum must confer the higher consecrations on it, the collector must pay for it" (p. 22). However, one needs to reflect as Thornton (2012) states, that the "art world is so diverse, opaque, and downright secretive, it is difficult to generalize about it and impossible to be truly comprehensive" (p. 17).

Artists are the core of the art world and the whole system would depends upon them. According to Pommerehne & Frey (1997), artists are distinguished by a higher degree of intrinsic motivation than other professional groups. However, the conventional perception of artists as purely creative individuals, lacking in strategic or economic knowledge, may be misleading. A retrospective analysis of Picasso's actions reveals that he intuitively mastered the principles of modern marketing and built a global brand (Dossi, 2007).

The importance of art **galleries** and **art dealers** in the artworld is evident, as 76% of HNW collectors purchased from them in 2021 (Mcandrew, 2022). Art dealers and galleries stimulate demand and regulate supply. Their main abilities are based on an instinct for the zeitgeist and a network of alliances. Galleries do not merely function as merchants but rather as discoverers of talent. The gallery serves as an intermediate between collector and artist, enabling interaction through primary efforts. Thus, one can argue that the gallery is the actual investor in the art market (Dossi, 2007).

Auctions are events where sales to potential buyers take place, with the highest price being determined through competition among all interested buyers, followed by the closing of the sale with the hammer price (Boll, 2011). In reference to the game theory phenomenon of the winner's curse, the winner of an auction lot is simultaneously the one who was willing to pay more than all other bidders and the second highest bidder it the price setter. Assuming that all bidders have, on average, a realistic perception of the price, the buyer has overpaid (Dossi, 2007). However, one could argue that the winner hasn't overpaid, considering the existence of asymmetries in information among bidders. Due to the public nature of auctions, auction

prices serve as a transparent and significant reference in comparison to the predominantly private transactions of the art market (Boll, 2021). Freeman (2017) indicates that mega-dealers and collectors not only bid on artworks at auctions because they want to collect or sell them but because they want to achieve a specific public listed price.

Art journalism or the general press acts as an authority in the artworld, serving as a mechanism for assessing and maintaining the quality of art (Boll, 2011). Charles Guarino, the former publisher of the Artforum, explains that the influence of the magazine directly depends on its independence and its integrity. He states that "Everyone knows - and this is based on facts - that you cannot buy a review in Artforum" (Thornton, 2012, p.188).

Museums serve as public institutions with extensive expertise, positioning them as independent authorities. Their exhibitions and research projects have a substantial impact on the market value of artists and their creations (Boll, 2011). However, Bossier et al. (2014) stated that 53% of market-dominant collectors are involved with a public museum or a public art institution. The lack of public funds for acquisitions and expansions increases the influence of private collectors, potentially jeopardizing the neutrality of museums.

Art collectors are the primary buyers and their motivations vary from self-discovery, and aesthetic pleasure, to the value of gained from group acceptance (Kossenjans & Buttle, 2016). Walter Benjamin (1991) stated that for collectors "possession is the deepest relationship one can have with things in general: it's not that they are alive in him, it is he himself who resides in them". However, the desire for monetary gain commodifies artworks, making them objects for speculation. Creating an art collection involves maintaining a balance between single items and the entire collection (Dossi, 2007). Hence, a carefully curated collection can be considered a cohesive artwork itself, with professional art advisors frequently providing guidance to collectors.

A clear distinction between the various players in the artworld is not always possible, as they often take on different roles. For instance, an art collector can also be a tastemaker or a dealer. The journey of artworks through the various stakeholders in the artworld can be viewed as a structural selection of quality (Boll, 2011). Ultimately, it is the artists and the surrounding system that transform an object into a piece of art (Dossi, 2007).

Investigating art in the context of the artworld allows applying game theoretical approaches to analyse the behaviour of the various players and fundamental mechanisms of the system. Perricone (2017) demonstrated that in the artworld, which consists according to his theoretical framework of interactions between appreciators and artists, categorized as either grudgers (reciprocal altruists), suckers (naive altruists), or cheaters (egoists), the only sustainable strategy over the long-term is that of the grudgers. Thus, cheating artists, who produce low-quality art and receive a high-quality response, deserving no praise in return, will perform better than suckers or grudgers in the short term but as soon as the artworld consists of a critical proportion of grudgers, the cheaters will eventually extinct. The same principle can be applied to art dealers who offer low-quality art or art forgeries deserving no praise and receives high-quality responses.

Fraiberger et al. (2018) demonstrated through analysis of over 500,000 artists, that nearly 40% of those who completed their first five exhibitions in prestigious galleries and institutions were still actively exhibiting a decade later, with the majority of survivors continuing to exhibit in high-prestige venues. On the other side, only about 14% of artists who began in low-prestige institutions continued to exhibit after 10 years, and only about 10% eventually achieved high-prestige status. The study also found that artists exhibiting in institutions with reputations in the top decile were 42 times more likely to exhibit in high-prestige institutions than in low-prestige ones. However, Schneider (2018) provides critical reflection as these findings may not necessarily be proof of the artworld being a manipulated system but rather reveal characteristics similar to the non-artworld. For example, Chetty et al. (2014) highlight social mobility in America, where a child born to parents in the bottom fifth income distribution have only a 10% chance of reaching the top fifth. These similarities suggest that broader mechanisms are responsible for patterns, rather than causal phenomena specific to the artworld alone.

At the height of postmodernism in the 1990s, Danto (1998) claimed that the end of art arrived, as art was no longer defined by intrinsic qualities and lacked historical meaning. Morgan (1998), however, argued that “art is now subjected to the same economic totalism as any other enterprise“, concluding that what ended up happening was differentiation of art from the art market (p.3). These points highlight fundamental aspects of the artworld and correct the widely held nimbus surrounding it. After a long period during which art struggled to break free from the constraints of clerical and feudal power, it has gained an independence and been released into free market capitalism (Dossi, 2007).

2.1.1 Art market

The term art market refers to a global network of buyers and sellers, such as art dealers, art galleries auction houses and thus the stock market (Sandler, 1997). However, many stakeholders, such critics and curators, are not involved in the market's commercial activities (Dossi, 2007). Museums even see themselves as a counterbalance to the commercial art market (Boll, 2011). While artists often critique capitalism and society, they also participate in this economy by exhibiting and selling their works as collectables (Camblin, 2019). The art market brings together art and money and balances artistic freedom and capitalis,. Unlike other more liquid and transparent markets, there are issues in determining the value of a traded asset. The degree of confidence in the abilities and knowledge of experts has an impact on the assessment of value during negotiations for unique items (Kalbermatten & Rausch, 2021). Nevertheless, the art market has achieved a distinct status among goods. A common belief is that a work of art is a gift from the artist to society rather than a commodity, its value derived from its inherent substance. But in the market, it is reduced to its monetary exchange value. In current society, art has become an ultimate symbol of status (Dossi, 2007). The art market is characterized by a high degree of opacity when it comes to determining prices, the processes that lead to appreciation, and the dissemination of information. As a result, the inner workings of this market are murky, particularly given that traditional economic principles do not always seem to apply (Velthuis, 2011).

The art market is a classic example of winner-takes-all. Only a small number of participants generate the majority of revenues and a significant price gap exists, even in cases where performance differences are negligible or non-existent (Merten, 2015). Abbing (2002) argues that the art market is this way because people have limited abilities to store and recall relevant details about several artists. Recent investigations have shown that only 25 artists are responsible for almost half of the turnover made in postwar and contemporary art and that half of all artworks in auctions are sold for under $800, further highlighting the structure of the art market (Halperin & Kinsella, 2017) (The 2022 Global Art Market Report, 2023).

The primary art market involves works which are new to the market, commonly sold by galleries, artists, or art fairs (Velthuis, 2011). This market should be further distinguished into works by established artists and emerging artists with no market history. Emerging artists are riskier and mainly sold in the primary market. However, emerging artists are increasingly

entering the secondary market (Zorloni, 2005) where works were already sold at least once. The latter is dominated by galleries, art dealers and auction houses (Robertson, 2015). Buyers here are generally more informed, which makes the market more predictable and less risky than the primary market (Zorloni, 2005).

The anthropological framework of Boltanski & Esquerre`s (2020) enrichment economy can be employed as an analytical lens to examine price evaluation processes. This approach relies on evaluating the transactional context in which a good is situated (Kalbermatten & Rausch, 2021). According to Boltanski & Esquerre, unlike traditional capitalism, which highly values innovation and mass production, the primary focus in an enrichment economy is on differences. Consequently, value is created by transforming existing goods into unique and authentic objects. The history and narrative surrounding these objects serve as key drivers of context (Boltanski & Esquerre, 2020). This phenomenon can be observed in the case of art forgeries. Two identical paintings, both attributed to the same artist, may have different values. One may be worth a fortune as it is authenticated, while the other is deemed worthless due to the absence of an authentication narrative. Industrial objects typically do not possess a narrative, resulting in no justification for a high price (Camblin, 2019). In an enrichment economy, various arguments about value are either justifications or critiques of price (Boltanski & Esquerre, 2017).

As introduced in section *1.2 Academic and Managerial Relevance*, the artworld represents a significant financial market. However, determining its size is challenging because of the absence of public data on private sales (Coslor, 2016). Results from global art auctions were relatively stable in 2022 and represent approximately 40 percent of the total art market (McAndrews, 2023).

The public nature of auction results grants valuable, data-driven insights into the market. According to the global auction report 2022 by artprice.com and artron.net, the US gained a 26 percent rise in revenue compared to 2021. China, however, experienced a two billion dollar decrease in hammer prices, while Britain gained back their pre-pandemic level of 2.1 billion dollars. Paintings were the most sold medium representing a share of 70.9 percent, followed by drawings and sculptures with 14.40 and 9.1 percent respectively. Non-fungible tokens, on the other hand, only represented 0.1 percent of global auction sales. Although 2022 had the highest number of works exceeding the $100 million threshold, the core of the market lies in

the affordable section as 50 percent of all works were sold for less than $762 (2023). In 2022, Post-War and Contemporary Art (defined as artists born after 1910), along with Modern Art (born between 1875 and 1910), proved again to be the most valuable sector in the global art auction market, representing 76% of the sales value. Impressionist and Post-Impressionist (born between 1821 and 1974) had an 18 percent share (Mcandrews, 2023).

Art is increasingly used to diversify portfolio risk through hedging mechanisms, as it is only weakly correlated with the stock market (Dossi, 2007). According to the Art Finance Report 2021, strong correlation between art and gold may illustrate the public perception of art as a store of value. Diversification within the art asset class means holding artworks by different artists from different eras (Gonzáles & Weis, 2013). Due to high transaction and storage costs and the inflation rate, works of art must double in value every five years to create a profit (Boll, 2021). However, as Becker (1982) noted, the artworld gives works their value, suggesting that the intertwined mechanism of the artworld allows tastemakers to fundamentally influence market prices and thus create investment opportunities. From an investment perspective, art forgery and authentication represent the greatest risk factor (Lorange et al., 2022).

2.1.2 Art forgeries

For Walter Benjamin, the originality and authenticity of an artwork depend on its “aura”, which consists among other factors of the work's history as cultural heritage, its time and location dependency and its uniqueness and not reproducibility. Benjamin`s concept of aura concludes that photography and lithography would lead to the “liquidation of the traditional value of cultural heritage” (Benjamin, 1936, p. 4). Various art and social historians strongly challenged Benjamin's concept of authenticity and even questioned whether nowadays originality is still important for an artwork's monetary and sentimental appreciation (Ellis, 2015).

Forgeries are fraudulent copies of works intended to deceive collectors and other buyers. They are passed off as genuine works, usually to make a profit. The impact of art forgeries on all stakeholders is significant. Since high-quality forgeries can deceive even the most knowledgeable experts and collectors, forgers create a toxic product in a market already plagued by information asymmetries and difficulties around price discovery. Fake artworks selling for high prices damage the reputation of the artist whose work is being copied, and result in financial losses for collectors who have been duped. As Butin (2020), compellingly

demonstrated, the success of forgers is systematically enabled by the strong interconnected and dependent social groupings of the artworld. Therefore, in addition to art forgers, the galleries, art dealers, and auction houses are also accountable for the existence and circulation of art forgeries.

Detecting forgeries not only bears upon the correct valuation of an asset but in relates to preservation art history. Forgeries can "deform and falsify our understanding of the past" (Jones et al., 1990, p.17). An investigation into the forged diaries of Adolf Hitler revealed that the forger, Konrad Kujau, who had close ties to the neo-Nazi scene, denied the Holocaust in several paragraphs and draw a inaccurate picture of Hitler (Schiffermüller, 2023). Referring back to Perricone (2017), undiscovered art forgeries may negatively impact the game theoretical mechanism of the art market. Cheaters who sell forged art would likely outplay the grudgers if forgeries are not detected. This could lead to a scenario where only cheaters survive, while grudgers and suckers are eliminated, thus creating a destructive confounding factor for the market.

TEFAF`s interdisciplinary vetting committee, composed of more than 150 world experts, highlights the efforts of one of the most important art fairs to try ensure quality of works on offer and indicates the increasing pressure and need to detect forgeries (Meticulous Vetting Sets TEFAF Apart, n.d.).

2.2.3 Authentication of art

Art attribution and art authentication are key processes in the art market. While art attribution involves the process of identifying the possible author, art authentication requires stronger evidence to prove that a work is indeed crafted by the presumed artist in order to be deemed genuine (Authentication and attribution, n.d., 2023).

Art authentication and the detection of art forgeries are not strictly defined processes or practices. The title of "art expert" is not legally protected as there is no official certification board to ensure quality standards and expertise. Instead, the art market establishes its own rules and guidelines, recognizing only the opinions of certain individuals or expert groups (Bandle, 2015). One can draw an analogy to the church designating reliquaries and thus deciding which works may be considered miraculous. The placebo effect of the reliquary was often supported by religious rituals (Dossi, 2007).

Conflicting views on art authentication between the courts and the art world, driven by competing financial interests, have created obstacles that discourage art experts. Many authentication boards or foundations have dissolved and art experts have refused to give an opinion due to fear of later legal disputes (Amineddoleh, 2015). The Andy Warhol Foundation, for instance, disbanded in 2014, after paying over $10 million in response to various lawsuits (Grant, 2014).

Art authentication nowadays is based on three main pillars – connoisseurship, provenance investigation and technical examination. According to Vivian E. Barnett, the author of several catalogues raisonnés of Kandinsky, "it is easier to fake a provenance than to fake a work of art," emphasizing the need to consider all the pillars of art authentication in a holistic and supplementary manner (Bayer, 2021).

Comparative stylistic and motivational analysis of an artist`s oeuvre, also referred to as connoisseurship, can be “defined as the attribution of artifacts to particular hands, or times, or places” (Neer, 2005, p.1). In past centuries, developments in various techniques changed the way artworks are studied. Milestones from scholars such as Giovanni Morelli (1900) or Maurits van Danzig (1953) further introduced a structured scientific approach to connoisseurship. For Friedländer (1942) analysis of an artwork does not consist of formal assessment, such as of individual forms and colours, but rather introspection with a holistic perception of the interplay between colours and forms. The prerequisite for connoisseurship is profound knowledge of the artist`s oeuvre and unique stylistic features. Thus, connoisseurship entails reexperiencing the emotions connected to something that has been previously perceived. However, Friedländer acknowledges that connoisseurship is mainly driven by intuition pointing to the subjective nature of the scholarship (cited in Laemers, 2015). Furthermore, Martin Kemp (2014) stated that “seeing is a very selective and malleable business…but what is seen within a framework of explanation is powerfully shaped by what the observer wants to see and what we are looking for, given our set of interests” (p.3) (cited in Frank & Frank, 2023). Over time, the art market has appointed specific experts, advisory boards, and galleries who serve as authoritative resources for comparative stylistic analysis of works by specific artists. However, since these authorities often involves the artist`s friends, family or galleries, their objectivity and independence is questionable (Sobolewski, 2017).

The second pillar of art authentication consists of investing a work`s provenance. Sources of research involve libraries, museums, gallery inventories, exhibition catalogues, invoices, contracts and letters (Butin, 2020). However, John Drewe, a supplier of art forgeries, demonstrated that documents of an artwork's history can be forged (Regai, 2015). A catalogue raisonné lists all of the currently known works by an artist in a structured manner and is widely accepted as a reliable source of information in the art market (Bandle, 2015). The term 'catalogue raisonné' is neither a protected expression nor legally binding. As a result, documents can be published without sufficient expertise or a rigorous methodology, leading to a high variance in quality.

Nowadays various techniques for a technological art examination can be used. Modern science allows, among others, ultraviolet fluorescence, infrared imaging, x-rays, and thermographic approaches (Gavrilov et al., 2014). However, it is difficult to establish the authenticity of a work of art through technical methods if the forger used materials from the original period of creation or if the forgery was created during the same period. Additionally, technological analysis is used infrequently due to the financial and logistical efforts required (Butin, 2020). Sotheby`s acquisition of the scientific research firm Orion Analytics highlights the art market's investment in technological-based art authentication (Rivetti, 2016).

Disagreements among leading art experts and misattributions have shown that even expert opinions must be critically challenged and proven scientifically (Hufnagel & Chappell, 2012). Furthermore, as Bandle (2015) argues that the stark distinction between courts and the art market with regard to methods and rules applied, expert language used, and outcomes of authentication processes leads to the courts not being “an adequate forum to resolve authenticity disputes” (p.1).

The case of Wolfgang Beltracci`s forgery of Heinrich Campendonk`s “Red painting with Horses” painted in 2006 rather than 1914 as presented, further questions the art market`s authentication processes. The Cologne-based auction house Lempertz sold the painting for almost €3 million and only in-house art historical examinations were conducted. Andrea Firmenich, the author of Campendonk’s catalogue raisonné, saw the painting only after the work had been sold. After the buyer conducted technological analysis of the work, it turned out that the titanium white used had not been invented in 1914 (Butin, 2020). Confronted with its negligence, Lempertz claimed that it had followed art market protocols (Auktionshaus Muss

Millionen Schadensersatz Zahlen, 2012). The Beltracci affair serves as an example of how the art market handles high-value assets under specific circumstances and highlights the need for better authentication processes.

Innovative ventures, such as ART Eye-D Associates and Art Recognition have proposed ML and, in particular CNNs, as an additional and promising tool, for authentication of art (Frank and Frank, 2023; Lorange, 2022).

2.2 Artificial intelligence

The term artificial intelligence was primarily proposed at the famous Darthmouth Conference by John McCarthy in 1956 (McCorduck, 1979). Russel and Norvig suggest, however, that "computational rationality" would have been a more accurate and less frightening terminology (2011). Following the European Commission`s definition:

> "Artificial intelligence (AI) refers to systems designed by humans that, given a complex goal, act in the physical or digital world by perceiving their environment, interpreting the collected structured or unstructured data, …. to achieve the given goal. AI systems can also be designed to learn to adapt their behaviour by analysing how the environment is affected by their previous actions … AI includes several approaches and techniques, such as machine learning (of which deep learning and reinforcement learning are specific examples) ..." (2018, p.7).

The omnipresence of mentions of AI in the media make one question whether the underlying technology is able to match the hype. According to the Stanford AI Report 2023, corporate investment into AI, including mergers and acquisitions, minority stakes, private investments and public offerings accounts for $189.59 billion in 2022, representing a 1,201% increase compared to 2014. The federal AI nondefense budget increased from $0.56 billion in 2018 to $1.84 billion (requested) in 2023. The report further highlights growing interest as the number of AI repository publications increased almost 27 times in the past 12 years (Maslej et al.). To understand the realistic implications of AI, it is essential to consider its broader historical context and development.

Examples such as Chat GPT, Midjourney, applications in synthetic biology, and the current influence of Palantir in the Ukraine war further highlight the implications of AI and its fast development. Mustafa Suleyman, co-founder of DeepMind and vice president of AI product management at Google, argues that large language models have long surpassed the Turing test,

indicating a need for a modernized version. The updated test should focus more on actions than on statements and should no longer merely test knowledge or intelligence as such, but rather the model`s capability “of making a meaningful impact in the world” (Suleyman, 2023, 1).

According to Norvig and Russel (2021), a human-level AI is “able to learn to do anything that a human can do”. In 2022 ninety percent of 356 Ai experts stated that there is a 50% chance that human-level AI will exist in the next 100 years (Katja Grace, et all). Rapid developments in domains such as neural voice cloning, where only a few audio samples are sufficient to achieve naturalness of speech similar to an original speaker, increase the possible misuse of ML (Arik et al., 2018). In 2021 AI incidents and controversies were 26 times greater than in 2012, reflecting the increasing danger (Maslej et al., 2023). In an open letter in March 2023, influential thinkers such as Yuval Noah Harari, Stuart Russell and Steve Wozniak appealed for a pause on giant AI experiments, intensifying the claims of an open letter from 2015 (Research Priorities for Robust and Beneficial Artificial Intelligence: An Open Letter, 2015) (Pause Giant AI Experiments: An Open Letter, 2023)

2.2.1 Key concepts

Basic AI relies on hard-coded knowledge which enables the system to reason about statements based on logical inference rules. This knowledge-based approach works well in a partitioned room, where clear rules and causal relations are given. In the real world, however, it is not possible to derive the formal rules to accurately describe context. Thus, AI systems need to acquire knowledge about the sphere in which they operate on their own (Goodfellow et. al., 2016).

Machine learning is a subfield of AI that enables systems to extract and learn patterns and make predictions or decisions from raw data rather than with explicit programming. The algorithms usually involve a significant amount of data, where rules are too complex to be hard-coded. Prominent examples are the data-fitting algorithm logistic regression and the classification algorithm naive Bayes. ML algorithms can be divided into supervised, unsupervised, semi-supervised and reinforcement learning. Supervised learning uses labeled data to learn a function that associates an input to its corresponding output, based on sample input-output pairs. Unsupervised learning, however, operates without labeled data and is therefore independent of human interference. It is mainly used to extract generative features of raw data and for clustering tasks. Semi-supervised learning operates with labeled and unlabeled data and

is mainly employed in a research context in which labelled data is rare. The additional use of copious amounts of unlabeled data can increase the system`s performance. Reinforcement learning operates based on rewards or penalties and the algorithm aims to increase the reward or minimize the risk. This allows such systems to evaluate the optimal behavior in particular environments. Reinforcement learning is often used to increase automation in tasks such as autonomous driving (Sarker, 2021).

Since ML methods rely on the representation of features, much of the researcher's effort goes into data transformations and designing the prepossessing pipelines. This feature extracts and organizes discriminate information from data (Bengio et al., 2023). A key problem in ML is that for many tasks it is not clear which features should be extracted. An algorithm, known as representation learning, can discover suitable representations (features). Autoencoders are used to convert input data into a different representation with the encoder function and to convert the new representation back to the original format with the decoder function. This enables the system to detect meaningful features, hierarchy structure and to reduce dimensionality. However, when it comes to tasks in which the system needs to extract abstract features on a relatively high level for raw data, a deeper understanding of the data is necessary (Goodfellow et. al., 2016).

Deep Learning (DL) is a subset of ML that uses representation learning by a multi-layer data architecture. The system is able to extract in the first layer the low-level features, while the final layers extract more abstract, high-level features. This architecture is inspired by the information processing patterns within the core sensorial region in the human brain. DL enables learning and classification in one go instead of the several sequential steps needed for ML, such as pre-processing, feature extraction, learning and classification. Additionally, the automatic data representation in DL leads to less human-caused biases in feature selection such as incorrect discrimination between classes (Alzubaidi et al., 2021).

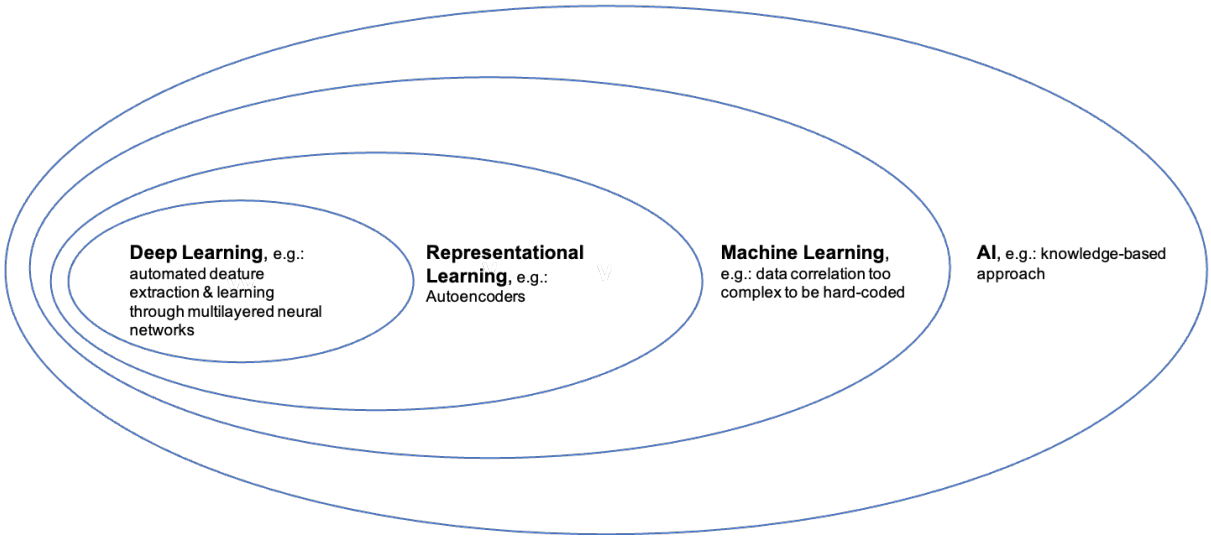

Figure 1: Modification of the Venn diagram of Goodfellow et. Al (2016), p. 9

The main fields of AI range from natural language processing, robotics, data analytics and forecasting, and audio speech processing to computer vision. In regard to the research question, this work will focus on image classification and **convolutional neural networks** (CNN).

2.2.2 Image classification and Convolutional Neural Networks

Image classification (IC) is a fundamental problem of computer vision (CV) and focuses on assigning an input image to one category from a predetermined set of options. Other CV tasks such as object detection, image segmentation or detection are based on IC (Karpathy, 2016). In the past, the classification problem was typically addressed with a dual-stage approach. Human-engineered features were initially obtained from images via feature descriptors and then employed as input for a trainable classifier. The classifier`s accuracy, however, was fundamentally dependent on the design of the feature and thus prone to biases (Rawat & Wang, 2017).

IC has numerous fields of applications, such as medical image analysis, autonomous vehicles, security and surveillance, quality control and much more. The ILSVRC, known as the ImageNet Large Scale Visual Recognition Challenge, can be used for benchmarking the progress of CV and accessing the performance of image classification (ImageNet Large Scale Visual Recognition Challenge (ILSVRC), 2019). According to Witten et. al (2017), most traditional visual recognition methods cannot score below a 25% "top-5 error" rate in the ILSVRC, meaning they frequently misclassify the target label among the 5 highest-probability predictions. CNNs, however significantly outperform the 25% plateau.

Due to its high performance, the supervised deep neural network CNN is the most commonly used algorithm for analyzing visual images today (Tripathy & Singh, 2022). The evolution in the ILSVRC showcases substantial advancements of DL in IC. The AlexNet model, with 60 million parameters, achieved an accuracy rate of 63.3% in 2012 (Krizhevsky et al., 2012). In 2023, the BASIC-L model, fine-tuned by the Lion algorithm, achieved an accuracy rate of 91.1% utilizing its 2,440 million parameters. The automatic and human-independent identification of the relevant features is a fundamental benefit of CNNs compared to its predecessors (Alzubaidi et al., 2021). The system is able to learn both the filters and the classifier using gradient descent and backpropagation (Witten et. Al, 2017).

CNNs consist of a series of layers (Figure 2), which capture different features. The initial layer tends to extract low-level features and as progressing deeper into the network, the layers capture more complex, high-level features. The architecture is inspired by the sequence of cells that form the visual cortex. The core of the CNN are the several convolutional filters (kernels) that lie in each of the convolutional layers. The filters are learnable weight matrices, that scan the input image. The results of the filter are obtained in the feature map, which displays detected patterns at various spatial location (Alzubaidi et al., 2021).

Post the convolution operation, an activation function is applied. Popular activation functions such as ReLU or Sigmoid introduce the concept of non-linearity, which enables the entire network to map complex (non-linear) relationships between input and output data. During training the important property of non-linearity enables the CNN to adjust its weights by non-linear transformation (Norvig & Russell, 2021).

Following the convolutional layers, a CNN consists of pooling layers. The pooling layer uses downsampling operations to reduce spatial dimensions to ensure computational efficiency and control the overfitting of the network. The optimal pooling operation aims to extract only relevant information and discard irrelevant details. A commonly used method for implementing the pooling operation is the max-pooling (Gholamalinezhad & Khosravi, 2020).

The fully connected layer (FC) is located at the end of a CNN architecture and operates similar to traditional neural networks. Each neuron inside this layer is directly connected to all neurons of the previous and next layer. While the last pooling or convolutional layer of a CNN serves as the input of the FC, the output of the FC represents the system`s classifier and thus the final decision (Albawi & Al-Zawi, 2017).

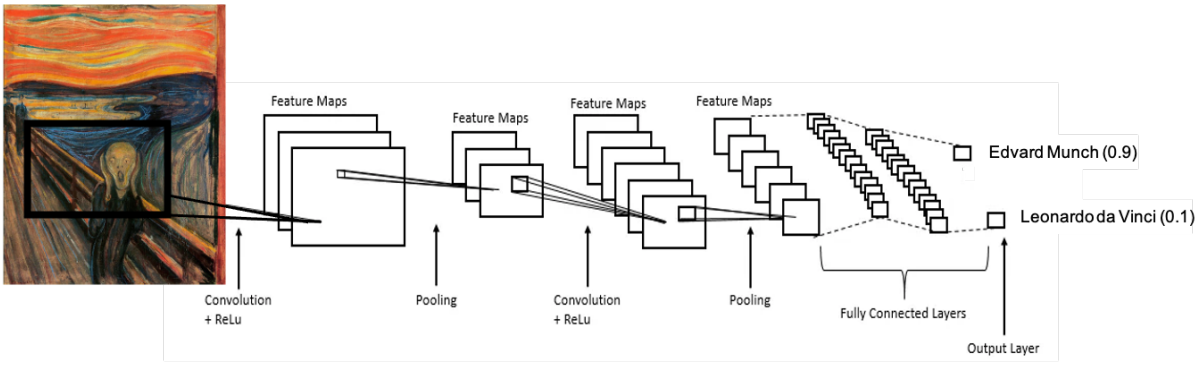

Figure 2: Modification of a CNN to classify images from Raghav (2018)

The training process represents the main feature of a CNN to detect features efficiently and classify the input accurately. To reach an acceptable performance a deep learning algorithm tends to require at least 5000 observations per class or category (Goodfellow & Courville, 2016). Backpropagation and gradient descent are two core concepts in the training process of neural networks. The gradient descent algorithm updates the network's parameters (weights of the layers) through every training epoch, optimizing the loss function by minimizing the difference between the network's predictions and the actual labels.

So far, the architecture of a CNN has been discussed from a forward-looking perspective – from input to output. The backpropagation algorithm, however, works backwards from the output to the input, transmitting the gradient of each neuron to the preceding layer. Crucially, the adjustments to the filter weights are guided by the gradients calculated during backpropagation, ensuring that each update made by gradient descent is informed and effective in improving the network's performance. In essence, the adjustments of the filter weights ensure that the features they extract become more relevant to the task at hand (Alzubaidi et al., 2021).

2.3 Digital transformation

The pandemic crisis accelerated the pace and urgency of transitioning towards more digitalized processes and systems. It also changed the business models of organisations and indirectly initiated digital transformation (Kutnjak, 2021). Nevertheless, there is lack of consensus concerning the exact definition of DT and thus the concept is not applied in a consistent manner (Warner and Wäger, 2019). As DT is a rather new phenomenon, no firm has reached the end state or clearly defined it (Kane et al., 2015). Hanelt et. al (2020) posit DT as “organizational

change triggered and shaped by the widespread diffusion of digital technology." They built on a multi-dimensional framework based on 279 articles, designed for scholars and practitioners to analyse DT (p. 1187). The framework (**appendix A)** uses the generic contextual conditions-mechanisms-outcome structure (Pawson and Tilley, 1997). DT is closely linked to other concepts of business studies such as the Technology Acceptance Model (TAM), the Diffusion of Innovations Theory (DIT) and Disruptive Technology (DT).

2.3.1 Related concepts

The TAM served as a conceptual framework to predict acceptance by users. Created in 1998 by Fred Davis, the TAM has undergone several developments with additional factors. In this study, we used the updated and cumulative **TAM 3** (Figure 3) by Venkatesh and Bala (2008), determined by two main factors. The perceived usefulness and the perceived ease of use. The first factor is defined as "the extent to which a person believes that using an IT will enhance his or her job performance", and perceived ease of use as "the degree to which a person believes that using an IT will be free of effort" (p. 5). The determinants of perceived usefulness do not have an effect on the perceived ease of use and vice versa, ensuring validity of the two main factors and ensuring no cross-over effects. The determinants of perceived usefulness can be categorised into social influence, with subjective norm and image and the category of system characteristics with job relevance, output quality, result demonstrability, and perceived ease of us. The factor of subjective norm is moderated by experience and voluntariness. Furthermore, the influence of perceived ease of use on perceived usefulness is moderated by experience.

Perceived ease of use is based on several anchors expressing individuals' general beliefs regarding computers and its usage. These anchors include self-efficacy, computer anxiety, and computer playfulness, and perceptions of external control (or facilitating conditions). The last two factors are moderated (negatively) by experience as these anchors influence initial judgments of perceived ease of use, while individuals will adjust their judgement with experience. Perceptions of external control on perceived ease of use, however, remain relatively stable with regards to experience. The two factors of perceived enjoyment and object usability determine perceived ease of use after an individual gains experience (positive moderation).

Venkatesh and Bala (2008) suggest actionable guidance by proposing interventions. The pre-implementation interventions take place in the domains of incentive alignment, management

support, user participation and design characteristics. The post-implementation interventions target the period after a system is deployed by focusing on the domains of training, organizational support and peer support.

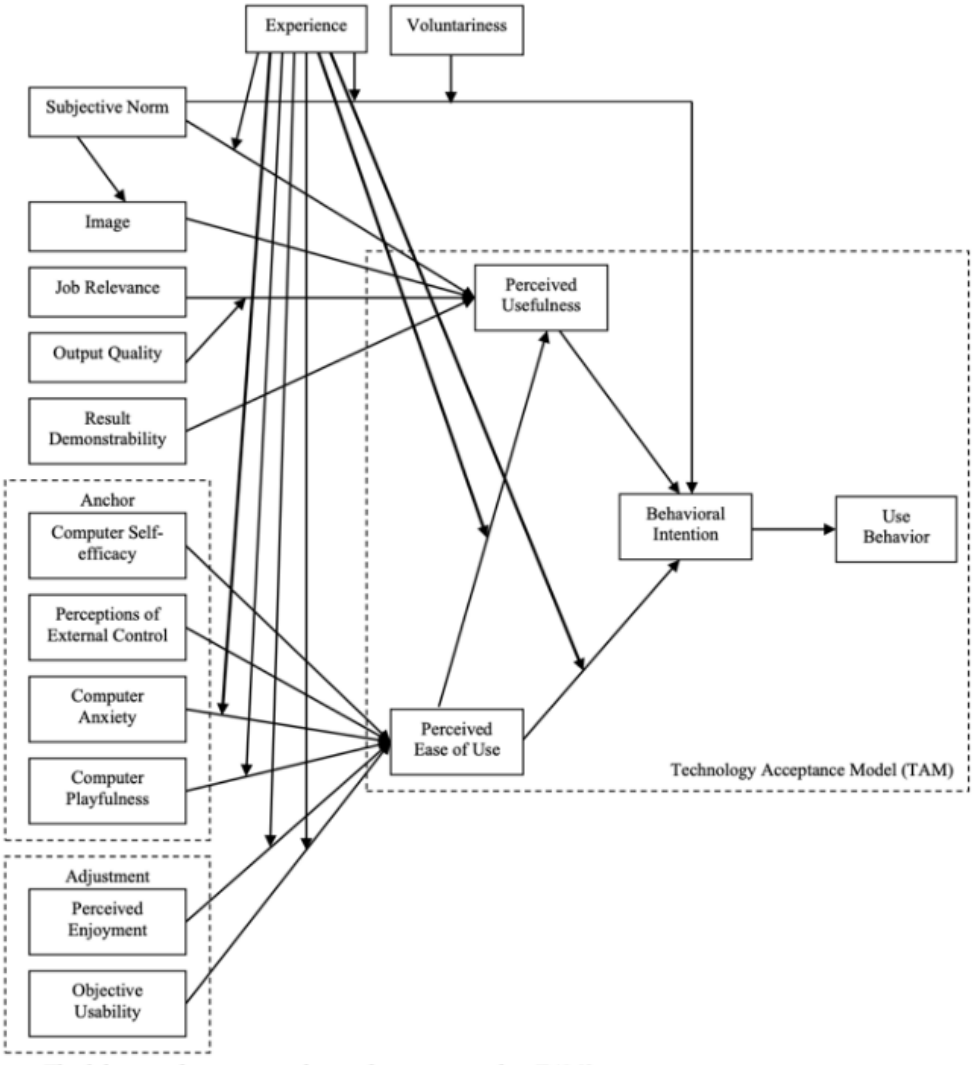

Figure 3: TAM3 by Venkatesh and Bala (2008, p.64)

The **DIT** by Rogers (2003) models how an innovation distributes within a social system and the main factors it influences (Karnowski & Kümpel, 2016). Rogers argues that the innovation decision process is influenced by four key elements – time, innovation, the communication channel and social system, and that it follows the phases of knowledge, persuasion, decision, implementation and confirmation. On the macro-level Rogers models the process of the innovation diffusion by analysing the distribution between different groups. The adaptation process of a successful innovation follows a classic normal distribution (Figure 5), in which

the gradient is relatively low until it reaches a critical mass, from which point on the diffusion increases until it begins to decrease again.

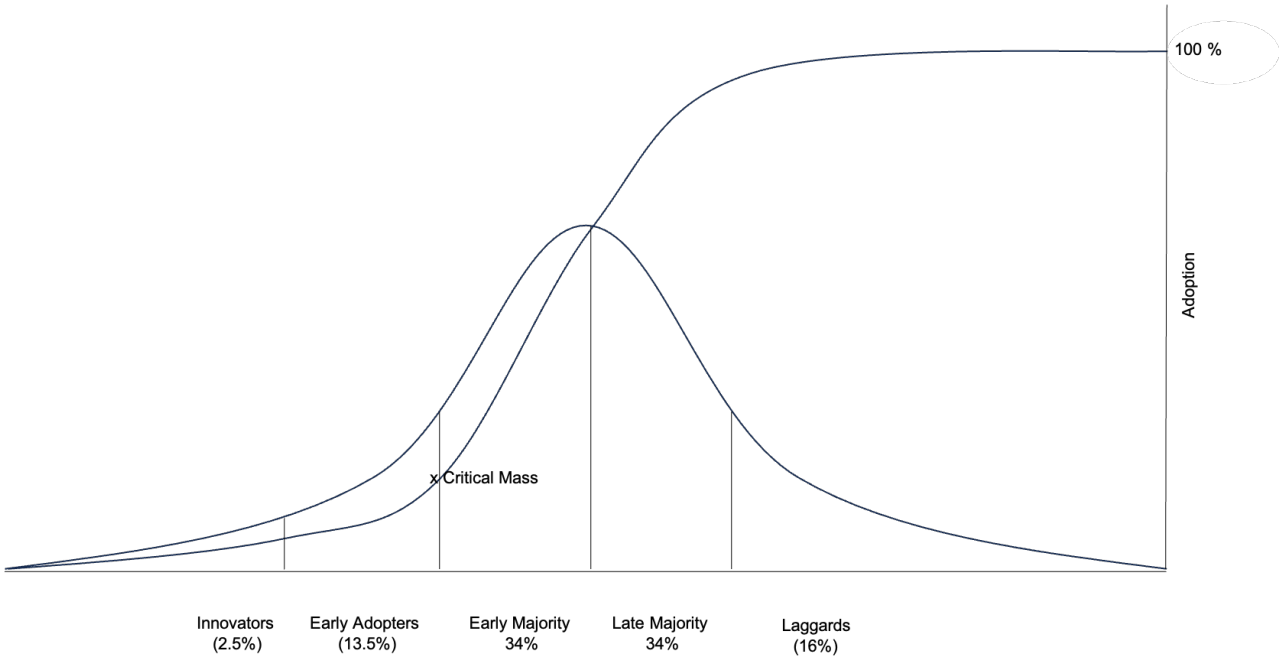

Figure 4: Technology diffusion model, modification after Karnowski & Kümpel (2016) and Rogers (2003)

Since Christenson (1997) first published "The Innovator's Dilemma", the concept of **disruptive technology** and disruptive innovation gained immense popularity reflecting a 350% increase of articles published in SSCI journals from 2022 to 2018 (Si & Chen, 2020). Due to its loose definition, scholars fear that it might just become a business buzzword (Nagy et al., 2016). A literature review of 208 articles, clarified the concept by drawing up a generic definition as

> "an innovation process in which technologies, products or services are initially inferior than those provided by incumbents in the attributes that mainstream consumers value, but these technologies, products or services can attract and satisfy the consumers in low-end or new markets with advantages in performance attributes (such as being cheap, simple, or convenient) that these consumers value but which at the same time are neglected by mainstream markets. Over time, through incremental improvement of technology or process, a disruptive innovation gradually satisfies the needs of mainstream consumers, so as to attain certain market share from or even replace incumbents in mainstream markets" (Si & Chen, p.6, 2020).

2.4 The Intersection of Art, AI and Digital Transformation

Despite the modern and avant-garde nature of art, the art market represents a rather traditional industry (Boll, 2021). The artworld often adopts new technology at a slower pace, preferring to observe its application and efficacy in other industries before integrating it into their own practices. Since 1990, the art market has undergone continuous digital transformation. Covid was a significant accelerator, and, as experts suggest, "the comprehensive set of digital tools clients can now access has not only broken down barriers to entry but reduced the need to view or physically handle works in person prior to purchasing" (Sotheby's 2021). The online art market grew by 7% in 2021, and accounted for 20% of sales in the overall market, more than doubling its pre-pandemic level of 2019 (Mcandrew, 2022). Automatizing routine tasks, streamline processes, digital certification and tokenization by companies such as Artory or Arcual demonstrate increasing relevance and use of blockchain applications. In 2021, 85 percent of young art collectors stated that blockchain technology could transform the way business is currently been conducted (Deloitte et al., 2021).

ML related aspects of the digital transformation of the art market show that 80% of the digital content consumed is based upon algorithmic recommendations (Mcandrew, 2019). Influential art sales databases, such as Artprice and Artnet, have played a pivotal role in enhancing transparency within the traditionally opaque art market. By providing public access to auction results, these platforms significantly improved appraising artworks. Furthermore, the growing power of data analysis tools, including advances in big data, data mining, and AI have elevated the importance of Art Analytics. This paradigm shift is evident in the strategic allocations of major industry players like Artprice, which now dedicates approximately 80% of its annual expenditure to research and development (Artprice, 2019). Nevertheless, the Artworld has not been extensively researched with respect to digital transformation in comparison to other industries (Kutnjak et al. 2019).

Recent advances in ML and especially IC could contribute to art authentication and solve the central problem of detecting art forgers. A prominent example is the Swiss-based company Art Recognition (AR), which uses AI for art authentication. It is no longer necessary to physically view the artwork, making transport and insurance costs obsolete (Lorange et al., 2022). Additional key benefits include the rapid testing time once a functional CNN is established, along with avoiding invasive chemical testing. However, there are major difficulties, which needs to be overcome to create reliable CNNs for art authentication. Companies with shoddy

results will promote scepticism in the traditionally conservative artworld towards this technology. Scholars such as Steve and Andrea Frank postulate a “as-transparent-as-possible-approach” and publishing techniques in peer reviewed journals to further develop AI art authentication in accordance with scientific norms and standards.

The selection of the training images is key as it defines the scope of the CNN and its explanatory power. As the training dataset underlies every prediction, it must be disclosed for any AI analysis of an artwork to be credible (2022). It is essential for a CNN to be trained on around 5000 observations per class, as stated earlier (Goodfellow & Courville, 2016). To reduce the number of high-quality images needed and to optimize the computationally expenses without losing valuable information, Frank and Frank (2020) introduced the “salient slices technique”. An image gets divided into partially overlapping tiles (Figure 6) and the image entropy criterion then retains only those tiles whose visual information exceed a specific threshold in regards to the diversity of the whole image. With this technique the CNN only includes tiles that contain visual information relevant to the specific artist, as artists may paint a characteristic figure in the middle of the canvas but the background is visually rather similar to another artist`s hand. The optimal tile size strongly depends on the studied artist as “smaller tiles concentrate the analysis on diminutive visual features like brushstrokes; bigger tiles allow consideration of compositional elements”, leading to van Gogh`s uniqueness only emerging at the brushstroke level and Rembrandt`s characteristics are most visual on a broader compositional scale (Frank, 2022, p.5 & p.9). Images contain scale-variant information and scale-invariant representations are incomplete representations of images (Noord & Postma, 2017). Thus, the salient slices technique considers the scale-sensitivity of CNNs by not combining tiles of different scales or sizes. Additionally, the resolution of the training images can’t vary by more than a factor of about five but need to exceed the resolution of 25 pixels per cm of canvas. The classification decision is based on an average tile probability metrics, where a probability converging towards 1 corresponds to a high likelihood that a tile is attributable to the artist under study. The final classification is not binary, it depends on whether the average

tile probability is equal or exceeding the decision boundary.

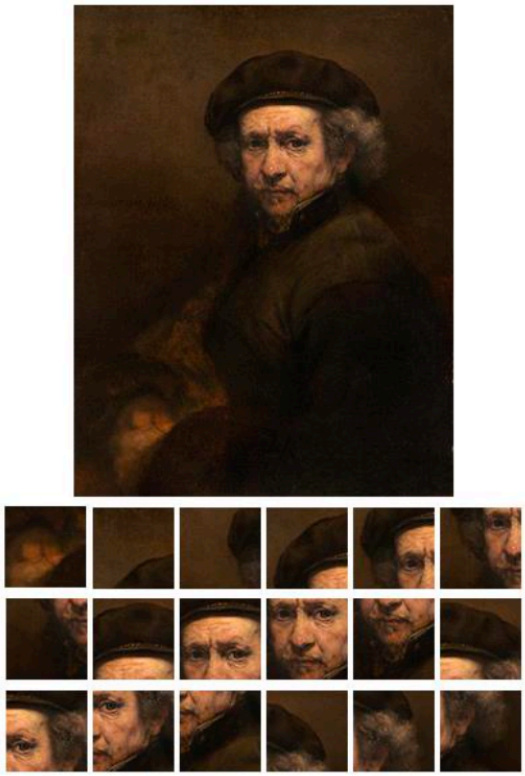

Figure 5: Salient slices technique applied at a Rembrandt image from Frank & Frank (2020, p.7)

The dataset gets commonly divided into a training and validation set. Both involve labelled images of paintings form the artist which is studied, forgeries and works from other comparison artists. The best preforming model of the validation set is then tested with an out-of-sample-set. This cross-validation of the data ensures the model´s performance with an independent data set. If the validation-set is not completely independent from the test-set, test accuracy will not be meaningful for new images tested with the model (Frank, 2023). In a recent study, Frank & Frank (2023) were able to apply the salient slices technique to contemporary works of art and achieved an accuracy level of 98%.

These findings highlight the strengths of AI authentication when using a robust methodology supported by a sufficient and high-quality data set. When testing the system with a smartphone-made image of the same artist, it is currently not able to identify the artist correctly. Initial tests, however, indicate that diversifying the training set with images from various cameras enables

the system to effectively handle variations among camera types (Frank & Frank, personal communication, 2023).

Scholars and companies are in agreement that this new technology should be used in conjunction with traditional methods (Lorange et al .2022) (Frank & Frank, 2022). However, "CNN analysis of two-dimensional artwork can help resolve basic questions of authenticity as well as more subtle nuances that trace the lived history of the work" (Frank & Frank, p.20, 2020).

3. Research Design

The review of literature led to the research gap regarding the potential of AI art authentication as a digital transformation in the art market. Based on this secondary research, the relevance of investigating this topic is evident. This research applies qualitative and quantitative methods to test multiple hypotheses and answer the research questions.

3.1 Research questions & hypotheses

RQ1: How is the art market assessing the current art authentication methods and what are the difficulties with the current process?

H1: Participants of the artworld are unsatisfied with the current methods available for authenticating art.

H1.1: Participants in the art market express the highest level of satisfaction with provenance investigation as a method for authenticating art among the various available techniques.

H1.2: The process of authenticating art is currently taking too much time.

H1.3: There is a lack of confidence and trust among participants in the art world regarding the outcomes of art authentication processes.

H1.4: The current cost of art authentication is viewed as excessively high by industry participants

H1.5: The logistical effort involved in authenticating art is too high.

H1.6: Optimizing the art authentication process would lead to an increase in the frequency of art being authenticated.

H1.7: The opinion about the currently art authentication process differs significantly between the three groups of users, current authenticators and the neutral party.

RQ2: In what stage of the Diffusion of Innovations model by Rogers (2003) is the adoption of machine learning for art authentication?
H2: AI art authentication is according to the Diffusion of Innovations (DIT) model by Rogers (2003), still in the early knowledge stage.

RQ3: To what extent can AI art authentication be considered a disruptive technology in the field of art verification and authentication?
H3: AI art authentication has the potential of being a disruptive technology.
H3.1: The opinion about the potential of AI art authentication being a disruptive technology differs significantly between the groups of users, current authenticators and the neutral party.

RQ4: Will the artworld accept the technology of AI art authentication and what factors influence the acceptance?
H4: People of the art world intent to use AI art authentication.
H4.1: People of the art world think that AI art authentication is relevant for the job.
H4.2: People of the art world have a low result demonstrability for AI art authentication.
H4.3: People of the art world currently believe in the quality of AI art authentication.
H4.4: People of the art world think they need to use AI art authentication.
H4.5: People of the art world show high level of computer anxiety.
H4.6: The perceive usefulness is significantly higher as the perceive ease of use.

3.3 Methodology

Triangulation was used to test the hypotheses and answer the research questions. However, “use of triangulation strategies does not strengthen a flawed study. Researchers should use triangulation if it can contribute to understanding the phenomenon,…..must be able to able to articulate why the strategy is being used and how it might enhance the study (Thurmond, p.253., 2001).

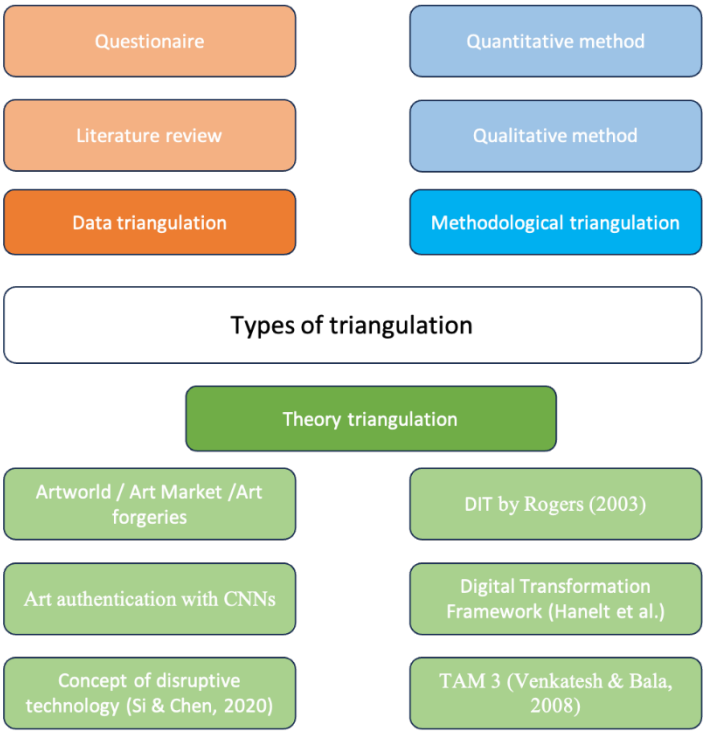

Figure 6: Dimensions of triangulation according to Thurmond (2001)

Data triangulation ensures a comprehensive understanding of the complex issues of AI art authentication by offering a more holistic view. Using multiple data sources enriches the gained insights by utilizing the diversity of these sources, identifying convergences and divergences in the research findings.

The study`s design uses techniques from scenario planning to consider multiple plausible future situations. There is no single approach to scenario planning, but models commonly define the issue, identify the key drivers, rank items by importance and uncertainty. Scenario planning approaches including a combination of qualitative and quantitative techniques enhance the construction of robust scenarios (Amer et al. , 2013).

Fundamental concepts from computer-simulated agent-based models were used to model the artworld as a complex system, in which different agendas interact. To model the motives and perspectives of the different participants, agents were clustered into three groups (Figure 8). The artworld represent the environment, in which the agents act autonomously and interact with each other. This enables the study to analyse AI art authentication by taking into account system dynamics of the different players in the artworld.

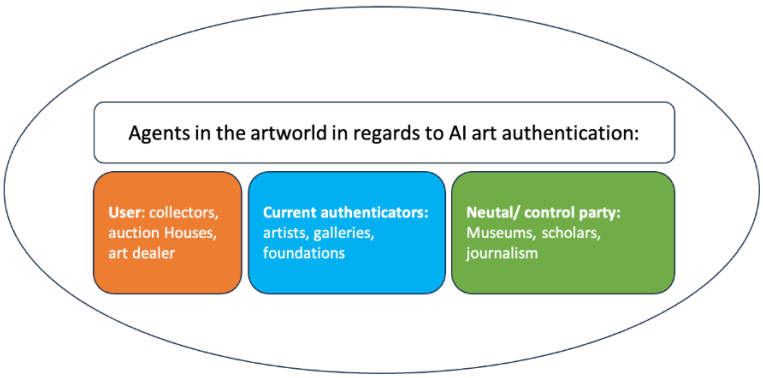

Figure 7: Clustering of the agends within the environment of the art world

An online questionnaire tested the hypotheses. Quantitative as well as qualitative methods were used. The instrument was designed in English and German and made use of Likert scales, where one represented “strongly disagree” and seven “strongly agree”.

3.3.1 Questionnaire

The questionnaire (appendix B) was created using Qualtrics and began with an introduction to the concept of AI art authentication and then described the three identified groups of agents in the artworld. Participants were then requested to answer from the perspective of the agent group to which they primarily belonged. The TAM 3 of Venkatesh and Bala (2008) was used to investigate the user’s acceptance. The internal consistency reliability of all factors are between 0.76 and 0.94, stating an good to excellence internal consistency reliability and thus the consistent measurement of the same underlying construct. The coefficient of determination for `Perceived Easefulness`, `Perceived Ease of Use` and `Behavioral Intention` is 0.67, 0.52 and 0.53 respectively. The wording of the items were adjusted by using the subjective mood as AI art authentication is not yet commonly used in the art market. Due to the same reason the factor of `Objective Usability` and `Use`are excluded from the questionnaire. All determinants of `Perceived Usefulness` are included in the questionnaire and most of the determinants for `Perceived Ease of use`. The constructs of `Computer Self-efficacy`, `Perception of External Control` and `Computer Playfulness` are excluded as the research focuses not on the implementation of a specific software. Instead, it analyses the usage of a technology, which is predominantly operated by an external party and not directly by the participant of the artworld.

3.3.3 Data Collection

Participants were recruited via the author's personal contacts within in the artworld and by contacting institutions and individuals via email, LinkedIn or telephone. The only screening criteria was belonging to one of the three agent groups, proposed in Figure 8. During recruitment the author aimed to achieve a balanced sample size across the three groups.

4. Findings

The questionnaire was answered by 96 participants, from which 65 completed all questions. To answer the research questions only the answers from participants who completed all questions were included.

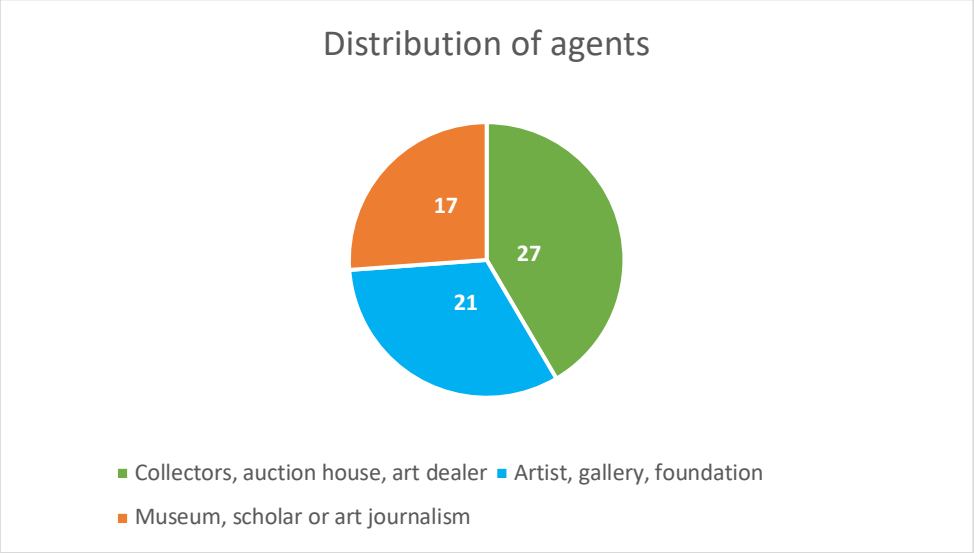

Figure 8: Distribution of agents within the study

During the Data collection, the author became aware of a mistake that occurred while programming the questionnaire with Qualtrics. The scales in all but the fourth part reached from 0-7, instead of a seven-point Likert scale. The answers were recoded, so that 0, 1 and 2 became 1, 2 and 3 respectively. Points 3 and 4 were recoded to 4. The mean was rounded to whole numbers, and the standard deviation (SD) was rounded to four decimal places.

4.1 RQ1: Current art authentication methods and obstacles

The following table shows the descriptive statistics and the testing of H.1, H1.2, H1.3, H1.4, H1.5 and H1.6.

Topic	Q. Nr.	Min	Max	Mean	SD.	H.	Test	Result
Overall Satisfaction with art authentication	Q6_1	2	6	3.4769	1.1195	**H.1**	<=3?	**Failed to reject**
Satisfaction with motivational analysis	Q6_2	2	7	3.6923	1.1716			
Satisfaction with provenance investigation	Q6_3	3	7	4.5077	0.9540			
Satisfaction with technical examination	Q6_4	2	6	3.3846	1.0108			
Amount of time is taking too long	Q6_6	2	7	3.3385	1.0647	**H1.2**	<=3?	**Failed to reject**
Lack of confidence	Q6_7	2	5	3.6562	0.8586	**H1.3**	<=3?	**Rejected**
Costs are too high	Q6_8	2	6	3.4531	1.0224	**H1.4**	<=3?	**Failed to reject**
Logistical effort is too high	Q6_9	2	7	4.1875	1.2709	**H1.5**	>=5?	**Rejected**
Less obstacles would lead to more art authentications	Q6_10	2	7	5.3281	0.9768	**H1.6**	>=5?	**Failed to reject**

Table 1: Descriptive statistics and the testing of H.1, H1.2, H1.3, H1.4, H1.5 and H1.6

The Kolmogorov-Smirnov, as well as the Shapiro-Wilk Test of Normality showed that the assumption of normality was violated for Q6_2, Q6_3 and Q6_4 (appendix C). The Mauchly´s Test of Sphericity showed that the assumption of Sphericity was violated (appendix D). However, due to the robustness of ANOVA, testing of H1.1 continued with the repeated measure ANOVA. Due to the violation of Sphericity, the Greenhouse-Geisser corrections of the ANOVA output were used and showed a significant difference between the three methods of art authentication (appendix E). The multiple comparison with Bonferroni further proved that the satisfaction of the participants differed significantly between the three authentication methods (appendix F). With a significant mean difference of -0.815, participants were less satisfied with the motivational analysis than with the provenance investigation. The technical examination scored significantly lower than the provenance investigation with a mean difference of -1.123. The motivational analysis scored significantly higher than the technical examination with a mean difference of 0.308. These findings didn`t reject H1.1.

In order to test H1.7, the assumptions for a MANOVA were investigated. The Kolmogorov-Smirnov, as well as the Shapiro-Wilk Test of Normality showed that the assumption of normality was violated for all items (appendix G). The assumption of homogeneity of covariance matrices was violated by a significant result (appendix H). If proceeding further with the MANOVA, despite the assumptions being violated, the Turkey HSD Post Hoc Test showed in "I am satisfied with the current method available for authenticating art" a significantly difference between the agent group of museum, scholar or art journalism and artist, gallery or foundation of -1.0812. In the item "I am satisfied with provenance investigation as a method for authenticating art" a significant difference of -0.7692 between collectors, auction house or art dealer and museum, scholar or art journalism was found. In "The current cost associated with art authentication is justified" a significant difference between the agent of museum, scholar or art journalism and collectors, auction house or art dealer of -1.1222 and a significantly difference between museum, scholar or art journalism and artist, gallery or foundation of -1.0672 was found (appendix I). This result led to the rejection of H1.7.

In response to "Are there any other major obstacles that you currently see in the process of art authentication?" participants identified three primary themes. The most frequently mentioned was "Trust and Expertise", followed by "Practical concern's and the "inclusion of artist" (appendix J).

The mean on the Likert scale of the question if participants use SMACIT in their day-to-day life in their role they have in the artworld is 4.1692 with a standard deviation of 1.05430 (appendix K). The MANOVA showed a significant difference of -1.3983 and -.8487 between museum, scholar or art journalism and between collectors, auction house and between museum, scholar or art journalism and artist, gallery or foundation, respectively.

4.2 RQ2: Current Stage of Diffusion of AI art authentication

Stage after Rogers (2003)	Item	Min.	Max	Mean	SD.	Test	Result
Knowledge stage. (1/2):	I have heard about AI art authentication before this survey and could	2	6	4.8462	1.4278	>=5?	**YES**

	describe what it is.						
Knowledge stage (2/2):	I understand the functioning and benefits of AI art authentication	2	7	4.9692	0.9838	>=5?	**YES**
Persuasion stage (1/2):	I believe AI art authentication is beneficial	3	7	5.3528	0.9752	>=5?	**YES**
Persuasion stage (2/2):	I would consider trying or recommending AI art authentication	2	7	5.4923	1.0019	>=5?	**YES**
Decision stage (1/1):	I have decided to use AI art authentication	2	7	4.6615	0.9565	>=5?	**YES**
Implementation stage (1/2):	I have integrated AI art authentication into my daily life or work	1	6	1.6923	1.2981	>=5?	**NO**
Implementation stage (2/2):	I have made changes or adaptations to AI art authentication technology to better suit my needs	1	6	1.6462	1.1650	>=5?	**NO**
Confirmation stage (1/1):	I am likely to continue using AI art authentication in the future	1	7	4.4000	1.0428	>=5?	**NO**

Table 2: Descriptive statistics of the questions regarding the current Stage of Diffusion of AI art authentication

The results indicated that AI art authentication reached the Knowledge, Persuasion, and Decision stage. The Implementation and Confirmation stage were not yet achieved according to Rogers (2003). This led to rejection of H2.

4.3 RQ3: Disruptive technology

Factor after Si & Chen (2020)	Min.	Max	Mean	SD.	Test	Result	Reasoning
Initial Inferiority	2	7	5.50	1.208	>=5?	**YES**	"Accessible to everyone, approval of the traditional art

							world and tradition, academic acknowledgment, it's not valued by current experts, tradition."
Target Market Attraction	3	7	5.23	1.178	>=5?	**YES**	"Transparency, speed and objectifiability, objectivity and independence of a person's opinion, the pace and convenience."
Neglected Attributes	2	7	5.06	0.957	>=5?	**YES**	"Speed and accessibility.
Incremental Improvement	2	7	4.23	0.792	>=5?	**NO**	
Mainstream Market Penetration	2	7	3.75	0.992	>=5?	**NO**	
Displacement Potential	2	7	4.41	1.244	>=5?	**NO**	"Only a supplement, not a replacement, traditional methods will always stay relevant, traditional methods are likely to remain relevant."

Table 3: Descriptive statistics of the questions regarding the disruptiveness of AI art authentication

The results indicated that AI art authentication fulfilled the criteria of Initial Inferiority, Target Market Attraction and Neglected Attributes for a a disruptive technology. However, since the criteria of Incremental Improvement, Mainstream Market Penetration and Displacement Potential was not fulfilled, H3 is rejected.

In order to test H3.1 the assumptions for a MANOVA were investigated. The Kolmogorov-Smirnov, as well as the Shapiro-Wilk Test of Normality showed that the assumption of normality was violated for all items (appendix L). The assumption of homogeneity of covariance matrices was violated by a significant result (appendix M). If proceeding further with the MANOVA, despite the assumptions being violated, the Turkey HSD Post Hoc Test

rejected H3.1 as no significant differences between the agent groups could be found (appendix N).

4.4 RQ4: Acceptance of the technology of AI art authentication in the artworld

To address RQ4, composite scores were constructed for each construct of Venkatesh and Bala (2008) by averaging the scores of the questions associated with each respective factor. The response scales for the items CANX1 and RES4 were reversed to ensure consistency with the other factors

Construct	Min	Max	Mean	SD.	H.	Test	Result
Behavioral Intention	3	7	4.6872	1.0489	**H4**	>=5?	**Failed to reject**
Job Relevance (REL)	3	7	4.8667	0.9553	**H4.1**	>=5?	**Failed to reject**
Result Demonstrability (RES)	2.75	6.75	4.5692	0.8965	**H4.2**	<=3?	**Rejected**
Output Quality (OUT)	3	7	4.4410	0.7220	**H4.3**	>=5?	**Rejected**
Voluntariness	3.33	7	5.4667	0.8329	**H4.4**	<=3?	**Rejected**
Computer Anxiety (CANX)	1	4.25	1.9769	0.6521	**H4.5**	>=5?	**Rejected**

Table 4: Descriptive statistics of the TAM factors

Since the the Kolmogorov-Smirnov, as well as the Shapiro-Wilk Test of Normality showed that the assumption of normality was violated the construct Perceived Usefulness and Perceived Ease of Use, the nonparametric Wilcoxon Signed-Rank Test was used to test H4.6 (appendix O). The two-tailed test showed a significant difference between the perceived usefulness and the perceived ease of use (appendix P). As the mean of perceived usefulness was 5.1308 with a SD of 0.8961 and the mean of perceived ease of use was 4.2038 with a SD of 0.8793, H4.6 is not rejected (appendix Q)

5. Conclusion

This last chapter discusses the findings of chapter four to answer the research questions. Furthermore, the limitations of the study and further research proposal are presented.

5.1 General conclusion

Regarding the status quo of the art authentication process and RQ1, participants from the art market showed moderate satisfaction with the current art authentication methods. Museums, scholars or art journalists were the least satisfied agent groups among the three. This indicated a deep-rooted problem and the potential to innovate and improve art authentication. Among the three current authentication methods, people were most satisfied with the provenance investigation, followed by the motivational analysis and the technical examination. Collectors, auction houses and art dealers, were less satisfied with the provenance investigation than museums, scholars or art journalisms. This might indicate that the commercial side of the art market has limited access to historical records, vital for a provenance investigation. The current time and costs of art authentication were seen as a significant problem by participants from the art market. Museums, scholars or art journalists perceived authentication costs as more justified than collectors, auction houses, art dealers, artists, galleries or foundations. This may indicate a knowledge gap of the named agent group regarding realistic market prices or the existence of different authentication channels, which are not accessible for the commercial market. Removing obstacles in the art authentication process would lead to more frequent art authentications. The main obstacles named were trust and expertise and practical concerns.

The second research question investigated diffusion of AI art authentication after Rogers (2003). The art market was already aware of the technology, understood how it works, and was favourable towards it. However, broad implementation as well as deciding if they wanted to continue using the technology has not yet taken place. This study emphasized the critical role of key players or opinion leaders in AI art authentication, particularly given the concentrated nature of the art market. Achieving a critical mass of users is vital for the broader adoption of any technology.

Research question three studied the disruptiveness of AI art authentication. The criteria of Initial Inferiority, Target Market Attraction and Neglected Attributes were fulfilled for AI art authentication to be a disruptive technology. Since the Incremental Improvement, Mainstream Market Penetration and Displacement Potential were not fulfilled criteria, the technology could not be seen as disruptive yet. To be disruptive, AI art authentication needs to significantly improve the current issues of art authentication. The public pricing through art data bases has helped grow the art market and generally, so transparency has led to increased liquidity in markets (Lang & Maffett, 2011). Furthermore, the quality and authenticity of the training data

of a system used for AI art authentication is crucial. AR claims to develop an AI system for under 1,000 Euros. It authenticates artwork using just a smartphone image, but the client is not allowed to know details about the technology including data used for training models. This appears to merely follow current trends in authentication methods rather than being a disruptive technology (Art Recognition, 2024). It is unlikely AI art authentication will displace current authentication methods.

Research question four investigated whether the artworld is likely to accept the technology and which factors influence acceptance. People intend to use AI art authentication and perceive the technology as relevant. The perception of output quality is rather moderate although results were demonstrable. Use of the technology was perceived as voluntary and was not shaped by high levels of computer anxiety. Participants from the art world rated perceived ease of use lower than perceived usefulness of AI art authentication. The results indicated that TAM intervention after Venkatesh and Bala (2008) should focus on the factor perceived usefulness with the Output Quality and Subjective Norm. The perceived Output Quality could be increased by educating users. Demonstrating that the features and capabilities are aligned with the user interests and incentives has the potential to increase the Subjective Norm. Furthermore, management support is likely to increases perceived usefulness. To enhance perceived ease of use, system-related characteristics should be stressed. The system should provide users with relevant information in a timely manner and in an understandable format. Flexibility and a user-friendly design further increased perceived enjoyment. Granting users greater control over the system enhanced their positive disposition towards using the system and potentially led to greater user acceptance and system success.

To conclude whether AI art authentication has the potential to digitally transform the art market the multi-dimensional model of Hanelt et al (2020) was applied. Within the contextual conditions and the material determinants, the study showed a significant role SMACIT had in the day-to-day life of participants in the art world. However, its role was significantly smaller for museums, scholars or art journalists. The emergence and diffusion of AI art authentication was proven – availability of art market data has increased over the years but availability of high-quality images of art works is restricted. With regard to organisational determinants, art market players are rather slow in adopting to new technology but if the pressure through a high-quality outcome of AI art authentication increases, transformative effects on organizational structures are likely to occur, especially since awareness of the technology is increasing. This

confirmed demand for alternative authentication methods and intention to use AI for art authentication. This suggests a digital transformation. However, the art market is traditional and the legal system poses constraints. After Covid-19, the pace of technology has accelerated significantly. The TAM interventions can be viewed as an enabler for the TAM3 Mechanisms.. AI art authentication should respect ethical standards, such as “The use of AI must enhance human development and not diminish it. AI should not replace humans. These are fundamental rules for ethical assessment” (“Ethikrat: Künstliche Intelligenz Darf Menschliche Entfaltung Nicht Vermindern,” 2023). Spillover effects may include higher exposure to cyber threats and a paradigm change towards a customer-centricity and a connected market.

Finally, the application of AI in art authentication can be seen as a potential digital transformation within the art market, aligning with several dimensions of the digital transformation framework. Its success, however, will depend on factors discussed and could contribute to securing the 'memorial power' of goods in an enriched economy (Boltanski and Esquerre, 2020). The story is a key driver of value creation in the enrichment economy, often involving various intermediaries like experts, galleries, and certifiers, who validate the value of the good. In a game-theoretical approach, failure to detect fraud can be seen as a fundamental form of market failure.

5.2 Limitations

The rather small sample size of 65 participants represents a limitation in the study´s methodology. The sample size of the single agent groups contained even fewer participants. A representative sample would enhance the generalizability of the results and enable advanced statistical testing. As the majority of the agent group of collectors, auction house or art dealers were recruited by the author´s personal network, selection bias could have influenced the data. The findings should be examined in light of this work's scope. Generalizing findings to the global art market or to all media types could lead to erroneous conclusions. Furthermore, the Likert scale could have introduced a skew into the findings. Given the undefined structure of the art market, the agent groups that were constructed might be inaccurate. Future research should consider conducting a cluster analysis to more accurately identify agent groups relevant to AI art authentication. Finally, investor triangulation was not conducted, making the study vulnerable to further criticism.

5.3 Further research

In the context ML and art authentication, it is recommended to research price elasticity of users and costs of building an AI system for specific artists. Furthermore, developing standards and regulations for using AI is needed as well as investigating ethical implications. This research provided general insights so it is recommended to quantitatively validate the scenarios. Constructing a regression model to analyse the influence of individual factors on the acceptance and implementation of AI art authentication may also yield valuable insights.

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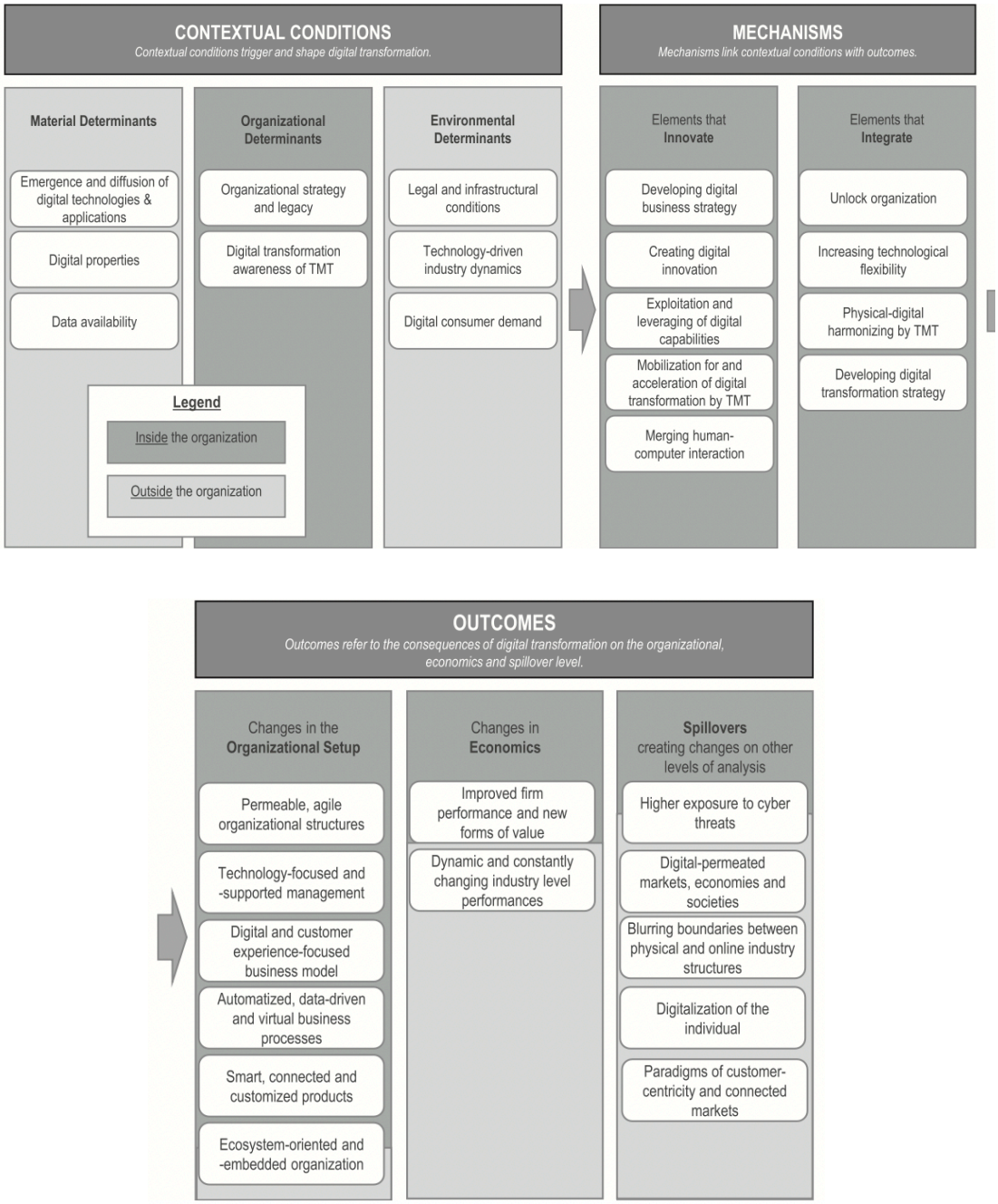
Appendix

Appendix A

Multi-dimensional framework of digital transformation, Hanelt et al., (2020, p. 1165)



Appendix B

English

Welcome Block

Thank you for participation in this research survey, which concerns the application of **Artificial Intelligence in the field of art authentication.**

This study aims to collate perspectives and insights from professionals within the art world, thereby enriching our understanding of AI's role and impact in this context.

We assure you that your responses will be treated with strict confidentiality and will b**e completely anonymous**.

Your contribution is invaluable to the academic discourse on this subject. Your participation is greatly appreciated and will significantly aid in **advancing academic research in AI art authentication.**

For any inquiries regarding the survey or subsequent results, please do not hesitate to contact me: s-okampik@ucp.pt

By confirming, you agree to participate in this research study. Your data will be used **solely for academic purposes**, ensuring confidentiality and compliance with **ethical research standards**. **Participation is voluntary,** and you have the right to withdraw at any time without any consequences

I agree

Introduction to AI Art authentication

AI Art Authentication is a **new method** in the realm of art verification, adding to the existing traditional approaches. This technique **utilizes artificial intelligence to analyze artworks,** focusing on intricate details like brushstrokes, color patterns, and textures. By comparing these elements against a vast database of known works, the **AI can assist in determining the authenticity of a piece**, especially useful in identifying forgeries. In addition to AI Art Authentication, there are three traditional mainstays in art verification:

Provenance Research: This involves tracing the artwork's history, including its ownership and transfer records. It helps establish the artwork's journey through time and its legitimacy.

Stylistic Analysis: Experts examine the style, technique, and materials used in the artwork. This analysis is often based on the known methods and characteristic styles of the artist.

Technical Analysis: This scientific approach involves examining the physical aspects of the artwork, such as the canvas, pigments, and binding agents. Techniques like X-ray, infrared imaging, and chemical analysis are used to understand the composition and age of the materials.

Art Authentication complements these traditional methods, offering a more technologically advanced examination. **It has the potential to enhance the accuracy and efficiency of the authentication process**, proving to be a valuable asset in the art world. Recent research indicates significant potential in this approach, marking the **first time a more quantifiable and data-driven method is available to make determinations about the authenticity of artworks**. This development could revolutionize the decision-making process in art authentication, making it more objective and reliable.

Agent Group

The art world is a complex network where individuals often assume multiple roles. From art dealers who are also collectors, to artists who curate, the overlapping of responsibilities creates a rich but intricate landscape of perspectives. This survey seeks to understand the **unique viewpoints** of each participant, based on their primary role in the art ecosystem. Whether you're an artist, curator, dealer, collector, or fill another crucial role, your insights are vital. Please respond to the questions considering **your primary role in the art world**.

What is **your primary role** in the art world?

Collectors, auction house, art dealer

Artist, gallery, foundation

Museum, scholar or art journalism

Non of the them (End of the survey)

Status quo of art authentication

Please rate the following statements from one to seven

the current obstacles were reduced

Are there any other major obstacles that you currently see in the process of art authentication?

DIT

Please rate the following statements from one to seven

	Strongly disagree 0	Disagree 1	Somewhat disagree 2	Neither agree nor disagree 3	Somewhat agree 4	Agree 5	Strongly agree 6	7
I have heard about AI art authentication before this survey and could describe what it is								
I understand the functioning and benefits of AI art authentication								
I believe AI art authentication is beneficial								
I would consider trying or recommending AI art authentication								
I have decided to use AI art authentication								
I have integrated AI art authentication into my daily life or work								
I have made changes or adaptations to AI art authentication technology to better suit my needs								
I am likely to continue using AI art authentication in the future								

Block 6

Please answer the following questions. Note that there are two fields per item

	Please rate the following statements from one to sever					
	Strongly disagree	Disagree	Somewhat agree	Neither agree not disagree	Somewhat agree	Agre
Does AI art authentication initially lack certain attributes that are highly valued by mainstream consumers?	○	○	○	○	○	○
Does ai art authentication offer						

unique advantages (like affordability, simplicity, or convenience) that attract low-end or new market consumers?	○	○	○	○	○	○
Does AI art authentication emphasize performance attributes (such as cost-effectiveness, user-friendliness, or compactness) that are overlooked by mainstream providers?	○	○	○	○	○	○
Is there a consistent effort to improve AI art authentication or process to better meet the needs of mainstream consumers over time?	○	○	○	○	○	○
Has AI art authentication gradually gained acceptance among mainstream consumers, thereby capturing a significant market share from established incumbents?	○	○	○	○	○	○
Is there a likelihood that AI art authentication will eventually replace existing solutions in mainstream markets due to its evolving capabilities and appeal?	○	○	○	○	○	○

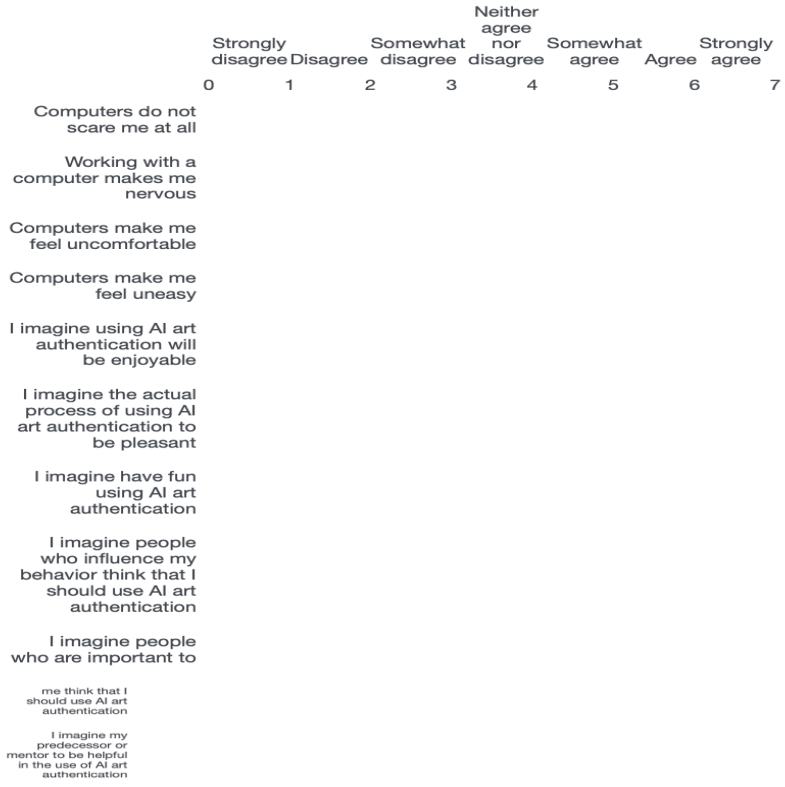
TAM3

Please rate the following statements from one to seven

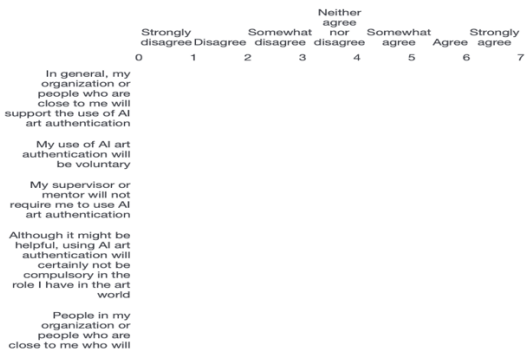
	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
	0	1	2	3	4	5	6	7
Using AI art authentication would enhance my performance in the role I have in the art world.								
Using AI art authentication would enhance my productivity in the role I have in the art world.								
Using AI art authentication would enhance my effectiveness in the role I have in the art world.								
I would find AI art authentication useful in the role I have in the art world.								
I imagine the interaction with AI art authentication to be clear and understandable.								
Interacting with AI art authentication would not require a lot of my mental effort.								
I imagine AI art authentication to be easy to use.								
I imagine it easy to								

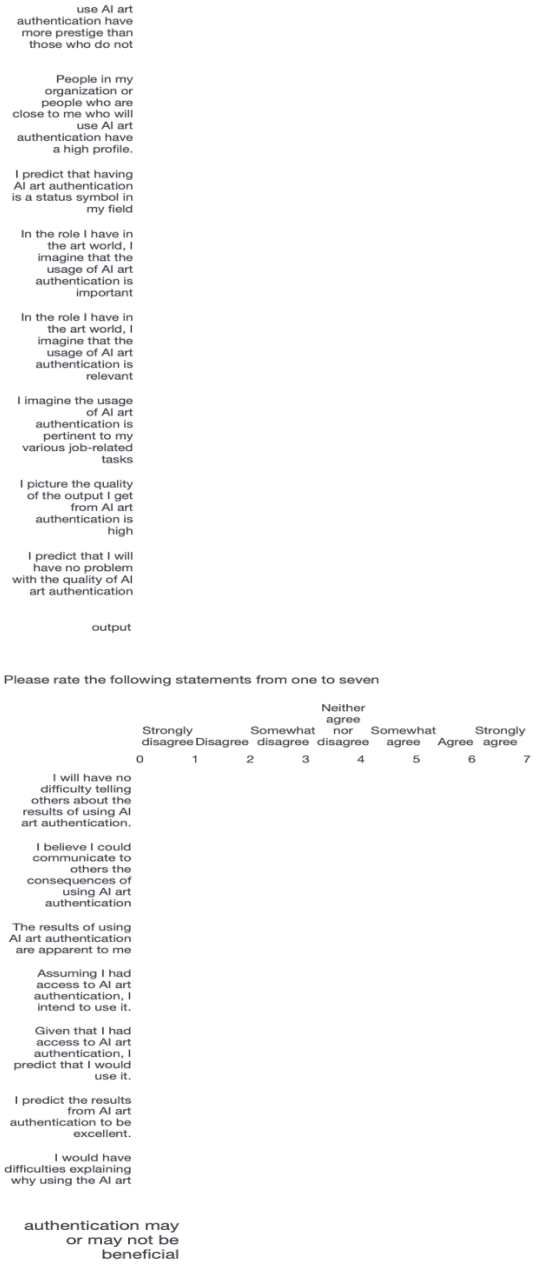
get AI art authentication to do what I want it to do.

Please rate the following statements from one to seven



Please rate the following statements from one to seven





Quest. No.	Item	Scale	Hypothesis	Testing

1	I am satisfied with the current methods available for authenticating art	1 - 7	H1	If mean of Q1 is <=3 than Hypothesis accepted
2	I am satisfied with the art motivational analysis as a method available for authenticating art	1 - 7	H1.1	Paired-Sample T-Test between the Q1 – Q2
3	I am satisfied with provenance investigation as a method available for authenticating art	1 - 7	H1.1	Paired-Sample T-Test between the Q1 – Q2
4	I am satisfied with technical examination as a method available for authenticating art	1 - 7	H1.1	Paired-Sample T-Test between the Q1 – Q2
5	I use SMACIT technologies (social, mobile, analytics, cloud, and Internet of Things) in my day-to-day life in the role I have in the art world	1 - 7		Descriptive
6	The amount of time it currently takes to authenticate a piece of art is reasonable	1 - 7	H1.2	If mean of Q6 is <=3 than Hypothesis accepted
7	I have a high level of confidence and trust in the process of art authentication decisions.	1 - 7	H1.3	If mean of Q7 is <=3 than Hypothesis accepted
8	The current cost associated with art authentication is justified.	1 - 7	H1.4	If mean of Q8 is <=3 than Hypothesis accepted
9	The logistical effort involved in authenticating art is significant	1 - 7	H1.5	If mean of Q9 is <=3 than Hypothesis accepted
10	I would authenticate art more frequently if the current obstacles were reduced	1 - 7	H1.6	If mean of Q10 is =<5 than

				Hypothesis accepted
11	Are there any other major obstacles that you currently see in the process of art authentication?	Qualitative		Cluster the answers

Stage	Item	Scale
Knowledge stage. (1/2):	I have heard about AI art authentication before this survey and could describe what it is.	1-7
Knowledge stage (2/2):	I understand the functioning and benefits of AI art authentication	1-7
Persuasion stage (1/2):	I believe AI art authentication is beneficial	1-7
Persuasion stage (2/2):	I would consider trying or recommending AI art authentication	1-7
Decision stage (1/1):	I have decided to use AI art authentication	1-7
Implementation stage (1/2):	I have integrated AI art authentication into my daily life or work	1-7
Implementation stage (2/2):	I have made changes or adaptations to AI art authentication technology to better suit my needs	1-7
Confirmation stage (1/1):	I am likely to continue using AI art authentication in the future	1-7

Factor	Item	Scale	Reasoning
Initial Inferiority	Does AI art authentication initially lack certain attributes that are highly valued by mainstream consumers?	1 - 7	
Target Market Attraction	Does ai art authentication offer unique advantages (like affordability, simplicity, or convenience) that attract low-end or new market consumers?	1 - 7	
Neglected Attributes	Does AI art authentication emphasize performance attributes (such as cost-effectiveness, user-friendliness, or compactness) that are overlooked by mainstream providers?	1 - 7	
Incremental Improvement	Is there a consistent effort to improve AI art authentication or process to better meet the needs of mainstream consumers over time?	1 - 7	
Mainstream Market Penetration	Has AI art authentication gradually gained acceptance among mainstream consumers, thereby capturing a significant market share from established incumbents?	1 - 7	
Displacement Potential	Is there a likelihood that AI art authentication will eventually replace existing solutions in mainstream markets due to its evolving capabilities and appeal?	1 - 7	

Constructs	Item	
Perceived Usefulness (PU)	PU1	Using AI art authentication would enhance my performance in the role I have in the art world.
	PU2	Using AI art authentication would enhance my productivity in the role I have in the art world.
	PU3	Using AI art authentication would enhance my effectiveness in the role I have in the art world.
	PU4	I would find AI art authentication useful in the role I have in the art world.
Perceived Ease of Use (PEOU)	PEOU1	I imagine the interaction with AI art authentication to be clear and understandable.
	PEOU2	Interacting with AI art authentication would not require a lot of my mental effort.
	PEOU3	I imagine AI art authentication to be easy to use.
	PEOU4	I imagine it easy to get AI art authentication to do what I want it to do.
Computer Anxiety (CANX)	CANX1	Computers do not scare me at all.
	CANX2	Working with a computer makes me nervous.
	CANX3	Computers make me feel uncomfortable.
	CANX4	Computers make me feel uneasy.
Perceived Enjoyment (ENJ)	ENJ1	I imagine using AI art authentication will be enjoyable.
	ENJ2	I imagine the actual process of using AI art authentication to be pleasant.
	ENJ3	I imagine have fun using AI art authentication.
Subjective Norm (SN)	SN1	I imagine people who influence my behavior think that I should use AI art authentication.
	SN2	I imagine people who are important to me think that I should use AI art authentication.
	SN3	I imagine my predecessor or mentor to be helpful in the use of AI art authentication.
	SN4	In general, my organization or people who are close to me will support the use of AI art authentication.
Voluntariness	VOL1	My use of AI art authentication will be voluntary.
	VOL2	My supervisor or mentor will not require me to use AI art authentication.

	VOL3	Although it might be helpful, using AI art authentication will certainly not be compulsory in the role I have in the art world.
Image (IMG)	IMG1	People in my organization or people who are close to me who will use AI art authentication have more prestige than those who do not.
	IMG2	People in my organization or people who are close to me who will use AI art authentication have a high profile.
	IMG3	I predict that having AI art authentication is a status symbol in my field.
Job Relevance (REL)	REL1	In the role I have in the art world, I imagine that the usage of AI art authentication is important.
	REL2	In the role I have in the art world, I imagine that the usage of AI art authentication is relevant.
	REL3	I imagine the usage of AI art authentication is pertinent to my various job-related tasks.
Output Quality (OUT)	OUT1	I picture the quality of the output I get from AI art authentication is high.
	OUT2	I predict that I will have no problem with the quality of AI art authentication output.
	OUT3	I predict the results from AI art authentication to be excellent.
Result Demonstrability (RES)	RES1	I will have no difficulty telling others about the results of using AI art authentication.
	RES2	I believe I could communicate to others the consequences of using AI art authentication.
	RES3	The results of using AI art authentication are apparent to me.
	RES4	I would have difficulties explaining why using the ai art authentication may or may not be beneficial.
Behavioral Intention (BI)	BI1	Assuming I had access to AI art authentication, I intend to use it.
	BI2	Given that I had access to AI art authentication, I predict that I would use it.
	BI3	On average, how often do you predict spending time on AI art authentication in the future?
		I plan to use AI art authentication in the next ( ) months

Appendix C

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Please rate the following statements from one to seven - I am satisfied with the art motivational analysis as a method available for authenticating art	.212	65	<.001	.902	65	<.001
Please rate the following statements from one to seven - I am satisfied with provenance investigation as a method available for authenticating art	.333	65	<.001	.823	65	<.001
Please rate the following statements from one to seven - I am satisfied with technical examination as a method available for authenticating art	.217	65	<.001	.892	65	<.001

a. Lilliefors Significance Correction

Appendix D

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

					Epsilon[b]		
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
MethodofAuthentication	.852	10.081	2	.006	.871	.893	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept
Within Subjects Design: MethodofAuthentication

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Appendix E

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
MethodofAuthentication	Sphericity Assumed	43.785	2	21.892	42.750	<.001
	Greenhouse-Geisser	43.785	1.742	25.130	42.750	<.001
	Huynh-Feldt	43.785	1.787	24.502	42.750	<.001
	Lower-bound	43.785	1.000	43.785	42.750	<.001
Error (MethodofAuthentication)	Sphericity Assumed	65.549	128	.512		
	Greenhouse-Geisser	65.549	111.510	.588		
	Huynh-Feldt	65.549	114.366	.573		
	Lower-bound	65.549	64.000	1.024		

Appendix F

Pairwise Comparisons

Measure: MEASURE_1

(I) MethodofAuthentication	(J) MethodofAuthentication	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-.815*	.122	<.001	-1.115	-.516
	3	.308*	.105	.014	.050	.566
2	1	.815*	.122	<.001	.516	1.115
	3	1.123*	.146	<.001	.763	1.483
3	1	-.308*	.105	.014	-.566	-.050
	2	-1.123*	.146	<.001	-1.483	-.763

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Appendix G

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Please rate the following statements from one to seven - I am satisfied with the current methods available for authenticating art	.182	64	<.001	.898	64	<.001
Please rate the following statements from one to seven - I am satisfied with the art motivational analysis as a method available for authenticating art	.213	64	<.001	.901	64	<.001
Please rate the following statements from one to seven - I am satisfied with provenance investigation as a method available for authenticating art	.339	64	<.001	.813	64	<.001
Please rate the following statements from one to seven - I am satisfied with technical examination as a method available for authenticating art	.212	64	<.001	.893	64	<.001
Please rate the following statements from one to seven - I use SMACIT technologies (social, mobile, analytics, cloud, and Internet of Things) in my day-to-day life in the role I have in the art world	.243	64	<.001	.889	64	<.001
Please rate the following statements from one to seven - The amount of time it currently takes to authenticate a piece of art is reasonable	.240	64	<.001	.836	64	<.001
Please rate the following statements from one to seven - I have a high level of confidence and trust in the process of art authentication decisions.	.312	64	<.001	.838	64	<.001
Please rate the following statements from one to seven - The current cost associated with art authentication is justified.	.251	64	<.001	.852	64	<.001
Please rate the following statements from one to seven - The logistical effort involved in authenticating art is significant	.160	64	<.001	.932	64	.002
Please rate the following statements from one to seven - I would authenticate art more frequently if the current obstacles were reduced	.212	64	<.001	.887	64	<.001

a. Lilliefors Significance Correction

Appendix H

Box's Test of Equality of Covariance Matrices[a]

Box's M	385.118
F	2.627
df1	110
df2	8067.489
Sig.	<.001

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + Q3

Appendix I

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) What is your primary role in the art world?	(J) What is your primary role in the art world?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Please rate the following statements from one to seven – I am satisfied with the current methods available for authenticating art	Collectors, auction house, art dealer	Artist, gallery, foundation	-.3278	.31120	.546	-1.0754	.4197
		Museum, scholar or art journalism	.7534	.33083	.067	-.0413	1.5481
	Artist, gallery, foundation	Collectors, auction house, art dealer	.3278	.31120	.546	-.4197	1.0754
		Museum, scholar or art journalism	1.0812*	.34605	.008	.2499	1.9125
	Museum, scholar or art journalism	Collectors, auction house, art dealer	-.7534	.33083	.067	-1.5481	.0413
		Artist, gallery, foundation	-1.0812*	.34605	.008	-1.9125	-.2499
Please rate the following statements from one to seven – I am satisfied with the art motivational analysis as a method available for authenticating art	Collectors, auction house, art dealer	Artist, gallery, foundation	-.5861	.34285	.210	-1.4097	.2375
		Museum, scholar or art journalism	-.1855	.36448	.867	-1.0611	.6900
	Artist, gallery, foundation	Collectors, auction house, art dealer	.5861	.34285	.210	-.2375	1.4097
		Museum, scholar or art journalism	.4006	.38125	.548	-.5153	1.3164
	Museum, scholar or art journalism	Collectors, auction house, art dealer	.1855	.36448	.867	-.6900	1.0611
		Artist, gallery, foundation	-.4006	.38125	.548	-1.3164	.5153
Please rate the following statements from one to seven – I am satisfied with provenance investigation as a method available for authenticating art	Collectors, auction house, art dealer	Artist, gallery, foundation	-.2930	.26524	.515	-.9302	.3441
		Museum, scholar or art journalism	-.7692*	.28197	.022	-1.4466	-.0919
	Artist, gallery, foundation	Collectors, auction house, art dealer	.2930	.26524	.515	-.3441	.9302
		Museum, scholar or art journalism	-.4762	.29494	.247	-1.1847	.2323
	Museum, scholar or art journalism	Collectors, auction house, art dealer	.7692*	.28197	.022	.0919	1.4466
		Artist, gallery, foundation	.4762	.29494	.247	-.2323	1.1847
Please rate the following statements from one to seven – I am satisfied with technical examination as a method available for authenticating art	Collectors, auction house, art dealer	Artist, gallery, foundation	.1007	.29480	.938	-.6074	.8089
		Museum, scholar or art journalism	.5769	.31340	.165	-.1759	1.3298
	Artist, gallery, foundation	Collectors, auction house, art dealer	-.1007	.29480	.938	-.8089	.6074
		Museum, scholar or art journalism	.4762	.32781	.321	-.3113	1.2637
	Museum, scholar or art journalism	Collectors, auction house, art dealer	-.5769	.31340	.165	-1.3298	.1759
		Artist, gallery, foundation	-.4762	.32781	.321	-1.2637	.3113
Please rate the following statements from one to seven – I use SMACIT technologies (social, mobile, analytics, cloud, and Internet of Things) in my day-to-day life in the role I have in the art world	Collectors, auction house, art dealer	Artist, gallery, foundation	.5495	.25928	.094	-.0734	1.1723
		Museum, scholar or art journalism	1.3982*	.27564	<.001	.7360	2.0603
	Artist, gallery, foundation	Collectors, auction house, art dealer	-.5495	.25928	.094	-1.1723	.0734
		Museum, scholar or art journalism	.8487*	.28832	.013	.1561	1.5413
	Museum, scholar or art journalism	Collectors, auction house, art dealer	-1.3982*	.27564	<.001	-2.0603	-.7360
		Artist, gallery, foundation	-.8487*	.28832	.013	-1.5413	-.1561
Please rate the following statements from one to seven – The amount of time it currently takes to authenticate a piece of art is reasonable	Collectors, auction house, art dealer	Artist, gallery, foundation	.3773	.29032	.401	-.3201	1.0747
		Museum, scholar or art journalism	.7330	.30864	.053	-.0084	1.4744
	Artist, gallery, foundation	Collectors, auction house, art dealer	-.3773	.29032	.401	-1.0747	.3201
		Museum, scholar or art journalism	.3557	.32284	.517	-.4198	1.1313
	Museum, scholar or art journalism	Collectors, auction house, art dealer	-.7330	.30864	.053	-1.4744	.0084
		Artist, gallery, foundation	-.3557	.32284	.517	-1.1313	.4198
Please rate the following statements from one to seven – I have a high level of confidence and trust in the process of art authentication decisions.	Collectors, auction house, art dealer	Artist, gallery, foundation	-.1850	.25489	.749	-.7973	.4273
		Museum, scholar or art journalism	-.0701	.27097	.964	-.7211	.5808
	Artist, gallery, foundation	Collectors, auction house, art dealer	.1850	.25489	.749	-.4273	.7973
		Museum, scholar or art journalism	.1148	.28343	.914	-.5660	.7957
	Museum, scholar or art journalism	Collectors, auction house, art dealer	.0701	.27097	.964	-.5808	.7211
		Artist, gallery, foundation	-.1148	.28343	.914	-.7957	.5660
Please rate the following statements from one to seven – The current cost associated with art authentication is justified.	Collectors, auction house, art dealer	Artist, gallery, foundation	.0549	.26770	.977	-.5881	.6980
		Museum, scholar or art journalism	1.1222*	.28459	<.001	.4385	1.8058
	Artist, gallery, foundation	Collectors, auction house, art dealer	-.0549	.26770	.977	-.6980	.5881
		Museum, scholar or art journalism	1.0672*	.29768	.002	.3521	1.7823
	Museum, scholar or art journalism	Collectors, auction house, art dealer	-1.1222*	.28459	<.001	-1.8058	-.4385
		Artist, gallery, foundation	-1.0672*	.29768	.002	-1.7823	-.3521
Please rate the following statements from one to seven – The logistical effort involved in authenticating art is significant	Collectors, auction house, art dealer	Artist, gallery, foundation	-.0385	.36425	.994	-.9135	.8365
		Museum, scholar or art journalism	-.8032	.38723	.104	-1.7334	.1270
	Artist, gallery, foundation	Collectors, auction house, art dealer	.0385	.36425	.994	-.8365	.9135
		Museum, scholar or art journalism	-.7647	.40505	.151	-1.7377	.2083
	Museum, scholar or art journalism	Collectors, auction house, art dealer	.8032	.38723	.104	-.1270	1.7334
		Artist, gallery, foundation	.7647	.40505	.151	-.2083	1.7377
Please rate the following statements from one to seven – I would authenticate art more frequently if the current obstacles were reduced	Collectors, auction house, art dealer	Artist, gallery, foundation	.0421	.28870	.988	-.6514	.7356
		Museum, scholar or art journalism	.3054	.30691	.583	-.4318	1.0427
	Artist, gallery, foundation	Collectors, auction house, art dealer	-.0421	.28870	.988	-.7356	.6514
		Museum, scholar or art journalism	.2633	.32103	.692	-.5079	1.0345
	Museum, scholar or art journalism	Collectors, auction house, art dealer	-.3054	.30691	.583	-1.0427	.4318
		Artist, gallery, foundation	-.2633	.32103	.692	-1.0345	.5079

Based on observed means.
The error term is Mean Square(Error) = .968.

*. The mean difference is significant at the .05 level.

Appendix J

Inclusion of Artists:	**Trust and Expertise:**	**Practical Concerns:**
"I think not only scholars and art historians should participate, but living artists should be involved in the authentication process."	"Yes, moral aspects and implications of art authentication. There has been an increasing sense that CT scanners—being used more recently in museums—as being an intrusive process to artifacts. This is not to mention the copyright laws associated with the image ownership rights which can become rather complex." "The neutrality of the experts"	"Find the right expert and have the financial possibilities"
	"It's rather subjective"	"Time"
	"Independence of the authenticator"	"Disputes between experts"
	"Yes, the monopoly position of certain experts who authenticate artworks of specific artists, no successors upon the death of the respective expert or author of the catalog raisonné, difficult contact with experts."	"Lack of use of technology"
	"Trust in Experts"	
	"Willingness to detect forgeries and public pressure"	

Appendix K

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Please rate the following statements from one to seven – I use SMACIT technologies (social, mobile, analytics, cloud, and Internet of Things) in my day-to-day life in the role I have in the art world	65	1.00	7.00	4.1692	1.05430
Valid N (listwise)	65				

Please rate the following statements from one to seven – I use SMACIT technologies (social, mobile, analytics, cloud, and Internet of Things) in my day-to-day life in the role I have in the art world	Collectors, auction house, art dealer	Artist, gallery, foundation	.5495	.25928	.094	-.0734	1.1723
		Museum, scholar or art journalism	1.3982*	.27564	<.001	.7360	2.0603
	Artist, gallery, foundation	Collectors, auction house, art dealer	-.5495	.25928	.094	-1.1723	.0734
		Museum, scholar or art journalism	.8487*	.28832	.013	.1561	1.5413
	Museum, scholar or art journalism	Collectors, auction house, art dealer	-1.3982*	.27564	<.001	-2.0603	-.7360
		Artist, gallery, foundation	-.8487*	.28832	.013	-1.5413	-.1561

Appendix L

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Does AI art authentication initially lack certain attributes that are highly valued by mainstream consumers?	.270	64	<.001	.876	64	<.001
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Does ai art authentication offer unique advantages (like affordability, simplicity, or convenience) that attract low-end or new market consumers?	.226	64	<.001	.901	64	<.001
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Does AI art authentication emphasize performance attributes (such as cost-effectiveness, user-friendliness, or compactness) that are overlooked by mainstream providers?	.255	64	<.001	.880	64	<.001
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Is there a consistent effort to improve AI art authentication or process to better meet the needs of mainstream consumers over time?	.320	64	<.001	.823	64	<.001
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Has AI art authentication gradually gained acceptance among mainstream consumers, thereby capturing a significant market share from established incumbents?	.260	64	<.001	.809	64	<.001
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Is there a likelihood that AI art authentication will eventually replace existing solutions in mainstream markets due to its evolving capabilities and appeal?	.192	64	<.001	.915	64	<.001

a. Lilliefors Significance Correction

Appendix M

Box's Test of Equality of Covariance Matrices[a]

Box's M	100.642
F	2.039
df1	42
df2	8807.581
Sig.	<.001

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + Q3

Appendix N

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) What is your primary role in the art world?	(J) What is your primary role in the art world?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Does AI art authentication initially lack certain attributes that are highly valued by mainstream consumers?	Collectors, auction house, art dealer	Artist, gallery, foundation	-.36	.357	.576	-1.22	.50
		Museum, scholar or art journalism	-.28	.380	.741	-1.19	.63
	Artist, gallery, foundation	Collectors, auction house, art dealer	.36	.357	.576	-.50	1.22
		Museum, scholar or art journalism	.08	.397	.979	-.88	1.03
	Museum, scholar or art journalism	Collectors, auction house, art dealer	.28	.380	.741	-.63	1.19
		Artist, gallery, foundation	-.08	.397	.979	-1.03	.88
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Does ai art authentication offer unique advantages (like affordability, simplicity, or convenience) that attract low-end or new market consumers?	Collectors, auction house, art dealer	Artist, gallery, foundation	-.15	.349	.903	-.99	.69
		Museum, scholar or art journalism	.17	.371	.889	-.72	1.06
	Artist, gallery, foundation	Collectors, auction house, art dealer	.15	.349	.903	-.69	.99
		Museum, scholar or art journalism	.32	.389	.687	-.61	1.26
	Museum, scholar or art journalism	Collectors, auction house, art dealer	-.17	.371	.889	-1.06	.72
		Artist, gallery, foundation	-.32	.389	.687	-1.26	.61
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Does AI art authentication emphasize performance attributes (such as cost-effectiveness, user-friendliness, or compactness) that are overlooked by mainstream providers?	Collectors, auction house, art dealer	Artist, gallery, foundation	-.34	.280	.441	-1.02	.33
		Museum, scholar or art journalism	-.39	.298	.397	-1.10	.33
	Artist, gallery, foundation	Collectors, auction house, art dealer	.34	.280	.441	-.33	1.02
		Museum, scholar or art journalism	-.04	.312	.989	-.79	.70
	Museum, scholar or art journalism	Collectors, auction house, art dealer	.39	.298	.397	-.33	1.10
		Artist, gallery, foundation	.04	.312	.989	-.70	.79
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Is there a consistent effort to improve AI art authentication or process to better meet the needs of mainstream consumers over time?	Collectors, auction house, art dealer	Artist, gallery, foundation	-.18	.235	.726	-.74	.38
		Museum, scholar or art journalism	-.08	.250	.943	-.68	.52
	Artist, gallery, foundation	Collectors, auction house, art dealer	.18	.235	.726	-.38	.74
		Museum, scholar or art journalism	.10	.261	.925	-.53	.73
	Museum, scholar or art journalism	Collectors, auction house, art dealer	.08	.250	.943	-.52	.68
		Artist, gallery, foundation	-.10	.261	.925	-.73	.53
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Has AI art authentication gradually gained acceptance among mainstream consumers, thereby capturing a significant market share from established incumbents?	Collectors, auction house, art dealer	Artist, gallery, foundation	-.34	.293	.486	-1.04	.37
		Museum, scholar or art journalism	-.09	.311	.954	-.84	.66
	Artist, gallery, foundation	Collectors, auction house, art dealer	.34	.293	.486	-.37	1.04
		Museum, scholar or art journalism	.25	.325	.730	-.53	1.03
	Museum, scholar or art journalism	Collectors, auction house, art dealer	.09	.311	.954	-.66	.84
		Artist, gallery, foundation	-.25	.325	.730	-1.03	.53
Please answer the following questions. Note that there are two fields per item – Please rate the following statements from one to seven – Is there a likelihood that AI art authentication will eventually replace existing solutions in mainstream markets due to its evolving capabilities and appeal?	Collectors, auction house, art dealer	Artist, gallery, foundation	-.50	.360	.350	-1.37	.36
		Museum, scholar or art journalism	.25	.382	.793	-.67	1.17
	Artist, gallery, foundation	Collectors, auction house, art dealer	.50	.360	.350	-.36	1.37
		Museum, scholar or art journalism	.75	.400	.154	-.21	1.71
	Museum, scholar or art journalism	Collectors, auction house, art dealer	-.25	.382	.793	-1.17	.67
		Artist, gallery, foundation	-.75	.400	.154	-1.71	.21

Based on observed means.
The error term is Mean Square(Error) = 1.504.

Appendix O

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PerceivedUsefulness	.173	65	<.001	.923	65	<.001
PerceivedEaseofUse	.187	65	<.001	.892	65	<.001

a. Lilliefors Significance Correction

Appendix P

Test Statistics[a]

	PerceivedEaseofUse – PerceivedUsefulness
Z	-6.139[b]
Asymp. Sig. (2-tailed)	<.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Appendix Q

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
PerceivedUsefulness	65	3.50	7.00	5.1308	.89607
PerceivedEaseofUse	65	2.75	7.00	4.2038	.87933
Valid N (listwise)	65				