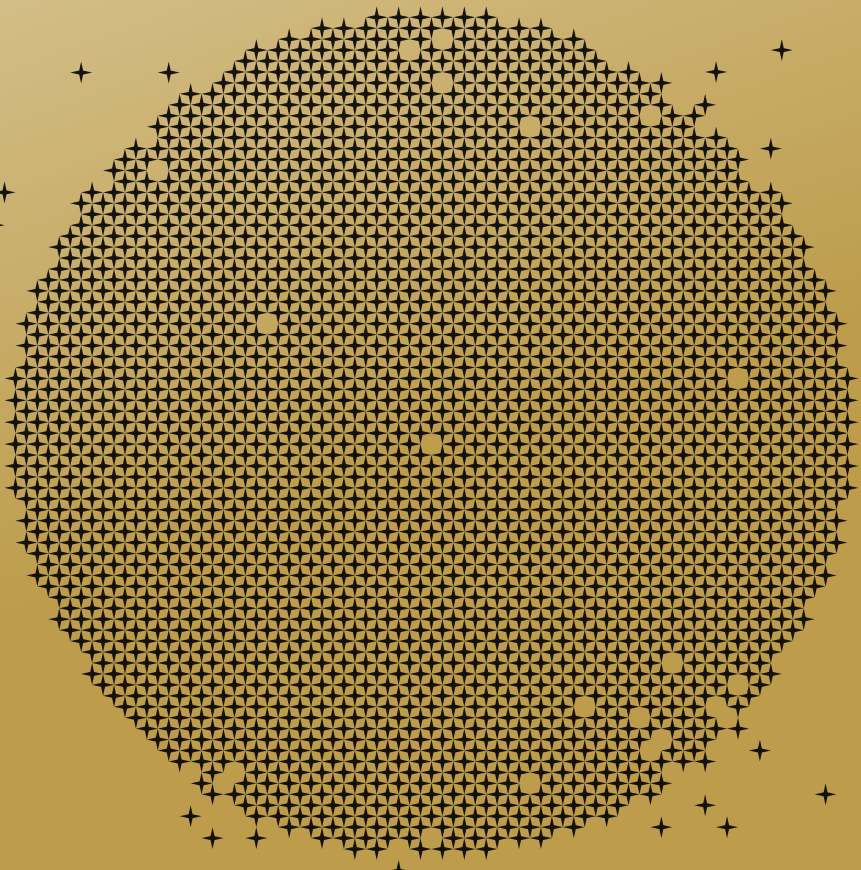
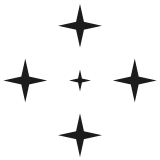
DISEÑO

VII/01
journal of design culture
_Designing Digital Humanities





Disegno

Journal of Design Culture
Double-blind peer-reviewed, open access scholarly journal

Aims and Scope

Disegno publishes original research papers, essays, and reviews on all aspects of design cultures. We understand the notion of design culture as resolutely broad: our aim is to freely discuss the designed environment as mutually intertwined strands of sociocultural products, practices, and discourses. This attitude traverses the disciplinary boundaries between art, design, and visual culture and is therefore open to all themes related to sociocultural creativity and innovation. Our post-disciplinary endeavour welcomes intellectual contributions from all members of different design cultures. Besides providing a lively platform for debating issues of design culture, our specific aim is to consolidate and enhance the emerging field of design culture studies in the Central European academia by providing criticism of fundamental biases and misleading cultural imprinting with respect to the field of design.

All research papers published in Disegno undergo a rigorous double-blind peer review process.
This journal does not charge APCs or submission charges.

Contact: *Moholy-Nagy University of Art and Design*
H-1121 Budapest, Zugligeti út 9–25.
disegno@mome.hu

The full content of Disegno can be accessed online: ***disegno.mome.hu***

Published by: *József Fülöp*
Publisher: Moholy-Nagy University of Art and Design, 1121 Budapest, Zugligeti út 9-25.

ISSN: *2064-7778 (print)* ***ISSN:*** *2416-156X (online)*

MOHOLY-NAGY
művészeti egyetem
university of art and
design budapest

DISEGNO_VII/01_DESIGNING DIGITAL HUMANITIES

Contents

INTRODUCTION
DESIGNING DIGITAL HUMANITIES

https://doi.org/10.21096/disegno_2023_1szmmsz

What is digital humanities? Some say it does not exist, some say it is contemporaneous with the humanities—as collection, organisation and formalisation were part of it from the very beginning—,and there are many advocates who say it is a new discipline. One thing is for sure: in the last seven decades, the arts and humanities have drawn a lot from the methodology and toolkit of computational technology. As the two domains linked and influenced each other, new research areas were defined under the terms of computational humanities, humanities informatics, and, from the 2000s onwards, digital humanities (DH).

How could we outline the role of design in DH? The articles of this Special Issue answer this question in numerous ways. Design may refer to the methodology (how we create models of knowledge), to the toolkit (how we design real or virtual objects and spaces), or to the object of a DH research (how we curate and analyse the memories of design history).

The latter approach can be observed in the papers of Ágnes Anna Sebestyén on literary networks, and of Dorottya Kun on art repositories. Sebestyén approaches the Hungarian architectural journal Tér és Forma with one of the now traditional methods of digital humanities, network analysis and visualisation. The paper analyses the social network of the editor Virgil Bierbauer and other authors connected to the journal. It demonstrates what content analysis possibilities the Croatian Artists' Networks Information System offered on the examined corpus, and how the extracted data can be structured and visualised using Gephi.

Kun deals with a specific area of formalisation, the cataloguing and digital archiving of design objects. In her study, she provides a literature review on this topic, and presents institutional practices on the use of different metadata standards. She introduces the challenges of preservation, document or object description and curation. The paper concludes, among other things, that research repositories have a key role to play in making outputs visible and open access in the arts and humanities.

Designing real or virtual objects and spaces, and the impact of the digitisation on architecture, are discussed in the project report

of Iacopo Neri, Darío Negueruela del Castillo, Pepe Ballesteros Zapata, Valentine Bernasconi, and Ludovica Schaerf; Stefano Corbo's essay dealing with the history of architecture, and Merve Pekdemir Başeğmez' study on Industry 4.0. The article of Neri et al. shows how they brought the Helsinki Art Museum's collection into urban space, creating a dialogue between artworks and public spaces. The project created virtual spaces by digitising outdoor and museum objects, using digital catalogue data, image-to-text tool, and the resulting prompts of this. The virtual exhibition was thus created using a combination of big data, AI and VR methods and tools.

AI also appears from a distance in Corbo's essay on architecture, which depicts the era of digital creation from a historical perspective. His work uses Jacopo de Barbari's *Portrait of Luca Pacioli* from around 1500 and Caravaggio's *Basket of Fruit* from around 1600 to show the influence of geometric construction in architecture and representation. As Corbo sees, the next turning point in architecture is the influence of the computer – both as a designing tool and as an integral part of the buildings. Pekdemir Başeğmez, focusing on the integration of computers, addresses a very different domain of digital transformation, the architectural and design approach of the Industry 4.0 phenomenon. As the author discusses, smart factories deal primarily with the design of production space, but also covers human-machine interaction.

The methodological approach is represented by Dinara Gagarina, who deals with the topic of modelling in DH research, and Zsolt Almási, who investigates text-to-image AI tools by reflecting on the artistic value of generated images. Gagarina's literature review shows how formalisation and modelling play an important role in digital humanities. As indicated above, a key question in the definition of digital humanities is whether it is seen as a discipline in its own right or rather as a new toolkit for traditional humanities. In Gagarina's work, it is primarily the former approach that prevails, positioning (computer) modelling through her examples as an indispensable foundation of DH as a discipline.

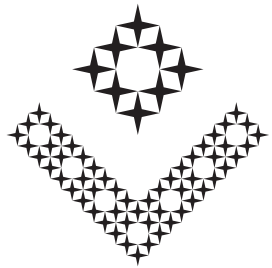
In his essay, Zsolt Almási takes the opposite path that Neri et al. took regarding the link of text and image. The author approaches the images created by image-generating algorithms and services as works of art. This essay, which is not without a sociological viewpoint, focuses on text-image generation and shows how artists and art critics have reacted in recent years to image-generating tools that are also available to the general public. The spectrum ranges from rejection through the cooperation or collaboration, to the praise of technology.

The issue concludes with an interview with Iván Horváth, a pioneering computational humanist (or humanistic informatics specialist), who worked in the field of computational literary studies as early as the 1970s. His achievements, personal story and unique vision illustrate the complex relationship between design and DH. In a conversation that meanders into literature, music, electrical engineering and history,

Horváth points to the turnaround in science, humanities – and also in HiFi design – that took place in the late 1960s, by giving a number of vivid examples of the technological and social changes that have influenced the reception of art and literature in different eras.

If design culture studies is a historically grounded but practice-oriented new "humanistic discipline" in Panofskyan terms, then several of its approaches to design culture have a lot to do with computational and digital humanities in the digital era. Especially, if we take into consideration that contemporary design culture studies does not focus on singularities but on continuous flows and waves of discourses, social practices and cultural products, that is on the pluralities of complex networks of creative human beings, assemblies, nodes and socio-cultural spheres in such a multidimensional way, which presuppose an understanding of culture that is as architectonic and sensual as discursive or pictorial. Further, these teleidoscopic lifeworlds are embedded in, enacted in, embodied in and extended into techno-aesthetic dimensions which are often virtual or digital themselves and way too complex to understand them without big data mining and AI technologies. The current issue of *Disegno* collected papers representing some of these emerging practices and approaches, however, several other aspects could have been touched upon, so the floor is still open for discussion and research in the field to which we would like to return every once in a while to critically observe new phenomena and understandings of the digital in design.

Szilvia Maróthy and Márton Szentpéteri



DESIGNING THE INTERNATIONAL NETWORK OF TÉR ÉS FORMA, 1928–1939.

A HUNGARIAN ARCHITECTURAL JOURNAL'S DATA-DRIVEN ANALYSIS

Ágnes Anna Sebestyén

ABSTRACT

Architectural periodicals were the major means of transferring textual and visual information about the current production, discourses, and problems of architecture during the interwar era. Illustrated magazines were widely available, and the immaterial sites of architectural publications became equally important as the construction site itself.

In interwar Hungary, the architectural journal Tér és Forma *(*Space and Form*) was the major organ of modern architecture under the editorship of the architect Virgil Bierbauer between 1928 and 1942. The periodical included the latest examples of modern architecture in Hungary and the current international scene covering most of Europe with an outlook on the USA, South America, and Japan. Bierbauer relied on his extensive international network of professional connections for transferring information and creating content for his journal.*

My paper focuses on the digital processing and analysis of Tér és Forma *using the Croatian Artists Networks Information System (CAN_IS) as a digital network analysis tool. It allows the representation of the international relations of the journal based on its content, and the changes in editorial directions and its social network. My paper considers the methodology of organising the information extracted from the system and how this knowledge can be visualised. My paper also addresses the problems of legibility and distortion in data visualisations.*

#modern architecture, #networks, #journals, #interwar Hungary, #Croatian Artists Networks Information System (CAN_IS)

https://doi.org/10.21096/disegno_2023_1aas

INTRODUCTION

Architectural periodicals were at the forefront in transferring textual and visual information about architecture during the interwar era. In the printed page, the production, the discourses, and the problems of architecture were widely discussed and presented. Illustrated professional journals became broadly available and were also circulated in the international architectural scene, crossing linguistic and geographic borders. The immaterial sites of architectural publications became equally important as the construction site itself (Colomina [1994] 1996, 14–15). The editors of these magazines relied on their extensive network of professional connections to collect up-to-date information for creating content and extending the scale of coverage.

In interwar Hungary, the architectural journal *Tér és Forma* (*Space and Form*) was the major organ of modern architecture (fig. 1). The magazine was first published as an illustrated appendix to the journal *Vállalkozók Lapja* (*Contractors' Journal*) in 1926, and in 1928, it was launched as a monthly periodical. It was edited by the architect Virgil Bierbauer between 1928 and 1942, and it ceased to be published not much later, in 1948. *Tér és Forma* focused on the latest examples of modern architecture in Hungary and it also followed the recent architectural production of the international scene covering most of Europe with an outlook on the USA, South America, and Japan. Bierbauer reached out to his international professional network, sought inspiration from his experiences during his travels and followed the latest architectural publications to collect information for his magazine.

My research in Virgil Bierbauer's editorial activities goes back many years, and this is also the subject of my ongoing research as a PhD candidate at Moholy-Nagy University of Art and Design (Sebestyén 2016, 2017, Ritoók and Sebestyén 2018, Sebestyén 2018, 2020, 2021). One of the major focuses of my research was Bierbauer's international network of professional connections. The primary source of reconstructing his network is his correspondence of approximately 900 letters held in the Virgil Bierbauer Archive of the Hungarian Museum of Architecture and Monument Protection Documentation Center in Budapest.[1] Other crucial archival materials include the memoir of Bierbauer's wife, Adrienne Graul, entitled Bottle post, which is also held in the

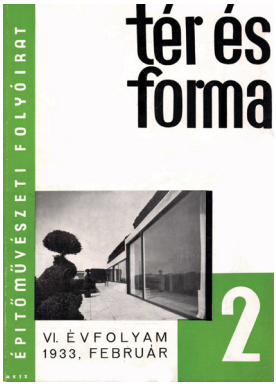


FIGURE 1. *The cover of* Tér és Forma *6/2 (1933), with the photograph of the Beistegui Apartment (Paris, 1929–1931), designed by Le Corbusier and Pierre Jeanneret, photograph by Marius Gravot*

[1] *Virgil Bierbauer's correspondence was catalogued by Ágnes Anna Sebestyén in the framework of her research project funded by the National Cultural Fund of Hungary (ref. n. 101102/00444).*

Bierbauer Archive;[2] as well as the journal itself with its international content that can be linked many times to specific letters in the correspondence, which, in this way, give an insight into the mechanisms of how the journal was created.

[2] *Adrienne Bierbauer (née Graul):* Palackposta *(Bottle post). Unpublished manuscript. Budapest 1958–1972. Holding of the Virgil Bierbauer Archive in the Hungarian Museum of Architecture and Monument Protection Documentation Center, Budapest.*

CHANNELLING INTO DIGITAL ART HISTORY—CHALLENGING "TRADITIONAL" ART HISTORY

During my research, I have mostly relied on the traditional methods of art history, and the tools and the methods of Digital Art History came relatively late into my research. Although, according to some experts, the distinction between traditional and digital art history will be irrelevant at some point in the future, and only the umbrella term art history will remain (Bentkowska-Kafel 2015), this point has not yet been reached. Art historians nowadays, of course, work within the realm of digitised art history, which means that we browse online databases, use online image collections and work with digitised artefacts—but digital art history involves a much more complex methodology. Digital art history is, in Claire Bishop's words, "the use of computational methodologies and analytical techniques enabled by new technology: visualisation, network analysis, topic modeling, simulation, pattern recognition, aggregation of materials from disparate geographical locations, etc." (Bishop 2018, 123) In this seminal paper titled "Against Digital Art History," she acknowledges the potential of computational metrics in aggregating data and indicating patterns, but at the same time, highlights the weakness of these tools for explaining causality, which should always be a subject of interpretation. (Bishop 2018, 127) Some consider this as an unlikely problem, since

> *[n]o one is advocating digital technologies as an objective, unmediated methodology in the humanities. They are intended as an addition, not a substitute. Human validation and analysis remains necessary after all the digital aids have provided their output. In fact, with help from digital tools the expert can devote less time to the search of documentation and more effort to the tasks where we humans work at our best: judgment, interpretation, evaluation. New hypotheses, new questions can be proposed to researchers, but answering them still requires a qualitative input that no machine can provide.* (Lozano 2017, 6)

Thus it is essential to the humanities in this digital environment "to tolerate ambiguity, uncertainty, to see the historical situatedness and constructed character of knowledge." (Kienle 2017b, 123) This means that it is vital for maintaining the relevance of the methods and critical attitude of the humanities, which is a challenge in the computation ecosystem that resists the ambiguities, irregularities and unpredictability inherent in the humanities (Kienle 2017a, 6).

In my research, this might be the reason why I have not (yet) found it a disadvantage that I entered the realm of Digital Art History at a relatively late stage of my research. I relied on archival sources such as Bierbauer's above-mentioned correspondence, the memoir, and other archival materials such as personal documents and photographs as well as printed matters. After the thorough processing of Bierbauer's letters, I used case studies and pinpointed small histories to reconstruct Bierbauer's decision making processes as editor and the mechanisms of information transfer. Understanding small histories can contribute to outlining the bigger picture and apprehending the overall mechanisms on a wider scale. This approach might also help to locate false outcomes in data visualisations.

In the realm of Digital Art History, another problem is the lacunae in historical archives or—in certain cases—the total lack of archival materials, let alone historical objects. It is always a challenge to work with fragmentary archives and hiatuses, as this scenario creates missing and ambiguous data that can hardly be translated into valid data visualisations. As Stephanie Porras put it: "Data is the product of history as much as a record of it." (Porras 2017, 44) Using well-preserved and well-documented archives and existing datasets based on the data of well-funded institutions and regions carries the danger of reinforcing and reinscribing historic and current power differentials that exist between different regions, countries, communities. (Porras 2017, 44) Speaking about only our region in the heart of Europe, there is an imbalance of available data if we compare Western and Central-Eastern European institutions. This means, for example, that we have to keep in mind that while processing primary sources it is advisable to start creating new data and datasets that can be the basis for a research that aims to use digital tools for analysis.

Data, however, is also not found and given, but always produced and constructed. As Johanna Drucker has argued: "*Data are capta*, taken not given, constructed as an interpretation of the phenomenal world, not inherent in it." (Drucker 2014, 128) In other words, data is not a neutral matter, as it is up to us researchers to select, process and interpret data, which is also a responsibility and a question of authorship. As Georg Schelbert explained: "We should not just see data as primary sources, we should also accept the various stages of data creation as a genuine part of research." (Schelbert 2017, 6) It means that data creation and sequencing data are authored, and thus might be also biased.

Social networks are also constructed and authored. There is no true social network out there that needs to be discovered and analysed by researchers. (Borgatti and Halgin 2011, 1170) It is always the researcher who defines the network by choosing the set of nodes and the types of the edges (Borgatti and Halgin 2011, 1169). The researchers' choices

should be dictated by the research question, which also means that each question creates its own set of nodes and edges and thus networks are generated with a structure specific to each question.

In my research, I have focused on case studies and small histories so far—as I mentioned above—to outline the mechanisms behind Bierbauer's editorial activities, and I tried to detect patterns and draw conclusions with reference to the bigger picture. In other words, I have concentrated on the microscopic view. The social network of the journal Tér és Forma, however, has never been drawn up. Entering the realm of Digital Art History, I decided to seek validations from a macroscopic perspective and to place the small histories into the bigger picture. As a first step—and only this part will be addressed in this paper—I decided to concentrate on the content of *Tér és Forma*, i.e. on the featured architects and designers as well as their related country to see the preferences and orientation of the journal and its editors. I also aim at tracing the changes of the direction of the journal if it can be detected via visualisations, therefore, I selected four specific time periods, which—according to my previous research—reflects slight shifts in connection with the editors' decisions as well as the historical and economic background. I also consider focal points in the visualisations whether these can be linked to specific findings from my previous research. These focal points might also designate never-before-analysed cases that need to be examined during further research.

BUILDING THE DATASET OF *TÉR ÉS FORMA*

The social network of *Tér és Forma* and its underlying dataset was created in the framework of the bilateral project entitled "Architectural Encounters of Croatia and Hungary: Modalities of Professional Knowledge Exchange, 1900–1945," which ran between the partner institutions the Hungarian Museum of Architecture and Monument Protection Documentation Center (Budapest) and the Institute of Art History (Zagreb). The two-year project (2021–2023) was funded by the National Research, Development and Innovation Office of Hungary (2019-2.1.11-TÉT-2020-00258) as well as by the Ministry of Science and Education of the Republic of Croatia (MBP-IPU-2021-410).

The Institute of Art History in Zagreb developed the Croatian Artists Networks Information System (CAN_IS) during another recent project titled "ARTNET— Modern and Contemporary Artist Networks, Art Groups and Art Associations. Organisation and Communication Models of Artist Collaborative Practices in the 20th and 21st Century." The intention of the ARTNET project was to reveal the unforeseen and never-before-visualised transnational histories of artistic exchange in the twentieth and twenty-first centuries (Kolešnik 2018, 11). As a Croatian-based project, it also aimed to shed light on the under-

represented actors and networks of the Central and Eastern European region. As, due to the above-mentioned computational inequality, it is important to highlight here as well that Western European and North American institutions are far ahead of Central and Eastern European institutions in building and sharing datasets based on archives and collections of museums, etc. Due to the research conducted prior to the ARTNET project, it was known that at least four different types of networks can be distinguished within modern and avant-garde networks, i.e. the networks formed by 1) magazines and publications, 2) artistic concepts and ideas, 3) exhibitions and public events, and 4) social networks. (Kolešnik 2018, 11) These four types of networks provided the basis for the separate data entry sections in CAN_IS—in other words, users of the system can insert data according to these four categories, which can be linked with different sets of relations. The ambition of ARTNET is to be open to the international research community, so the project "Architectural Encounters of Croatia and Hungary" fits ideally into ARTNET's objectives. With regards to my research, the focus on a Hungarian magazine with an international scope provided a fitting case to be studied with the help of CAN_IS.

In the case of *Tér és Forma*, no dataset existed, so it became part of my research process to create the data and the dataset. The preliminary archival research based on primary sources and my existing research findings were essential in building the dataset especially when deciding what to include and what to omit. To remain objective and consistent while enriching, reviewing, and cutting the data was a challenge, as several important aspects had to be considered.

CAN_IS was used for data entry: the basic data for all *Tér és Forma* issues were recorded such as bibliographical details for all magazine articles, as well as biographical details of all editors, authors, contributors, and featured persons. The main challenge in building the dataset was to select the relevant "mentioned persons" from *Tér és Forma*, as recording all the persons who were mentioned in each article would have resulted in a confusing outcome that is not representative of the content of the magazine. To put it simply, the major subject of an article would have ended up on the same level as just a single not-so-important mention. This was one of the phases where the preliminary research proved to be essential to locate the real subject of an article and to distinguish him/her from a less relevant mentioned person. This is also a decision-making process where the researcher's choice constructs the data and thus the dataset. Despite all my efforts to be consistent, the outcome might be biased due to the preceding knowledge of my research topic and the primary sources that were previously used. As my intention is to show the international coverage in *Tér és Forma* and the national distribution

during different phases of the journal, the related countries also had to be linked to each person. In many cases it was obvious, but due to the turbulent political and historical climate, a significant number of architects migrated between different countries. Thus, choosing the only relevant country for each person for each timeframe was a decision in itself (it is important to note here that the system can only manage one attribute per record—i.e. one country per person per time period).

This paper concentrates on the international content and national distribution of *Tér és Forma*, therefore, data was exported from CAN_IS with only the mentions and co-mentions from the journal selected, which defined the sets of the edges. In this way, the exported nodes represent the mentioned and co-mentioned persons (most of the time architects) and those who mentioned them, and the edges are defined by the relations mentions and co-mentions. For the export, CSV files were chosen, and separate files were exported for each chosen time period of *Tér és Forma*. The exported CSV files were then imported to the data visualisation software Gephi, where the visualisations were created for each of the four time periods. The selection for the criteria of the data export shaped the four graphs, i.e. the networks that represent the content of the magazine in different years. I used different colour schemes for each represented country, which appear as the colour of the nodes and the edges. It was difficult to distinguish the represented persons according to countries and maintain a sufficient level of readability. (The chosen colours for each country are indicated in the image captions.) The size of the nodes represents the extent of the appearance of the linked person in *Tér és Forma*. The position of the nodes reflects the centrality of each person in the network. Finally, the thickness of the edges indicates the frequency of mentions between two nodes, in other words, a thicker edge represents more mentions.

THE MACROSCOPIC VIEW OVER *TÉR ÉS FORMA*

The main objective of this paper is to visualise how the content of *Tér és Forma* changed over the course of the period between 1928 and 1939. 1928 marks the launch of *Tér és Forma* as a monthly periodical under the editorship of the architects Virgil Bierbauer and János Komor. Although Bierbauer edited the magazine until 1942, I chose 1939 as the endpoint of my analysis because this paper does not extend to analysis to the time of World War II, with its significant political, economic, and geographic shifts—though I acknowledge that these changes did not happen overnight, and many historical events preceded and anticipated the outbreak of the war during the 1930s. These political and social circumstances of course had a major effect on the building industry

as well as on the circulation of ideas and the migration of artists and architects. I chose the four periods according to different levels of changes, i.e. along with changes in personnel and editorial direction as well as historical changes. 1931 marks the first shift, as János Komor acted as co-editor until the end of this year, and the architect Lajos Kozma served as a contributor between December 1929 and June 1931 as it was indicated in the imprint. Komor's influence on the magazine truly ended in 1931, while Kozma's presence was still noticeable later on—which is also decipherable in the visualisations. I decided to break the period between 1931 and 1935 into two phases because of the Nazis rise to power in 1933, which had a significant effect on architectural culture in Germany as well as the direction of modern architecture and the migration of modern architects. The German orientation of Hungarian modernist architects prevailed in the late-1920s and early 1930s, and of course it was prevalent in the pages of *Tér és Forma*, so it proved essential to mark and visualise the shift in 1933. 1935 was chosen for the next break, as in this year, Bierbauer published a pivotal editorial, which signalled some changes in the magazine's direction. Along the lines of these negotiations above, I selected the four periods of 1928–1931, 1932–1933, 1934–1935 and 1936–1939 as the subject of the present analysis (figs. 2, 3, 4, 5).

To see the bigger picture, it is important to evaluate whether the visualisations confirm my presuppositions based on my previous research and whether solely the mention–co-mention networks reflect these changes. Regarding the creators of the magazine, it was obvious that Virgil Bierbauer would end up as the node of the highest degree of centrality in each network—not just as an actor but as a featured architect in the magazine. Until 1931, the graph reflects the two other major creators of the journal: János Komor as the co-editor, and then Lajos Kozma as a collaborator. As an emerging important figure in the magazine, Farkas Molnár also needs to be mentioned here: he was an author of a few articles and he was also included in the magazine as a progressive architect several times—acknowledging his past Bauhaus-training, as it is visible in the graph via his ties to his peer Marcel Breuer and his mentor Walter Gropius.

Although 1933 did not immediately change architectural culture or compel Jewish architects to emigrate, the rising of Nazism can be measured indirectly in the number of mentions, i.e. how many names appear with regards to Germany and in what context. The most German names (or to be more accurate, the most names of architects based in Germany) with German-based works appear in the period 1928–1931—in fact, these are the second most-covered group of architects after, of course, the Hungarians. Although Bierbauer's primary aim was to promote and disseminate modern architecture and to implement its best ideas into Hungarian architectural

https://disegno.mome.hu/articles/Sebestyen_Fig2.pdf

FIGURE 2.

https://disegno.mome.hu/articles/Sebestyen_Fig3.pdf

FIGURE 3.

https://disegno.mome.hu/articles/Sebestyen_Fig4.pdf

FIGURE 4.

https://disegno.mome.hu/articles/Sebestyen_Fig5.pdf

FIGURE 5.

practice, he did not only focus on the most progressive branch of German modernism. It means that besides the Bauhaus—hallmarked by Walter Gropius' and Marcel Breuer's names—and Ernst May's Neue Frankfurt, Bierbauer covered examples from a much more diverse scale including the works of Fritz Höger, Alexander Klein, Otto Bartning, Emil Fahrenkamp and Albert Bosslet, among others. With regards to the number of mentions, German-based architects are ranked as the fifth between 1932–1933, only the tenth between 1934–1935 and fifth again between 1936–1939. However, it is important to look beyond the numbers, as after 1933, these German mentions were usually taken in retrospect, and they generally also represented modern architecture (except Albert Bosslet's churches).

In the sixth issue of 1935, Bierbauer published an article entitled "Revision's revision," where Bierbauer explained that due to economic difficulties it is not possible to cover international architecture on the same level as before, since the limited spread of the magazine had to be mostly dedicated to the production of Hungarian architecture. (Bierbauer 1935, 158) The impact of these economic difficulties can indeed be noticed by the diminishing length of the issues as well as the decrease in international coverage. Foreign examples of the current architectural production, however, did not disappear completely, but their length, frequency and way of presentation changed. These changes are noticeable in the visualisations. Compared to earlier phases of *Tér és Forma*, the clusters including people from mostly from the same country became smaller and more diverse. The article "Revision's revision" is immediately apparent in the visualisation as a big colourful cluster with architects representing Czechoslovakia, France, the Netherlands, Italy, Turkey, Great Britain, Norway, the USA and Japan. These mentions are just glimpses from a certain period in modern architecture. They give a panoramic view but not a full idea of what is happening in a certain country or region. Such mixed big clusters appear also in the visualisation of the period between 1936 and 1939: the biggest cluster shows an article written by Lajos Kozma in 1938 about the free floor plans describing selected pieces of residential architecture mostly in retrospect (Kozma 1938); while the smaller mixed cluster represents an article about the "Art et technique" exhibition of the Paris International Exhibition of 1937. (Weltzl 1937) Other international features and mentions are only decipherable as small, less-connected nodes in the visualisation.

It is evident that *Tér és Forma* always placed Hungarian architecture in its main focus (see the big clusters in all visualisations in medium green), but Bierbauer aimed at covering the best practices from the international scene to varying degrees over the course of his fifteen years of editorship. The visualisation of 1928–1931 shows a solid international coverage with distinctive national clusters: the biggest is the

Italian (in light green), but also distinct are the German (in black), Polish (in pale blue), British (in red), and Austrian (in orange). These clusters clearly visualise that the foreign content of *Tér és Forma* at the time was more comprehensive and frequent in comparison with the international coverage in the second half of the 1930s. There are several articles in *Tér és Forma*, which present one or just a few specific buildings—either from the Hungarian or the international scene. In the visualisations, these contents often appear as two or a few interconnected nodes depending on the number of architects who participated in the design of the featured building. In many cases, these persons are just single mentions and thus do not constitute noticeable clusters, as is quite apparent in the visualisation of the late 1930s.

The major significance of the Italian content of *Tér és Forma* and the prominence of the Italians in Bierbauer's network of professional connections had been already known from previous research, especially from the study of his correspondence. Italians are the third most mentioned in the period between 1928–1931, and the second most mentioned after 1932 (after of course the Hungarians), which means a solid Italian coverage in the journal. Regarding the political implications, Bierbauer's attitude towards Nazism and Italian fascism was completely different, as it is known from Bierbauer's writings in *Tér és Forma* as well as from the memoir Bottle post by Bierbauer's wife. While Bierbauer published explicit critiques of the architecture of the Third Reich, he praised the architectural culture of fascist Italy in particular due to Mussolini's preference for modernist architecture and the great number of state-funded projects such as new public buildings as well as the new cities like Sabaudia and Littoria. Italy was also Bierbauer's major travel destination—for both work and leisure—and he also befriended many Italian architects whose projects he continuously covered in the magazine.

To read the visualisations accurately, it is essential to know the magazine contentwise, because there are some distorting parts in the visualisations. For example, it is crucial to understand that those features that speak about a greater number of persons are shown as bigger clusters in the visualisations and thus seem to be of greater importance than the others. For instance, in the visualisation of 1932–1933, there is a big Austrian cluster (in orange) that seems to be of outstanding importance, though it is just the visualisation of one article: the piece written by Virgil Bierbauer about the Werkbundsiedlung in Vienna in 1932 (Bierbauer 1932). But because of the number of co-mentions, the software outlines these kinds of contents as bigger clusters, although they represent just one article among the many others. This is the reason of the visual inequality between articles mentioning only a few and articles covering a greater number of people, which distorts the overall picture, shifts the emphasis, and makes legibility

difficult. Furthermore, the article of the Vienna Werkbundsiedlung represents only one project—albeit a building ensemble with many individual buildings—which is content-wise equal to a project of a single building with one or two designers. We can also compare the cluster of the Vienna Werkbundsiedlung to the Polish cluster in the visualisation of 1928–1931, which represents Heinrich Lauterbach's article about contemporary architecture in Poland (Lauterbach 1930). In the case of the Lauterbach piece, this comprehensive essay features a greater number of projects and all the related architects. Thus, it is impossible to tell the structural differences in the magazine only from a cluster in the visualisation.

The other factor associated with distortion is due to a technical issue. It is not possible to export those mentions from CAN_IS, where the related author is unknown or unidentified. This means that some important architects are missing from the visualisations because two nodes are needed to create edges (in this case the person who mentions someone and the person who is mentioned), and in this way, the system cannot translate it to relations. This problem does not affect the statements of this article, however, it needs to be solved in the near future in order to create valid data visualisations that truly reflect the content of *Tér és Forma*. As, in this case, there are hiatuses, which are not caused by the lack of source materials but technological problems. Unfortunately, this is an unsolved problem in this stage of my work, which clearly signals that this present paper is more of a research report than the milestone of a finished work.

THE MICROSCOPIC VIEW OVER *TÉR ÉS FORMA*

The visualisations also give an insight into the microhistories of the magazine, as it is possible to locate the positions of artists' groups and individuals over the different time periods, and to trace the nodes that provide the context of certain coverages.

The Congrès Internationaux d'Architecture Moderne (CIAM, the International Congresses of Modern Architecture) was one of the most important professional organisations in twentieth-century architecture.[3] It was founded in 1928 (the same year as the launch of *Tér és Forma*) and aimed at disseminating modern architecture, providing solutions for housing and town planning problems and giving internationally adaptable answers. National working groups provided the basis of CIAM, the Hungarian branch was established in 1929 with young and progressive modern architects. Farkas Molnár served as the first delegate, József Fischer as the second, and other members included Fred Forbát, József Molnár, Gábor Preisich and Zoltán Révész. Bierbauer joined CIAM only in 1937. The exact date is proven by a recent research finding in the Fred Forbát Archive of ArkDes, the Swedish Centre for

[3] *Tamara Bjažić Klarin and Nikola Bojić conducted thorough research into the CIAM networks in the framework of the ARTNET project, see: Bjažić Klarin and Bojić 2018.*

Architecture and Design, where there are exchanges of letters between Farkas Molnár and Fred Forbát from December 1936 about Bierbauer's possible admission to the Hungarian CIAM group, and in related correspondences from 1937, Bierbauer is already listed as a member of the group.[4] Despite Bierbauer's absence from CIAM before 1937, he generally sympathised with the works of the group's members, so he broadly featured these in *Tér és Forma* from the beginning. From 1932, the Hungarian CIAM group was given the opportunity to present their work in separate magazine issues—ideally in one issue per year. Finally, it was in 1932 and between 1934 and 1937, when at least one issue per year was dedicated to the works of the Hungarian CIAM group in the journal.[5] The publication material was put together by the group, led by Farkas Molnár as editor of these issues. 1937 was marked by the formation of CIAM-Ost, the Eastern European branch of CIAM, which intended to handle problems specific to the East-Central and Eastern European region. In the visualisation of 1928–1931, when there were no individual CIAM issues published, a separate CIAM cluster is not detectable, but its members are still relatively close to each other in the mention–co-mention spectrum. From 1932, when the first CIAM issue was launched, the CIAM cluster became increasingly visible in the graphs; while the visualisation of the late-1930s shows the formation and connectedness of CIAM-Ost based on the published reports on the CIAM-Ost meetings with participants such as Walter Loos from Vienna, Szymon and Helena Syrkus from Warsaw, František Kalivoda from Brno, Vlado Antolič from Zagreb and CIAM secretary Sigfried Giedion (fig. 6). In the same graph, between Bierbauer and Farkas Molnár, the position of Fred Forbát with his link to the Dutch architect Jacobus Johannes Pieter Oud represents a tension within the Hungarian CIAM group. It is a microhistory behind the visualisation that is about a debate between Molnár and Forbát in which Oud took Forbát's side concluding the greater importance of function over form, when Molnár did not consider one of Forbát's houses in Pécs modern enough to be published in a CIAM issue.[6]

Tér és Forma played a big part in shaping the canon of Hungarian modern architecture, and at the same time also internalised the canonisation processes of modern architecture on an international level. Le Corbusier was a constant reference point for Bierbauer both with positive and negative connotations—i.e. Bierbauer appraised his theoretical works but at times criticised his built works such as his two houses in the Weißenhofsiedlung in Stuttgart. As I explained earlier, I did not record every mention in the journal, only the actual coverage of buildings and publications, as otherwise it would have distorted the result in the visualisation. This is especially the case with regards to Le Corbusier, who is a highly cited person in *Tér és Forma*, but including his mention every time would not be reasonable if we want

[4] *The letters are organised in the folder Korrespondens M (1/2) AM1970-18-193 (without unique inventory numbers) in the Fred Forbát Archive in ArkDes, the Swedish Centre for Architecture and Design, Stockholm.*

[5] *The special CIAM issues of Tér és Forma are: 5/12 (1932), 7/1 (1934), 8/1 (1935), 9/1 (1936), 10/1 and 12 (1937).*

[6] *The related correspondence between Virgil Bierbauer and Fred Forbát is without a unique inventory number in the Fred Forbát Archive in ArkDes, the Swedish Centre for Architecture and Design, Stockholm.*

https://disegno.mome.hu/articles/Sebestyen_Fig6.pdf

FIGURE 6.

a relevant picture of him in the graphs. However, Le Corbusier as an already canonised figure at the time, is still a much recognisable node with a definitive tie with Bierbauer in all four visualisations. It is also clearly visible at first glance from the visualisations—and of course it is already known from *Tér és Forma*—that although Bierbauer promoted modern architecture, he did not exclusively include the progressive architectural productions of the era, but incorporated new buildings that matched his criteria of good practice in architecture in line with the functional requirements, the inhabitants' everyday needs and the environmental context (climate, locally available building materials, etc.). It is especially true to the Hungarian scene, where there was a steady presence of a great number of contemporary architects beyond the CIAM branch such as Bertalan Árkay, Dénes Györgyi, Alfréd Hajós, István Hamburger, Iván Kotsis, Endre Kotsis, Gyula Rimanóczy, Károly Weichinger, and others.

The selection of the international material was at many times biased because of Bierbauer's personal preferences, his favoured architects, many of whom he befriended, as well as the direction of his travels. Bierbauer's friends can be located in the visualisations. He was on very good terms with many Italian architects, but it was Giuseppe Capponi who was really considered a close friend according to their correspondence and the memoir of Bierbauer's wife. (Sebestyén 2020, 206–7) In the graphs representing the periods between 1928 and 1933, Giuseppe Capponi stands quite close to Bierbauer with marked edges (it means more mentions, fig. 7). This was the time of their closest friendship: they started corresponding in 1928, they personally met first in 1929 in Rome, then Bierbauer and his wife joined the Capponis in their summer home in Capri, where they spent their holidays later as well in 1932 and 1933.[7] (Sebestyén 2018, 393–94) The lessons learned from Capri had a significant impact on Bierbauer's ideas aboutthe connection between modern and vernacular architecture, which is quite similar to Giedion's engagement with Greece and Heinrich Lauterbach's interest in Santorini. (Sebestyén 2018, 394–95) The Breslau-based German architect Heinrich Lauterbach was a friend almost as close as Capponi, and he also acted as a mediator many timesfor Bierbauer contributing to the expansion of Bierbauer's professional network. (Sebestyén 2020, 205–7) In 1930, Lauterbach wrote an article about the new architecture in Poland featuring the works of e.g. Szymon Syrkus, Bohdan Lachert, Józef Szanajca, Bohdan Pniewski, Stanisław Brukalski, Barbara Brukalska, Jan Stefanowicz, Edgar Aleksander Norwerth, Maksymilian Goldberg, and Hipolit Rutkowski—who all constitute a Polish cluster in the visualisation with Lauterbach in the position of a mediator (i.e. bridge in terms of social network analysis) between Bierbauer and the Polish as well as between the Polish and the German architects (Lauterbach 1930) (fig. 8). We find

[7] *Ágnes Anna Sebestyén's research on Virgil Bierbauer's travels was funded by the National Cultural Fund of Hungary (ref. no. 101102/00578).*

https://disegno.mome.hu/articles/Sebestyen_Fig7.pdf

FIGURE 7.

https://disegno.mome.hu/articles/Sebestyen_Fig8.pdf

FIGURE 8.

the Hungarian architect Ernő Heim in the same mediator position towards Sweden and Norway, as he took a study trip to Sweden in 1929, worked in Ivar Tengbom's and Erik Gunnar Asplund's office and took the opportunity to build a Scandinavian network. This group of architects included his mentors Tengbom and Asplund, as well as Wolter Gahn, Nils Einar Eriksson, Ture Wennerholm, and Eskil Sundahl from Sweden, and also Eyvind Moestue and Ole Lind Schistad from Norway. Hungarian émigré architects also acted as agents such as Marcel Breuer, who between 1928 and 1939 relocated several times to Berlin, Zürich, Budapest, London, and finally to the USA, while maintaining his Hungarian connections, expanding his own international network and acting as a tie to the international from a Hungarian perspective. In the visualisations of *Tér és Forma*, he is usually linked to the Hungarians, especially to the Hungarian CIAM group as his works (regardless of their whereabouts) were often published together with the works of the Hungarian CIAM members, which beside signalling their connectedness, underlines Breuer's position as a tie to the international from the perspective of his CIAM peers in Hungary (fig. 9.)

https://disegno.mome.hu/articles/Sebestyen_Fig9.pdf

FIGURE 9.

CONCLUSION

This paper represents only a phase of the ongoing research about Virgil Bierbauer's professional network and the social network around the journal Tér és Forma. Firstly, as I explained earlier, the mentions – co-mentions networks need to be completed with the data that could not be visualised here due to the characteristics of data export from CAN_IS. Taking this issue in consideration, it is still can be stated that the delineation of the four time periods—which represents a decision based upon my previous research—proved to be representative with regards to the overall changes in the magazine's direction and content. The selected microhistories also appeared to be highlighted in the visualisations. Secondly, my future plan is to import the data of Bierbauer's correspondence into CAN_IS to visualise Bierbauer's own social network. Here hiatuses have to be considered, as despite the fact that Adrienne Graul took great care of her husband's legacy and archive, Bierbauer's correspondence did not remain intact: some letters were lost during or after Bierbauer's lifetime, others were simply thrown out or reused. Thus, the visualisations of his network will be shaped by the lacunae in the archive and by research questions based on previous research findings. Finally, it is also necessary to investigate previously undetected focal points that only became visible via the visualisations and to assess whether these can be considered important and relevant regarding the magazine's history and the editorial decisions.

ACKNOWLEDGEMENTS

I would like to thank all the help of my Croatian colleagues at the Institut za povijest umjetnosti (Institute of Art History–IPU) in giving me access to the CAN_IS system as well as for their invaluable advice for its usage and methods. I especially thank Ljiljana Kolešnik, the project leader of ARTNET (operating project of CAN_IS) for her support, and Sanja Sekelj, project member, who tirelessly answered all my technical and methodological questions related to CAN_IS and data visualisation. I thank Tamara Bjažić Klarin, the Croatian leader of the bilateral project "Architectural Encounters of Croatia and Hungary," who invited me in the first place to enter the world of Digital Art History by using CAN_IS. I also thank András Ferkai, my doctoral supervisor and the Hungarian leader of our bilateral project, who thoroughly supported my work in Digital Art History in the course of the project.

REFERENCES

Bentkowska-Kafel, Anna. 2015. "Debating Digital Art History." *International Journal for Digital Art History* 1: 50–64. https://doi.org/10.11588/dah.2015.1.21634

Bierbauer, Virgil. 1932. "Werkbundsiedlung Wien 1932." *Tér és Forma* 5 (8): 255–65.

Bierbauer, Virgil. 1935. "A revízió revíziója." *Tér és Forma* 8 (6): 157–66.

Bishop, Claire. 2018. "Against Digital Art History." *International Journal for Digital Art History* 3: 122–31. https://doi.org/10.11588/dah.2018.3.49915

Bjažić Klarin, Tamara, and Nikola Bojić. 2018. "CIAM Network Visualisation—Detecting Ideological Ruptures in the CIAM Discourse." In *Modern and Contemporary Artists' Networks. An Inquiry into Digital History of Art and Architecture*, edited by Ljiljana Kolešnik and Sanja Horvatinčić, 64–82. Zagreb: Institute of Art History. https://doi.org/10.31664/9789537875596.04

Borgatti, Stephen P., and Daniel S. Halgin. 2011. "On Network Theory." *Organization Science* 22 (5): 1168–81. https://doi.org/10.1287/orsc.1100.0641

Colomina, Beatriz. (1994) 1996. *Privacy and Publicity: Modern Architecture as Mass Media*. Cambridge, MS: MIT Press.

Drucker, Johanna. 2014. *Graphesis: Visual Forms of Knowledge Production*. Cambridge, MA: Harvard University Press.

Kienle, Miriam. 2017a. "Between Nodes and Edges: Possibilities and Limits of Network Analysis in Art History." *Artl@s Bulletin* 6 (3): 4–22. https://docs.lib.purdue.edu/artlas/vol6/iss3/1/

Kienle, Miriam. 2017b. "Digital Art History 'Beyond the Digitized Slide Library': An Interview with Johanna Drucker and Miriam Posner." *Artl@s Bulletin* 6 (3): 121–25. https://docs.lib.purdue.edu/artlas/vol6/iss3/9/

Kolešnik, Ljiljana. 2018. "On Digital Art History: The Objectives and the Results of the Project ARTNET." In *Modern and Contemporary Artists' Networks. An Inquiry into Digital History of Art and Architecture*, edited by Ljiljana Kolešnik and Sanja Horvatinčić, 6–13. Zagreb: Institute of Art History. https://doi.org/10.31664/9789537875596.01

Kozma, Lajos. 1938. "A felszabadított alaprajz." *Tér és Forma* 11 (5): 138–45.

Lauterbach, Heinrich. 1930. "Az új építészet Lengyelországban." *Tér és Forma* 3 (7): 307–14.

Lozano, Jorge Sebastián. 2017. "Digital Art History at the Crossroads." *Kunsttexte* 4 : 1–14. https://doi.org/10.48633/ksttx.2017.4.88511

Porras, Stephanie. 2017. "Keeping Our Eyes Open: Visualizing Networks and Art History." *Artl@s Bulletin* 6 (3): 41–49. https://docs.lib.purdue.edu/artlas/vol6/iss3/3/

Ritoók, Pál, and Ágnes Anna Sebestyén. 2018. "Communicating "space and form": The history and impact of the journal *Tér és Forma* as the Hungarian pipeline of Modernism." *Docomomo Journal* 59: 18–25. https://doi.org/10.52200/59.I.I2TT8LJ0

Schelbert, Georg. 2017. "Art History in the World of Digital Humanities. Aspects of a Difficult Relationship." *Kunsttexte* 4: 1–10. https://doi.org/10.48633/ksttx.2017.4.88512

Sebestyén, Ágnes Anna. 2016. "Strategy and Agency in Architectural Photographs: Imaging Strategies that Shaped an Architectural Magazine in Interwar Hungary." In *Inter Photo Arch, Congreso Internacional, inter-fotografía y arquitectura: interpretaciones; Inter Photo Arch, International Conference, Inter-Photography and Architecture: Interpretations*, edited by Rubén A. Alcolea and Jorge Tárrago Mingo, 178–89. Pamplona: Universidad de Navarra.

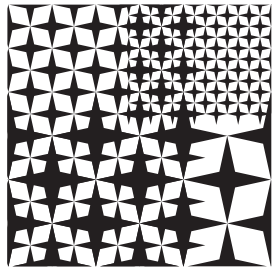
Sebestyén, Ágnes Anna. 2017. "Architectural Photographs as Agents of Travel and Information: Virgil Bierbauer's Travels to Circulate Visual Information in the Architectural Press in Interwar Hungary." *Revelar* 2: 104–22. https://ojs.letras.up.pt/index.php/RL/article/view/3616/3375

Sebestyén, Ágnes Anna. 2018. "Disseminating the Regional within the Global: Representing Regionalist Ideas and the Global Scale of the Modern Movement in the Hungarian Journal Tér és Forma." In *Regionalism, Nationalism & Modern Architecture. Proceedings*, edited by Jorge Cunha Pimentel, Alexandra Trevisan and Alexandra Cardoso, 382–98. Porto: Centro de Estudos Arnaldo Araújo / ESAP-CESAP. http://hdl.handle.net/10400.26/24574

Sebestyén, Ágnes Anna. 2020. "Media as Network: The Editor's Network as Reflected in the Journal *Tér és Forma* in Interwar Hungary." In *Nicht nur Bauhaus – Netzwerke der Moderne in Mitteleuropa / Not Just Bauhaus—Networks of Modernity in Central Europe*, edited by Beate Störtkuhl and Rafał Makała, 190–210. Berlin: De Gruyter/Oldenbourg.

Sebestyén, Ágnes Anna. 2021. "Democratizing Access to Modern Architecture in the Interwar Era." In *Inheritable Resilience: Sharing Values of Global Modernities—The 16th International Docomomo Conference Tokyo Japan 2020+1 Proceedings*, edited by Ana Tostões and Yoshiyuki Yamana, 690–95. Tokyo: Docomomo International.

Weltzl, János. 1937. "„Art et Technique"—avagy „Művészet és Technika." *Tér és Forma* 10 (12): 373–80.



DATA AND KNOWLEDGE MODELLING AS THE METHODOLOGICAL FOUNDATION OF DIGITAL HUMANITIES

Dinara Gagarina

ABSTRACT

Digital humanities is a multidisciplinary field that leverages digital technology and methodologies to explore and answer questions pertaining to the humanities. It is a dynamic intersection between the domains of computer science and the humanities, promoting innovation, collaboration, and research at the highest levels. However, as a relatively young field, the methodological foundations of the digital humanities are still being established. This paper seeks to explore the core methodologies that underpin digital humanities.

The modelling of data, information, and knowledge can be considered one of the foundations of digital humanities. One of the arguments confirming this is that the development of digital humanities and the development of technologies in general are the development of ways to formalise and present data and knowledge. Science has come a long way from the modelling and computer representation of numbers to generating texts and art on the basis of prescribed inputs. With the advent of artificial intelligence, especially machine learning and deep learning techniques, the potential for more sophisticated and nuanced data modelling in the digital humanities has expanded significantly, linking computational capabilities with humanistic inquiries in unprecedented ways.

The article considers the periodization, classification, and trends of approaches and methods for modelling data, information and knowledge in the humanities. The article provides an overview of existing examples and data models of different complexity from various humanities disciplines, including history, linguistics, literary criticism, and cultural studies.

#data modelling, #knowledge representation, #semantic networks, #GPT, #digital history

https://doi.org/10.21096/disegno_2023_1dg

INTRODUCTION

The transformation of the humanities through the adoption of digital technologies has led to a new age of scholarship. The rapidly developing field of digital humanities combines traditional humanities disciplines such as history, literature, philosophy, and art with computer science, focusing on the use of computational tools for the analysis, visualization, and understanding of human culture. This confluence of digital tools and humanistic enquiry is reshaping how we understand and represent the vast spectrum of human experience, particularly in an era of big data and increasing digitisation of all kinds of historical and cultural heritage.

The term "Digital Humanities" is an umbrella term that covers a wide range of activities and disciplines (Gold 2012; Burdick et al. 2012). Because of its integrative and interdisciplinary nature, the field of digital humanities is constantly exploring its methodological core and establishing methodological foundations that can guide its research, applied projects, and educational endeavours. Many scholars have written about the need for a methodological core or foundation in digital humanities, as it is a vital part of establishing the field's credibility and facilitating its further development. Two notable figures in this conversation are Patrik Svensson and Paul Rosenbloom. Svensson's work deals with the humanities computing as a field, considers how the digital humanities could be considered a field or a discipline, and discusses methodological commonplaces (Svensson 2010). Rosenbloom's work, on the other hand, engages more deeply with the computational aspects of the digital humanities, providing a framework for building a multi-level methodology for the digital humanities (Rosenbloom 2012).

As one of the fundamental pillars, data and knowledge modelling plays a pivotal role in shaping the future of digital humanities. Data and knowledge modelling refers to the process of creating structured representations of information. These models offer a framework for organising, categorising, and analysing data. In the context of the digital humanities, data and knowledge modelling allows for the representation of complex concepts, narratives, and relationships in a form amenable to computational analysis. The assertion that

modelling forms the bedrock of the digital humanities has gained wide acceptance (McCarty 2005, Flanders and Jannidis 2015). However, it is still a complicated field with many attempts to develop this insight further and conceptualize the modelling and its associated characteristics in the digital humanities (Jannidis 2018; Ciula et al. 2018).

Recent advancements, including the rise of large language models like GPT-3 and the broad adoption of AI techniques, have driven significant growth in the digital humanities. This growth underscores the urgent need to revisit the foundational methodological pillars of digital humanities research and its applications. Central to this discourse is data and knowledge modelling, a crucial methodology in the field. This approach allows for the computational analysis of cultural artifacts and dynamics at a large scale but also runs the risk of oversimplifying intricate humanistic nuances. Such analyses, especially when incorporating state-of-the-art tools like BERT for computational text analysis, require careful human interpretation and judgment. Moreover, the increasing influence of large language models is reshaping knowledge representation within the digital humanities. This paper aims to critically evaluate these methodologies, emphasising both their capabilities and limitations, especially amidst the rapid technological advancements. It posits that while these techniques offer a robust framework for enquiry, they mandate ethical application and critical evaluation, a sentiment growing in importance due to the swift progression of AI. Furthermore, as AI continues to evolve, fostering discussions both within and outside the digital humanities community about its implications becomes essential, ensuring that emerging tools align with humanistic values.

THE HUMANITIES AND EVOLUTION OF DATA AND KNOWLEDGE MODELLING

The progression of data and knowledge modelling has shown significant development over time. Primitive models were often rudimentary, linear, and devoid of the capacity to represent intricate relationships. In contrast, contemporary models are proficient in demonstrating a diverse array of relationships, attributes, and entities. Several mathematical, computational, and philosophical pioneers, such as Claude Shannon, Alan Turing, John von Neumann, Donald Knuth, Marvin Minsky, and Judea Pearl, have been formulating theoretical models of computers and computing for approximately a century (Shannon 1948; Turing 1937; von Neumann 1945; Knuth 1968; Minsky 1986; Pearl 2000). Simultaneously, a shift has occurred in the comprehension of modelling and knowledge formalisation within the realm of the humanities.

In the formation of theoretical and conceptual foundations for modelling within the humanities, numerous influential figures have emerged, including Johanna Drucker, Willard McCarty, Lev Manovich,

Ted Underwood, Manfred Thaller, Peter Doorn, among others (Drucker 2014; Drucker 2021; Fiormonte et al. 2015; McCarty 2005; McCarty 2018; Manovich 2013; Underwood 2019; Thaller 1985; Thaller 2012; Doorn 2021). For instance, in "Graphesis: Visual Forms of Knowledge Production", Johanna Drucker (2014) emphasized the significance of graphical systems in the knowledge production process, thereby addressing the challenges and opportunities of modelling humanities data. Similarly, in "Humanities Computing" Willard McCarty (2005) underscored the methodological implications of data modelling within the humanities, providing a theoretical basis for the discipline of the digital humanities.

Noteworthy research has been conducted by pioneers in the digital humanities field, spanning the entire scope of the humanities as well as specific disciplines such as history, literary criticism, and cultural studies. Lev Manovich's "cultural analytics" demonstrate the potential of data modelling in visual culture and art history. Ted Underwood's work showcases the efficacy of data modelling in literature. Manfred Thaller and Peter Doorn have significantly contributed to the modelling of historical databases and information systems (Doorn 2021; Thaller 1985; Thaller 2012). Each of these scholars, with their distinct areas of focus and methodologies, has significantly contributed to the progression of data and knowledge modelling in the humanities.

We can broadly segregate the evolution of the formalisation and modelling of knowledge within the humanities into four distinct stages.

PRE-DIGITAL AND EARLY DIGITAL PHASES

In the pre-digital and early digital phases, scholarly works in the humanities were fundamentally analogue, leaning heavily on written texts, artefacts, or oral traditions. Information was typically organised in the form of documents, with knowledge predominantly catalogued through indices. During this phase, data was primarily unstructured, preserved as manuscripts, books, and other physical documents, with knowledge representation being largely narrative and qualitative.

Notable instances from this pre-digital era abound across various humanities domains. One significant example includes the development of extensive catalogues and indices designed to aid scholars in locating works within vast collections comprising books, maps, manuscripts, and more. Additionally, we can reference various historical atlases seeking to represent data visually and spatially.

A seminal early example of digital humanities is the Index Thomisticus project spearheaded by Roberto Busa in the mid-20th century. This project, which entailed creating a comprehensive index and concordance of the works of Thomas Aquinas and related authors, initially took form as a print project before transitioning into a digital medium, thus representing one of the earliest instances of digital humanities (Busa 1980).

In this phase, we can also discern preliminary endeavours in data modelling, chiefly stemming from early attempts at representing numerical data via basic computational techniques. Here we can cite the emergence of statistical analyses in disciplines like history and sociology, as well as the rise of economic history and historical demography as initial examples of digital or mathematical history. A notable figure here is Robert Fogel, who shared the 1993 Nobel Prize in Economics with Douglass North. Fogel used innovative statistical techniques to examine the economic impact and efficiency of institutions such as railways and slavery, as discussed in his significant work "Time on the Cross: The Economics of American Negro Slavery" (Fogel and Engerman 1974), which marked a pivotal point in economic history. Despite inciting controversy, Fogel's methodologies further spurred the development of economic analysis in historical processes.

DIGITAL PHASE

The digital phase in humanities commenced with the advent of digital computers, which enabled the digitisation, storage, and manipulation of enormous volumes of data. Fundamental data models such as flat files and relational databases gained popularity during this era. The introduction of markup languages, including XML and HTML, facilitated the encoding of semantics in texts, heralding the digital representation and organisation of information (Riley 2017).

Relational, hierarchical, and graph data models emerged as significant areas during this phase. As an example, relational databases were central to early digital humanities projects such as the Perseus Digital Library at Tufts University, which aimed to collect and provide access to classical texts and artifacts (Mylonas 1993). This project utilised relational databases to store and organise information in a structured manner, thereby paving the way for more complex digital humanities projects.

Other examples of innovative projects during the digital phase include the Text Encoding Initiative (TEI), which was founded in 1987. This initiative developed a standard for encoding machine-readable texts in the humanities and social sciences, with a specific emphasis on the markup of texts (Sperberg-McQueen and Burnard 1994). The development of graph models led to the rise of network analysis in the digital humanities. An instance of this is the work of Scott Weingart, a digital humanities specialist, who applied network analysis to historical studies, thus offering new insights into historical relationships and processes (Weingart 2011). Lastly, projects like Manfred Thaller's (1985) "Beyond Collecting: On the Design and Implementation of CLIO, a DBMS for the Historical Sciences" showcased the power of databases

and data modelling in digital humanities research. These early pioneers laid the groundwork for the sophisticated models and techniques that are now commonplace in the field.

SEMANTIC PHASE

The semantic phase of the digital humanities represents a significant advancement in data modelling, where the focus shifts towards creating intricate representations of knowledge using advanced semantic technologies and artificial intelligence. Here, it is the establishment of ontologies, semantic networks, and knowledge graphs that have led to a more nuanced understanding and depiction of the relationships and complex concepts within humanities research.

A seminal work in this phase is the project "Pelagios" led by Leif Isaksen, Elton Barker, Rainer Simon, and Pau de Soto. The project aims to create a comprehensive semantic graph of ancient places, annotated from a vast array of resources spanning multiple millennia and languages. It applies semantic web technologies to create an interconnected web of historical geographical information (Isaksen et al. 2014). In this phase, TEI begins to play more and more increasingly important role. An example of semantic modelling in digital humanities is seen in "Prosopographies" and "TEI Guidelines" which refer to the development of detailed collections of people, networks, and relationships in historical or literary contexts, usually encoded in TEI or similar XML-based schemas (McCarty 2004; Romanello et al. 2013). The TEI Guidelines enable scholars to represent complex textual phenomena and their semantics in a standardized way, which is crucial for interoperability and data exchange in the digital humanities (Sperberg-McQueen and Burnard 1994). A further pioneering project in this phase is the Linked Jazz Project, which uses linked open data technologies to uncover relationships between jazz musicians based on data extracted from interviews and other documents (Liu and Pattuelli 2013). This project exemplifies the way semantic web technologies can be applied in digital humanities research to uncover and visualize complex networks of relationships. Kim et al. (2017) investigate the relationship between literary genres and emotional plot development comparing different models that use emotion-related information to classify genres of stories with traditional bag-of-words models for genre classification. They find that different genres have different emotional arcs, with some genres showing more uniform emotional development than others. In digital history, knowledge graphs and semantic web technologies are uncovering new connections between historical events and figures (Meroño-Peñuela et al. 2014). Ontologies and linked open data help model the complexity of historical relationships (Ide, 2007).

Recent years have seen remarkable advances in data and knowledge modelling techniques across various humanities domains. In literary analysis, models like BERT (Bidirectional Encoder Representations from Transformers) are revolutionising computational text mining (Devlin, 2018). Luccioni and Rogers (2023) discuss the use of Large Language Models (LLMs) in Natural Language Processing (NLP) research, highlighting the limitations and challenges associated with their evaluation and impact on the field. They emphasize the need for rigor, transparency, and diversity in research approaches, as well as reproducibility and access to resources.

The semantic phase revolutionizes how we understand and interconnect data in the digital humanities. It has allowed for the digital representation and analysis of complex relationships in the humanities in a way that was not possible with previous approaches.

GENERATIVE ARTIFICIAL INTELLIGENCE PHASE

The utilisation of generative AI and its associated models in the humanities presents revolutionary avenues for exploration and interpretation. Generative AI models, such as OpenAI's Generative Pretrained Transformer (GPT), leverage vast datasets to produce novel content that mirrors learned patterns and structures.

The application of generative artificial intelligence and associated models within the humanities heralds innovative and thrilling possibilities for research and interpretation, potentially deepening and refining our understanding of human culture and history. In literary studies, these models hold potential for style analysis, thematic pattern recognition, and new text generation based on training data. Models can be trained on texts from a specific author or literary period and subsequently generate content that emulates the style and theme of the source material (Jockers 2013). Historical research can also benefit from generative AI models. They can be employed to analyse and reproduce historical documents and artifacts. For instance, training these models on images of historical documents allows them to generate new images mirroring the style and characteristics of the original sources, offering an effective method for studying and recreating historical contexts and cultures. Cultural studies, too, can leverage generative AI for analysing and recreating artistic styles and cultural trends. By training models on images of art pieces, new images that emulate the style and characteristics of the training data can be generated, proving beneficial for researching and analysing artistic styles and cultural trends (Elgammal et al. 2017).

Recent large language models like GPT-4 and Claude from Anthropic promise to transform knowledge representation and text generation within digital humanities domains (Bommasani et al. 2021; Anthropic

2023). By learning patterns from vast datasets, these models can generate synthetic content mimicking various writing styles. Such capabilities allow examining textual attributes at scale, like analysing genre conventions or authorial voice across corpora.

DIGITAL HUMANITIES: METHODOLOGICAL FOUNDATIONS AND TASKS

Data and knowledge modelling can be viewed as the fundamental methodological basis of the digital humanities, as they enable the creation and implementation of computational tools and techniques in humanities research (Borgman, 2009). At the heart of these operations is the transformation of humanistic data into a computational format. This transformation encompasses two main stages: data modelling, referring to the conversion of humanities data into a computer-processable format, and knowledge modelling, which involves organising humanities knowledge into structured formats, typically comprising relationships between entities (Kitchin and McArdle 2016). These processes underpin a myriad of applications in digital humanities, from analysing linguistic patterns in literature to charting historical events and tracking cultural trends (McCarty, 2005; Rockwell and Sinclair 2016).

As the digital humanities evolve and flourish, the role of data and knowledge modelling becomes increasingly vital for several reasons.

First, data and knowledge modelling significantly foster interdisciplinary research within the digital humanities. By enabling diverse data source integration, these models facilitate a comprehensive and holistic approach to complex problems. This integration permits exploration at the intersection of various fields, thus expanding the scope of enquiry and potential discoveries.

Second, data and knowledge modelling contribute immensely to the preservation and digitisation of cultural artifacts, thus playing a crucial role in safeguarding our cultural heritage. By employing these techniques, precious artifacts are preserved and made accessible for future generations, ensuring the continuous availability of cultural resources for ongoing and future research.

Third, data and knowledge modelling enhance data analysis, a critical advantage in digital humanities. Through these techniques, scholars can perform comprehensive and scalable data analyses, a feat unachievable by traditional, non-digital methods. These advanced analyses yield novel insights and discoveries, making data and knowledge modelling powerful tools for unearthing new knowledge in the humanities (Manovich 2013).

In essence, data modelling serves as a foundation for the digital humanities. It involves converting traditional humanities sources

into machine-readable formats, such as texts, databases, or GIS files. During this process, information from primary and secondary sources is systematically encoded, annotated, and categorized, enabling computational tools to process and analyse it. This methodology facilitates the discovery of patterns, correlations, and other significant phenomena that may not be discernible through conventional humanities research methods (Drucker 2014).

The tools of data modelling play crucial roles in digital humanities, including computational analysis, data visualisation, digital archiving and preservation, and fostering a collaborative and open-source approach (Jockers 2013; Manovich 2013; Unsworth 2000; Spiro 2012):

1. Computational analysis: Using computer algorithms, researchers can manipulate and analyse large datasets, perform intricate statistical analyses, and apply machine learning techniques to identify patterns and derive insights. Text analysis, topic modelling, sentiment analysis, and network analysis are among the key computational methods employed in digital humanities.

2. Data visualisation: Visualisation plays an essential role in the digital humanities. Given the human eye's natural inclination towards and swift processing of visual representations, digital humanities scholars utilize data visualisation techniques to depict their computational analysis findings. These visualisations can range from graphs, charts, and maps to more sophisticated interactive interfaces, allowing users to examine data and findings in depth.

3. Digital archiving and preservation: Digitally preserving cultural and historical artifacts is a vital task in the field of the digital humanities. This process entails not just digitising these resources but also maintaining them in formats that ensure their longevity and accessibility for future research. Efficient data and metadata models are necessary for these tasks.

4. Collaborative and open-source approach: A foundational methodological principle in digital humanities is a commitment to collaboration and an open-source ethos. Digital humanities projects often involve teamwork, with various scholars contributing their unique skills and perspectives. Furthermore, many scholars and projects adopt an open-source approach, sharing their code, data, and findings openly with the community. This collaborative spirit promotes greater transparency, reproducibility, and knowledge sharing.

Data and knowledge modelling in the humanities is closely related to the concept of uncertainty. Edmond (2019) suggests several measures to address challenges and improve data modelling in the humanities. One approach is to focus on interoperability and comparative legibility, allowing researchers to fluidly move between different sources and perspectives. This can be achieved by enabling the combination and comparison of siloed sources, without losing

their context and complexity. Another measure is to incorporate fuzzy search capabilities that reduce false negatives and increase interrogability. By allowing for more flexible and nuanced searches, researchers can navigate the uncertainties and ambiguities inherent in humanistic data (Edmond 2019).

THE USE OF MODELLING IN THE DESIGN OF EDUCATIONAL PROGRAMS IN DIGITAL HUMANITIES

The integration of modelling in the design of educational programmes in digital humanities has substantial potential to revolutionise pedagogical approaches, engender critical thinking, and prepare students more effectively for a digital age. Scholars like Willard McCarty have advocated for the incorporation of modelling in digital humanities education, arguing that the process of constructing models can enhance students' comprehension of their subject matter (McCarty 2004).

Modelling, which serves as a cornerstone concept in digital humanities education, introduces students to the practice of representing intricate systems and phenomena in a simplified, structured manner, fundamental to much computational analysis. This notion of modelling becomes palpable when students engage with work by scholars such as Stephen Ramsay, renowned for both his use of modelling in his research and his emphasis on its role in pedagogy. His writings reflect on teaching computational literacy in the humanities, focusing on critical engagement with models (Ramsay 2011).

Moreover, the process of model construction can help students foster crucial skills such as critical thinking, problem-solving, and data literacy. This perspective is often associated with scholars like Johanna Drucker, who have contributed significantly to the pedagogical discourse in digital humanities. Drucker has extensively discussed the interpretive aspects of data modelling, and the critical use of visualisation and graphical models in humanities education (Drucker 2011).

The use of modelling also promotes a more active, project-oriented approach to learning. Instead of passively absorbing information, students engage in the creation and testing of models, which can foster a deeper understanding and engagement. This concept aligns with the contemporary pedagogical theories that emphasise the importance of active learning and real-world application of knowledge. In this context, the work of scholars like Ted Underwood is notable. Underwood is known for his application of machine learning and statistical modelling in literary studies and has actively discussed how these modelling techniques can be incorporated into digital humanities curricula (Underwood 2014).

Lastly, modelling can be applied in structuring the design of the curriculum itself. As a model can represent a complex system, it can

similarly represent the structure and sequence of an educational programme. This perspective can help educators identify gaps in the curriculum, logically sequence courses, and ensure that learning outcomes are aligned with instructional activities and assessments. Elijah Meeks, a digital humanities specialist with a strong focus on data visualisation, has written about using these methods in an educational context (Meeks 2015).

In our endeavour to develop digital humanities educational programs, we have conducted extensive experiments between 2016 and2018 that have confirmed the practical effectiveness of utilising data and data modelling as a foundation for program structure (Gagarina, Kornienko 2018). We explored a variety of strategies for structuring courses, such as aligning it with different humanities fields, digital humanities sections, methodologies, technologies, software, or data types. Across several academic years, we examined two course formation approaches: a collaborative method, which involved both students and teacher, and a data-centric method. Remarkably, we found that the data-centric approach, which built the course around different types of data and its modelling, was more effective for students, especially for those who had limited exposure to traditional humanities disciplines.

The integration of modelling in the design of educational programmes in digital humanities has substantial potential to endow students with a deep understanding of the methods and techniques employed in this field, develop critical thinking and problem-solving skills, and promote active, project-based learning. Furthermore, it can offer a structured framework for the design of the curriculum itself, helping to ensure that it is comprehensive, logical, and aligned with learning outcomes.

Incorporating critical data literacy into digital humanities pedagogy represents a valuable opportunity to engage students in evaluating the implications of data modelling. Curricula can guide students to think critically about how selection, cleaning, and transformation of data embed certain assumptions and biases. Exercises in identifying exclusion or misrepresentation in dataset construction and model design help sensitize students to issues of epistemic injustice that may be obscured by technical processes (Irgens 2020). Further critical engagement involves assessing whose perspectives and narratives are privileged in data modelling pipelines, prompting reflection on power dynamics and marginalisation (D'Ignazio and Klein 2020). This ties into broader ethical questions around consent, access, and control over cultural data that students can unpack. Ultimately, cultivating skills to decode and interrogate the construction of data models, rather than passively accepting their authority, enables students to apply digital humanities tools thoughtfully.

CHALLENGES AND LIMITATIONS OF DATA MODELLING IN THE DIGITAL HUMANITIES

While data and knowledge modelling has been celebrated for its ability to structure, simplify and analyse complex systems in digital humanities, it is not without criticism. Scholars have pointed out potential issues ranging from the risk of oversimplification to the challenge of interpretation, and even ethical concerns around data usage and representation.

One key challenge is managing the complexity inherent in humanities data. This involves not only the complexity of the data itself but also the complexity of the socio-cultural phenomena it represents. This can be mitigated to an extent by adopting robust modelling techniques like semantic networks, ontologies, or machine learning models, which can handle high-dimensional, interconnected data. However, the challenge of adequately representing the intricacies of human experience within a model remains an open issue.

Managing complexity refers to the risk of oversimplification, which is one of the central concerns of digital humanities. When modelling complex phenomena, like social interactions or historical events, the process requires an element of abstraction, condensing reality into quantifiable parameters. For example, Johanna Drucker (2011) warns that this process might lead to overlooking nuances, complexities, and outliers, leading to misleading conclusions.

Ensuring data integrity is another concern. The quality of a model depends heavily on the quality of the input data. Unclear, missing, or incorrect data can distort the model's output. Techniques such as data cleaning, validation, and redundancy checks can help mitigate this issue, but perfect data integrity is rarely achievable, especially when dealing with historical or other hard-to-verify data sources.

Further critique emerges around the interpretation of models and their outputs. While models can help visualize data and reveal patterns, they cannot replace human judgment and critical thinking. David M. Berry articulates the necessity for a critical digital humanities, emphasising the potential for misinterpretation or manipulation of model results without proper understanding and contextual knowledge (Berry 2014). Techniques such as critical discourse analysis can provide systematic approaches to interpretation, but the inherent subjectivity of interpretation cannot be entirely eliminated. As Johanna Drucker argues, visualizations and models remain constructed representations, requiring contextualization (Drucker 2011). Data models cannot replace deep humanistic understanding. Similarly, generaliation in data models may fail to account for outliers and exceptions requiring close reading to identify (Piper 2018).

Beyond interpretational pitfalls, ethical issues arise in the realm of data usage and representation. In dealing with vast datasets, especially

those involving personal data, concerns around privacy, consent, and potential misuse of data come to the fore. Tara McPherson cautions against the racial and gender biases that can be present in coding and computational thinking, extending to data and knowledge modelling (McPherson 2012). Furthermore, the choice of which data to include or exclude in a model can reflect certain biases, which might lead to misrepresentation or marginalisation of certain groups or perspectives.

Critiques extend to the digital humanities' emphasis on quantitative methods, perceived by some as favouring scientific methods and the so-called "hard" sciences over traditional humanities disciplines, which often prioritize qualitative analysis and interpretive approaches. This concern is vocalized by Alan Liu, who contends that the critical cultural interpretation essential to the humanities should not be overshadowed by computational methods (Liu 2012).

While data modelling facilitates new research capabilities, it also warrants careful examination given its potential limitations. Scholars have argued computational techniques carry inherent biases that can propagate through data modelling pipelines (Benthall, Haynes 2019). Models trained on biased datasets may amplify distortive assumptions. Even in the absence of explicit biases, researchers caution that data models risk perpetrating "epistemic injustice" by flattening complex humanistic phenomena (Noble 2018). Generative text also risks perpetrating harmful biases embedded in training data. Models may reproduce stereotypical tropes or skew aggregate style representations towards overrepresented groups (Manela 2021). This necessitates critical assessment of model-generated content as constructed output requiring contextual interpretation. Ethical implications arise with text generation. Large language models trained on copyrighted data raise legal questions around creative ownership. Their ability to automate written content also warrants considering effects on human creativity and scholarship. Such models currently function as assistants, not autonomous creators or experts. Still, their interpretive limitations mean humanists must continue close reading, contextual analysis and cultivation of wisdom. By spurring critical discourse about AI's capacities and biases, large language models like GPT-4 demonstrate how digital humanities must guide emerging technologies towards ethical application in humanities enquiries. Other ethical concerns involve privacy, consent, and appropriate use of cultural data. Digital humanities research drawing on large datasets of personal information needs to implement safeguards around individual privacy and autonomy. As entities like archives and libraries digitise materials at scale, they must consider thorny issues around public access versus consent, as with indigenous community materials (Christen 2015).

Berry et al. (2019) argue that the digital humanities often takes a "signal processing" approach to cultural heritage, focusing on extract-

ing and manipulating data/signals while neglecting symbolic meaning and interpretation. This risks flattening complex phenomena into quantitative parameters and prioritising computation over humanistic interpretation. Data modelling enables new discoveries but should not lead to "signal processing" at the expense of humanistic questioning, ethics and symbolic understanding. Computational techniques require thoughtful application and decoding.

In summary, while there are methodologies and techniques that can help address some of the challenges associated with data and knowledge modelling in digital humanities, other issues, particularly those related to representation, bias, and interpretation, remain difficult to resolve entirely. These challenges highlight the importance of critical, reflective, and ethical practices in digital humanities. Ultimately, while enabling computational analysis, data modelling in the digital humanities demands a critical lens attending to biases, subjectivity, generalization, ethics, and context. Hybrid teams of humanists and computer scientists can thoughtfully apply modelling while avoiding pitfalls through transparent practices.

CONCLUSION

The methodological foundation of data, information, and knowledge modelling is integral to the field of digital humanities. It has not only enabled scholars to apply computational tools to humanities research but also opened up new avenues for discovery and understanding. These models, by providing a structured way to represent and analyse humanities data, have made research more systematic, scalable, and insightful.

The historical development, contemporary trends, and applications of data and knowledge modelling in various humanities disciplines attest to their transformative impact on research, analysis, and preservation of cultural heritage. They have not only served as crucial methodological foundations but also unlocked new dimensions of insight into the human experience and cultural heritage.

Looking to the future, advancements in artificial intelligence and machine learning promise to further enrich the complexity and depth of these models. As these technologies continue to evolve, data and knowledge modelling will undoubtedly play an increasingly vital role in shaping the future of digital humanities, driving new insights and understanding in the field.

This examination of data and knowledge modelling elucidates its vital yet complex role within digital humanities methodology. Modelling techniques enable computational analysis of cultural artifacts, dynamics and relationships at an unprecedented scale. By extracting patterns from corpora spanning genres, eras and languages, data

models reveal phenomena otherwise invisible to human scrutiny. However, as constructive simplifications, they risk flattening nuance and exception. Interpreting model outputs necessitates humanistic wisdom and scepticism towards generalisation.

Furthermore, employing data modelling in ethical, socially conscious ways remains imperative given dangers of perpetrating bias and other harms. As the digital humanities continue adopting advanced techniques like large language models, critical interrogation must accompany technical innovation. Ongoing progress will create immense opportunities for scholarship, but humanists must steward these tools towards expansive, equitable ends.

Ultimately, data and knowledge modelling establishes a framework to activate cultural data computationally while upholding principles of critical enquiry fundamental to the humanities. It enables asking new questions and marshalling new evidence. But humanistic study also connotes questioning how models construct reality, probing their constraints and biases. By maintaining this spirit of reflective application, the digital humanities can leverage data modelling for positive transformation while remaining grounded in humanistic ethics and understanding.

REFERENCES

Anthropic. 2023. "Introducing Claude." Anthropic blog. https://www.anthropic.com/index/introducing-claude

Benthall, Sebastian, and Bruce D. Haynes. 2019. "Racial Categories in Machine Learning." In *FAT* '19: Proceedings of the Conference on Fairness, Accountability, and Transparency*, 289–98. New York: Association for Computing Machinery. https://doi.org/10.1145/3287560.3287575

Berry, David M. 2014. *Critical Theory and the Digital*. London: Bloomsbury.

Berry, David M., M. Beatrice Fazi, Ben Roberts, and Alban Webb. 2019. "No Signal without Symbol: Decoding the Digital Humanities." In *Debates in the Digital Humanities 2019*, edited by Matthew K. Gold and Lauren F. Klein, 61–74. Minneapolis: University of Minnesota Press. https://doi.org/10.5749/j.ctvg251hk.8

Bommasani, Rishi, Drew A. Hudson, Ehsan Adeli, Russ Altman, Simran Arora, Sydney von Arx, Michael S. Bernstein, Jeannette Bohg, Antoine Bosselut, Emma Brunskill, et al. 2021. "On the Opportunities and Risks of Foundation Models." ArXiv 2108.07258. http://arxiv.org/abs/2108.07258

Borgman, Christine L. 2009. "The Digital Future Is Now: A Call to Action for the Humanities." *Digital Humanities Quarterly* 3 (4). http://www.digitalhumanities.org/dhq/vol/3/4/000077/000077.html

Burdick, Anne, Johanna Drucker, Peter Lunenfeld, Todd Presner, and Jeffrey Schnapp. 2012. *Digital_Humanities*. Cambridge, MA: MIT Press.

Busa, Roberto. 1980. "The Annals of Humanities Computing: The Index Thomisticus." *Computers and the Humanities* 14 (2): 83–90. https://doi.org/10.1007/BF02403798

Christen, Kimberly. 2015. "Tribal Archives, Traditional Knowledge, and Local Contexts: Why the 's' Matters." *Journal of Western Archives* 6 (1). https://doi.org/10.26077/78d5-47cf

Ciula, Arianna, Øyvind Eide, Cristina Marras, and Patrick Sahle. 2018. "Modelling: Thinking in Practice. An Introduction." *Historical Social Research Supplement* 31: 7–29. https://doi.org/10.12759/hsr.suppl.31.2018.7-29

Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova. 2018. "BERT: Pre-Training of Deep Bidirectional Transformers for Language Understanding." ArXiv 1810.04805. http://arxiv.org/abs/1810.04805

D'Ignazio, Catherine, and Lauren F. Klein. 2020. *Data Feminism*. Cambridge: MIT Press.

Doorn, Peter. 2021. "Historical Databases, Big and Small." *Historical Life Course Studies* 10: 24–29. https://doi.org/10.51964/hlcs9562

Drucker, Johanna. 2011. "Humanities Approaches to Graphical Display." *Digital Humanities Quarterly* 5 (1). http://digitalhumanities.org:8081/dhq/vol/5/1/000091/000091.html

Drucker, Johanna. 2014. Graphesis: Visual Forms of Knowledge Production. Cambridge: Harvard University Press.

Drucker, Johanna. 2021. *The Digital Humanities Coursebook: An Introduction to Digital Methods for Research and Scholarship*. Abingdon: Routledge.

Edmond, Jennifer. 2018. "Managing Uncertainty in the Humanities: Digital and Analogue Approaches." In *TEEM18: Proceedings of the Sixth International Conference on Technological Ecosystems for Enhancing Multiculturality*, 840–844. https://doi.org/10.1145/3284179.3284326

Elgammal, Ahmed, Bingchen Liu, Mohamed Elhoseiny, and Marian Mazzone. 2017. "CAN: Creative Adversarial Networks, Generating 'Art' by Learning About Styles and Deviating from Style Norms." *ArXiv* 1706.07068. http://arxiv.org/abs/1706.07068

Fiormonte, Domenico, Teresa Numerico, and Francesca Tomasi. 2015. *The Digital Humanist*. Translated by Desmond Schmidt and Christopher Ferguson. Brooklyn: Punctum.

Flanders, Julia, and Fotis Jannidis. 2015. "Knowledge Organization and Data Modeling in the Humanities." White Paper. https://www.wwp.northeastern.edu/outreach/conference/kodm2012/flanders_jannidis_datamodeling.pdf.

Fogel, Robert William, and Stanley L. Engerman. 1974. *Time on the Cross: The Economics of American Negro Slavery*. Boston: Little and Brown.

Gagarina, Dinara, and Sergei Kornienko. 2018. "Introduction to Digital Humanities: Course Based on Data Types." In *Proceedings of the First EADH Conference: "Data in Digital Humanities"*. Galway: NUI Galway. https://eadh2018.exordo.com/files/papers/151/final_draft/gagarina-eadh-final.pdf

Gold, Matthew K., ed. 2012. Debates in the Digital Humanities. Minneapolis: University of Minnesota Press.

Gold, Matthew K., and Lauren F. Klein, eds. 2019. *Debates in the Digital Humanities 2019*. Minneapolis: University of Minnesota Press. https://doi.org/10.5749/j.ctvg251hk

Ide, Nancy, and David Woolner. 2007. "Historical Ontologies." In *Words and Intelligence II*, edited by Thierry Poibeau, Horacio Saggion, Jakub Piskorski, and Roman Yangarber, 63–79. Dordrecht: Springer Netherlands. https://doi.org/10.1007/1-4020-5833-0_7

Irgens, Golnaz Arastoopour, Simon Knight, Alyssa Friend Wise, Thomas M. Philip, Maria C. Olivares, Sarah Van Wart, Sepehr Vakil, Jessica Marshall, Tapan Parikh, M. Lisette Lopez, et al. 2020. "Data Literacies and Social Justice: Exploring Critical Data Literacies Through Sociocultural Perspectives." In *Proceedings of the 2020 International Conference of the Learning Sciences*. Nashville: International Society of the Learning Sciences (ISLS).

Isaksen, Leif, Rainer Simon, Elton T.E. Barker, and Pau de Soto Cañamares. 2014. "Pelagios and the Emerging Graph of Ancient World Data." In *Proceedings of the 2014 ACM Conference on Web Science*, 197–201. New York: Association for Computing Machinery. https://doi.org/10.1145/2615569.2615693

Jannidis, Fotis. 2018. "Modeling in the Digital Humanities: A Research Program?" *Historical Social Research Supplement* 31: 96–100. https://doi.org/10.12759/hsr.suppl.31.2018.96-100

Jockers, Matthew L. 2013. Macroanalysis: Digital Methods and Literary History. Topics in the Digital Humanities. Urbana: University of Illinois Press.

Kim, Evgeny, Sebastian Padó, and Roman Klinger. 2017. "Investigating the Relationship between Literary Genres and Emotional Plot Development." In *Proceedings of the Joint SIGHUM Workshop on Computational Linguistics for Cultural Heritage, Social Sciences, Humanities and Literature*, 17–26. Vancouver: Association for Computational Linguistics. https://doi.org/10.18653/v1/W17-2203

Kitchin, Rob, and Gavin McArdle. 2016. "What Makes Big Data, Big Data? Exploring the Ontological Characteristics of 26 Datasets." *Big Data & Society* 3 (1). https://doi.org/10.1177/2053951716631130

Knuth, Donald Ervin. 1968. *The Art of Computer Programming*. Vol. 1. Reading: Addison-Wesley.

Liu, Alan. 2012. "The State of the Digital Humanities: A Report and a Critique." *Arts and Humanities in Higher Education* 11 (1–2): 8–41. https://doi.org/10.1177/1474022211427364

Luccioni, Alexandre, and Anna Rogers. 2023. "Mind Your Language (Model): Fact-Checking LLMs and Their Role in NLP Research and Practice." *ArXiv* 2308.07120. http://arxiv.org/abs/2308.07120.

Manela, Daniel de Vassimon, David Errington, Thomas Fisher, Boris van Breugel, and Pasquale Minervini. 2021. "Stereotype and Skew: Quantifying Gender Bias in Pre-Trained and Fine-Tuned Language Models." In *Proceedings of the 16th Conference of the European Chapter of the Association for Computational Linguistics*, 2232–42. https://aclanthology.org/2021.eacl-main.190/.

Manovich, Lev. 2013. *Software Takes Command: Extending the Language of New Media*. New York: Bloomsbury.

Manovich, Lev. 2020. *Cultural Analytics*. Cambridge, MA: MIT Press.

McCarty, Willard. 2004. "Modeling: A Study in Words and Meanings." In A Companion to Digital Humanities, edited by Susan Schreibman, Ray Siemens, and John Unsworth. Oxford: Blackwell. http://www.digitalhumanities.org/companion/

McCarty, Willard. 2005. *Humanities Computing*. Basingstoke: Palgrave Macmillan.

McCarty, Willard. 2018. "Modelling What There Is: Ontologising in a Multidimensional World." *Historical Social Research Supplement* 31: 33–45. https://doi.org/10.12759/hsr.suppl.31.2018.33-45

McPherson, Tara. 2012. "Why Are the Digital Humanities So White? or Thinking the Histories of Race and Computation." In *Debates in the Digital Humanities*, edited by Matthew K. Gold, 139–60. Minneapolis: University of Minnesota Press.

Meroño-Peñuela, Albert, Ashkan Ashkpour, Marieke van Erp, Kees Mandemakers, Leen Breure, Andrea Scharnhorst, Stefan Schlobach, and Frank van Harmelen. 2014. "Semantic Technologies for Historical Research: A Survey." *Semantic Web* 6 (6): 539–64. https://doi.org/10.3233/SW-140158

Minsky, Marvin Lee. 1986. *The Society of Mind*. New York: Simon and Schuster.

Moretti, Franco. 2013. *Distant Reading*. London: Verso.

Mylonas, Elli, Gregory Crane, Kenneth Morrell, and D. Neel Smith. 1993. "The Perseus Project: Data in the electronic age." In *Accessing Antiquity: The Computerization of Classical Studies*, 133–157. Tucson: University of Arizona Press.

Noble, Safiya Umoja. 2018. Algorithms of Oppression: How Search Engines Reinforce Racism. New York: New York University Press.

Pearl, Judea. 2000. *Causality: Models, Reasoning and Inference*. Cambridge: Cambridge University Press.

Piper, Andrew. 2018. *Enumerations: Data and Literary Study*. Chicago: The University of Chicago Press.

Riley, Jenn. 2017. *Understanding Metadata: What Is Metadata, and What Is It For? A Primer.* Baltimore: NISO Press.

Rockwell, Geoffrey, and Stéfan Sinclair. 2016. *Hermeneutica: Computer-Assisted Interpretation in the Humanities*. Cambridge, MA: MIT Press.

Romanello, Matteo, and Michele Pasin. 2013. "Citations and Annotations in Classics: Old Problems and New Perspectives." In *Proceedings of the 1st International Workshop on Collaborative Annotations in Shared Environment: Metadata, Vocabularies and Techniques in the Digital Humanities*, 1–8. New York: Association for Computing Machinery. https://dl.acm.org/doi/10.1145/2517978.2517981

Rosenbloom, Paul S. 2012. *On Computing: The Fourth Great Scientific Domain*. Cambridge, MA: MIT Press.

Shannon, Claude Elwood. 1948. "A Mathematical Theory of Communication." *The Bell System Technical Journal* 27 (3): 379–423. https://doi.org/10.1002/j.1538-7305.1948.tb01338.x

Sperberg-McQueen, C. M., and Lou Burnard, eds. 1994. *Guidelines for Electronic Text Encoding and Interchange*. Chicago: Text Encoding Initiative. https://tei-c.org/Vault/GL/p4beta.pdf

Spiro, Lisa. 2012. "'This Is Why We Fight': Defining the Values of the Digital Humanities." In *Debates in the Digital Humanities*, edited by Matthew K. Gold, 16–35. Minneapolis: University of Minnesota Press.

Svensson, Patrik. 2010. "The Landscape of Digital Humanities." *Digital Humanities Quarterly* 4 (1). http://www.digitalhumanities.org/dhq/vol/4/1/000080/000080.html

Thaller, Manfred. 1985. "Beyond Collecting – On the Design and Implementation of CLIO, a DBMS for the Historical Sciences." In *Data Bases in the Humanities and the Social Sciences* 2, edited by Robert F. Allen, 443–68. Osprey: IDEA Publications.

Thaller, Manfred. 2012. "Controversies around the Digital Humanities: An Agenda." *Historical Social Research / Historische Sozialforschung* 37 (3 (141)): 7–23. https://www.jstor.org/stable/i40077811.

Turing, A. M. 1937. "On Computable Numbers, with an Application to the Entscheidungsproblem." In *Proceedings of the London Mathematical Society*, s2-42 (1): 230–65. https://doi.org/10.1112/plms/s2-42.1.230

Underwood, Ted. 2014. "Theorizing Research Practices We Forgot to Theorize Twenty Years Ago." *Representations* 127 (1): 64–72. https://doi.org/10.1525/rep.2014.127.1.64.

Underwood, Ted. 2019. *Distant Horizons: Digital Evidence and Literary Change*. Chicago The University of Chicago Press.

Unsworth, John. 2000. "Scholarly Primitives: What Methods Do Humanities Researchers Have in Common, and How Might Our Tools Reflect This?" Presented at the Symposium on Humanities Computing: Formal Methods, Experimental Practice, King's College London, May 13. https://people.brandeis.edu/ũnsworth/Kings.5-00/primitives.html.

von Neumann, John. 1945. "First Draft of a Report on the EDVAC." Contract No. W-670-ORD-4926 between the United States Army Ordnance Department and the University of Pennsylvania. https://web.mit.edu/STS.035/www/PDFs/edvac.pdf.

Weingart, Scott B. 2011. "Demystifying Networks, Parts I & II." *Journal of Digital Humanities* 1 (1). http://journalofdigitalhumanities.org/1-1/demystifying-networks-by-scott-weingart/.

DESIGN CULTURE'S PERSPECTIVE ON INSTITUTIONAL REPOSITORIES

CHALLENGES AND OPPORTUNITIES

Dorottya Kun

ABSTRACT

This paper aims to identify and summarise the challenges of preserving the outputs of design universities in institutional repositories (IRs) and share the developments and lessons learned from similar fields' successful projects. For traditional academic disciplines, metadata models and standards are well-developed for publication and preservation practices. Research in this area is presently underrepresented in academia; furthermore, the collections tend to be scattered or hidden. In the last fifteen years, preserving works in repositories has become one of the central issues in design institutions. This study examines the problems and other collections' responses to these challenges — observations which can be utilised in the field of design where it is difficult to make visible and present the values created in design.

#design institution, #institutional repository, #metadata model, #metadata standard, #knowledge management

https://doi.org/10.21096/disegno_2023_1dk

PURPOSE AND STRUCTURE OF THE PUBLICATION

The first section of this paper will examine the key knowledge management terms and concepts and the potential applications of essential data standards and models. The second part of the paper aims to identify and summarise the challenges of preserving the outputs of art and design (a&d) universities in institutional repositories (IRs) and share the developments and lessons learned from similar fields' successful projects. The study examines the difficulties and other collections' responses to these challenges—observations which can be utilised in the field of design where it is difficult to make the value of design visible. This paper focuses mainly on the resources related to a&d, performing art, and other creative repositories in the literature of nearly twenty years.

1. INTRODUCTION

Now that the web has been part of our lives for almost three decades, preserving, describing, managing, and making the outcomes from the field of design accessible online has become one of the central issues for art and design institutions, such as universities, museums, and galleries. The creative results emerging in this field, as compared to the primarily text-based publications in other disciplines, take a wide variety of forms, from vehicles, buildings, information systems, user interfaces, objects of use, or even services, and in many cases, these are the outcome of experiments with new technologies and materials. They are complex works that can incorporate various artistic expressions and technological innovations. These can in turn take different forms, including exhibitions, fashion shows, dance, music, and performance. Archiving all this presents many challenges for institutions, both in terms of technology and concepts. However, the endeavour to preserve and facilitate access to the outputs of design is undertaken by only a limited number of institutional repositories. Research in this area is presently underrepresented in academia; furthermore, the collections tend to be scattered or hidden. Design studies is a relatively new discipline, and the archival practices still need to be well-established based on the characteristics and unique needs of the field.

Galleries, libraries, archives, and museums (GLAM) practices can help cover this diverse field through established methods of describing works of art and other types of museum objects. It is essential to examine the descriptive practices that have emerged in this field, such as the VRA Core data model developed by the Library of Congress and the Visual Resources Association, Categories for the Description of Works of Art (CDWA), a set of guidelines for describing works of art, architecture and other cultural works provided by Getty Institute, as their metadata models for publishing visual culture outputs are already widespread. Likewise, the museum (CIDOC CRM) and library (Dublin Core, MARC) systems of practice can be used as a starting point for future research. .

2. KNOWLEDGE ORGANISATION ACROSS UNIVERSITIES AND THE GLAM SECTOR—INSTITUTIONAL REPOSITORIES, METADATA STANDARDS, AND MODELS

An institutional repository (IR) is an archive that collects, preserves, and disseminates digital copies of the intellectual output of an institution, particularly a research institute. The collection managers originally envisioned the IRs as the tool that facilitates access to traditional text-based research outputs, especially peer-reviewed research articles. However, they later recognised that IRs offer universities and other institutions the opportunity to independently manage and preserve their own scientific outputs, research data, and other relevant information. IR is one of the most effective knowledge management platforms because it documents in a standardised and authoritative way the results produced in an institution through the work and supervision of archiving experts. (Callicott, Burton B., David Scherer, and Andrew Wesole 2015; Clobridge 2010; Lynch 2003)

Design institutions create mainly non-text-based research outputs and may include objects such as everyday objects, animated films, exhibitions, designs, performances, material experiments, glass art, and installations. IRs are primarily designed to preserve bibliographic references of text-based research; non-text-based research results do not necessarily fit within the framework of the descriptive practices used so far, and the solution to this problem is crucial to the issue of archiving and making accessible design works.

To fulfil its intended role of collecting, preserving, and disseminating digital copies of intellectual output, an IR requires access to data models and sources because information on works must be recorded in a standardised and interoperable format. Efforts towards structured description and standardization enable information storage and accurate management. Sharing this information is vital to making it accessible and usable by others, helping to promote the visibility of design work in the academic community.

The works preserved in the repository are described, identified, and made accessible by using metadata. By definition, metadata is 'data about data' and provides a structured reference that helps to sort and identify attributes of the information it describes. A set of descriptive data and content information that characterises a work, helps to identify, retrieve, and legally define it. It includes data stored by bibliographic records in library catalogues, such as author, title, subject headings, and publication details, including author name, genre, style direction, or material. Metadata, specifically descriptive metadata, is vital for ensuring the effective discoverability of digital objects in IRs and outside IRs. In essence, as with traditional academic publication, "the metadata that is created for each object ensures proper understanding of what the work is and allows it to be discovered and cited." (Nadim and Randall, 17)

Galleries, libraries, archives, and museums (GLAM) practices use different metadata models, usually based on document type and subject area characteristics. . The acronym LAM (libraries, archives and museums) was coined by Zorich in 2008 (Zorich, Waibel, and Erway 2008, 5), and later added galleries to it. GLAM means cultural heritage institutions, libraries, archives, and museums share the "common goals to acquire, preserve, and make accessible artifacts and evidences of the world's social, intellectual, artistic, even spiritual achievements." (Dupont 2007, 13) The MARC and DublinCore (DC) models represent widely adopted standards in the library domain, while EAD and METS are commonly utilised in archival contexts. Museums predominantly employ the CIDOC and LIDO models for documentation and metadata management practices. The following part provides an overview of the characteristics of standards and models that can be used to describe design works.

The DC mentioned above is one of the most universal and commonly used metadata standards due to its flexibility, and the set of elements can be easily refined according to the needs of a discipline. However, it is criticised that metadata based on simple DC is often not sufficient for describing scientific work, art or design works. (Allinson 2008; Arvidsson 2009, Baca 2016; Řezník et al. 2022) While complex and advanced schemas exist for describing artistic and cultural objects, IRS can adhere to different documentation standards than archives and museum collections. Due to limited resources and the strictness of archiving standards, recommended to prioritise metadata that ensures end-user understanding, enabling users to have a clear understanding of the content what it is that they are looking at. (Nadim and Randall, 12). The core set for all items should include title, creators, contributors, abstract/description/synopsis, date, location, and keywords. Including additional metadata, like format, technique, duration, dimensions, media, genre, and copyright is recommended.

However, the Academy of Performing Arts in Prague (AMU) has taken advantage of the possibility provided by DC to link multiple records. In their repository, AMU apply the DC model to describe the theses created at the university. AMU specialises in music, dance, drama, film, television, and multimedia, and these can take various formats: texts, audio recordings, videos, photos, and scores. The collaborative nature commonly involves multiple roles, such as a film shared by a director, screenwriter, producer, or sound artist. Thus, several types and genres of documents are linked to a single performance and need to show these connections in the IR, indicating the relationship of subordination and superordination between parts of the work. The "superior" metadata record represents the textual work, while the "subordinated" metadata records represent the non-text works. Metadata records of textual works are designated as the main "superior" records, while the non-text records are considered "subordinated" records. Each superior record includes a link to the subordinated records, and vice versa. This approach involves describing each part of the work with a separate metadata record and then connecting them using the relations element. Although uncommon, this method is highly effective in supporting the discovery of the objects, as it allows for easy and clear recognition of all necessary and relevant details in the descriptions. Importantly, it ensures the accurate recognition of relationships between works and records.

The Moholy-Nagy University of Art and Design (MOME) Repository (MOME-R) relies on HUNMARC, but we developed the metadata model with a slightly different approach. In addition to processing and preservation, the IR also helps to manage the graduation process, as it was the first in the country to introduce the uploading of diploma works to the IR for students in 2013. Also, the IR enabled other participants in the process to access and evaluate diplomas and theses. (Kun 2016, 60) Students across all academic levels at MOME must create various final qualifying works. A written thesis is always required, complemented by documentation of a&d works with specific topics, consultants, and examiners. The preservation, exploration, and accessibility of these works are necessary, just as is the case with traditional written works. As a first step in the workflow, we created forms for every graduating student, one for each type of document (thesis, presentation, portfolio for BA, master project in addition to the previous for MA, thesis, and masterwork for DLA/PhD). Students log in with their student ID, give a detailed description of the work, and upload works within the deadline. After that, only specific groups can access the uploaded documents to verify and evaluate the work. The IR is also the platform where the opponents can upload their reviews, and the diploma committee can examine the graduates' work. As there are many participants in the workflow, both MOME and external, the access system had to be

adapted accordingly: we developed user groups and strict access levels. Based on preliminary surveys, the data model was tailored to the needs of each department, and the library's joint catalogue provided a single interface for searching and filtering theses alongside the library's printed and electronic books and other special collections. Thus, the repository has been equipped with functionalities that are not typical, but this proves that IRs can support the work in the institution from another perspective.

A more specific data standard than the DC is the Library of Congress and Visual Resources Association VRA Core Categories (VRA Core) standard, which is similar to the principles and structure of the DC model but is designed specifically for describing visual objects. It is a widely recognised and applied standard used by the Getty Research Institute, Stanford University, and Central European University, among others. VRA CORE considers the visual works created by human culture and their associated image objects as its subject matter and thus considers multiple representations of a given work. This data standard includes three primary entities: collection, work, and image, in addition to which it can record the agents, cultural context, date, description, inscription, location, material, dimensions, relationships, rights of use, source, condition, edition, style, subject, technique, title and type of work. The primary focus is on the record of the work, which can be associated with one or more images via the relation element. (Mandal 2018, 3) Likewise, a single image may be associated with one or more works, in which case the collection record can be used to aggregate multiple work or image records. The schema can be used to record the data of an original image (painting or photograph) according to the parameters of a given format, along with the printed reproduction or a digital version. Understanding the complexity of the data model and the relationship between the many pre-defined fields and relations can take time and effort for the collection manager.

The Getty Institute has developed two data standards for describing art and other man-made objects. One of the standards is the Categories for the Description of Works of Arts (CDWA), which provides a detailed and comprehensive data model for describing works of art. The standard includes extensive data fields and categories, allowing for a precise and rich description. The other one is the Categories for the Description of Works of Art Lite (CDWA Lite), which is a simplified profile of CDWA for smaller collections and institutions—mainly used by museums and galleries, including The Metropolitan Museum of Art, Museum of Modern Art, and Tate.The model primarily employed for cataloguing museum artifacts is the CIDOC Conceptual Reference Model (CRM), which covers a much broader range of domains than the data standards discussed above; its flexibility and extensibility make it suitable for other cultural works. This data model exhibits a higher

complexity level than the previous ones, owing to its ontological structure comprehensively depicting rich and precise information, including objects, events, places, and people. It facilitates modelling relations and events between objects, achieving a detailed description and representation of relationships and events between objects. It enriches data with ontologies, concepts, and relations, which enables more complex description and interpretation. "The primary role of the CIDOC CRM is to serve as a basis for mediation of cultural heritage information and thereby provide the semantic 'glue' needed to transform today's disparate, localised information sources into a coherent and valuable global resource." (Short Intro: CIDOC CRM)

Ensuring the accurate and comprehensive association of controlled vocabularies with digital objects is essential for optimizing the description. Applying vocabularies enhances the accessibility and exploration of digital collections, improving the user experience and enabling more meaningful discovery of relevant content. By providing standardised terms and unique identifiers, these tools ensure unambiguous identification of entities and concepts. This clarity enhances precision and consistency in data representation, facilitating effective information retrieval and sharing within the scientific community. The clarity of this data is ensured by standardised lists and authority files that offer a controlled choice to describe some aspect of a given work. The credibility of these lists is underpinned by the fact that the development and maintenance of these lists is carried out with the contribution of libraries, archives, and museums in the relevant discipline. Standardised lists organise the specific representations of a language category into a simple list according to some kind of structure. This allows names (personal, geographical, or proper nouns) to be clearly identified. Whereas these lists are built on semantic relationships, they also allow the exploration of the relationship between persons, places, works of art, and other related concepts. Beyond its information richness, its usefulness as a research tool lies in its ability to place objects in context, thereby highlighting relationships other searches would not discover.

One type of authority file is the namespace. Artist names can be disambiguated using the Union List of Artist Names (ULAN) provided by the Getty Institute. ULAN is a structured vocabulary containing artist names and other information about people and corporate bodies related to art, architecture, and other cultural visual works, which includes given names, pseudonyms, variant spellings, names in multiple languages and the default preferred name for the record. It includes names, relationships, and biographical information required for documentation, collection, and discovery. Furthermore, it captures various associations between mentors, colleagues, or personal affiliations. ULAN can provide a richer context for design history researchers and

although it is currently focused on visual arts creators, it could also better represent designers.

Thesauri have a more complex nature than the previously mentioned controlled vocabularies as they encompass not only a compilation of accepted concepts and terms but also significant conceptual relationships, antonyms, synonyms, and hierarchical relationships. The Art and Architecture Thesaurus (AAT, Getty Institute) enables more accurate and standardised descriptions of artistic and architectural works, improving their discoverability and facilitating cross-referencing between related objects. One of its limitations is inadequate coverage in other fields, such as design, digital art, or new technologies. New and alternative art forms, media, and concepts are only sometimes found in AAT, and their expansion and maintenance require expertise and time.

The interconnection of repositories and data sources is facilitated by OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting), which allows content harvesting services to collect, query, and disseminate metadata information about digital content on the internet in a structured way. With OAI-PMH, repositories can easily and efficiently share metadata associated with their content with aggregator services and other repositories, facilitating search and interoperability across different data sources. It means an institution can share its metadata via an OAI-PMH server to enable it to be harvested by other organisations or search engines - regardless of the platform and software used by the institution. The digital content of the archive is not duplicated during the data provisioning process; it remains in the repository and continues to be held by the IR.

The Europeana portal embodies this approach, providing a platform for the unified presentation of Europe's cultural heritage via OAI-PMH. They have developed the Europeana Data Model (EDM) to enhance data connections in Europe's cultural heritage, allowing partners to link information about persons, places, subjects, etc. This interconnectivity enables the sharing and enrichment of content across various initiatives and institutions, surpassing domain-specific metadata standards. EDM accommodates diverse standards like LIDO, EAD, DC, MARC and METS.

3. THE MODERN WUNDERKAMMER

IRs offer various benefits to support curatorial activities, including preserving, discovering, controlling, managing, reusing, and repurposing institutional intellectual content. The academic acceptance of the design discipline partially depends on the visibility and accessibility of design works, innovations, or collaborations, while the values created in the field of design are often trapped within its (online or offline) walls of institutions or remain in the ephemeral world of designers'

websites. The provision of sharing content across institutions broadens the horizons of design theory research, as previously hidden contexts and new research are revealed for designers and researchers while breathing new life into the works.

Representing the history and biographies of design works is essential for recognizing social history, cultural change, values, sustainability, and creativity. Knowing the history of objects helps us better understand our world and the meaning of the objects around us. "In connecting disparate and relatively small yet invaluable archives and collections, they represent design histories that are inevitably more representative." (Moriarty 2016, 62) The IRs support the design process by preserving the achievements of the past, knowledge of which is essential to designing better products, services, and practices. IRs act as a living history, keeping the design works in a state of continuous motion, and due to their properties and characteristics, they create a network between creators, institutions, events, and collaborations.

4. LITERATURE REVIEW

This section presents the unconventional solutions and issues related to design institutions and design works in IRs. Jacqueline Cooke (2007) was the first to summarise the problematic adapting of the terms of the academic world into the language of art and design, and the difficulties of applying tools typical of scientific databases in art. Cooke mentions the key aspects that distinguish visual arts from traditional disciplines: the wide range of genres, formats, and work types. Her work highlights the difficulties of describing exhibitions and performance artworks and copyright problems. It addresses all the concepts that shape the flow of academic knowledge—publication, citation and quotation, peer-review, and evaluation—and examines whether these can be understood in the context of art and artistic research. Cooke's insights have been the starting point for a lot of research, but many of the questions remain unanswered.

The next section focuses on universities, associations, and research institutions with a similar profile to the fields of visual arts, performing arts, and music. By examining the related literature in the co-fields, several problem areas emerged, from which the paper addresses the following: the difficulties of describing and categorizing design works, terminological conflict and contextual change, and the possible role of IRs in evaluation, which is a much debated and controversial topic in the a&d world.

4.1 The objects and escape from the category of 'Other'

IRs can include not only peer-reviewed academic publications but also other work types related to the institution in question, which can be

considered important sources of research on design culture, such as invitations, laudations, pamphlets, exhibition catalogues, book reviews, translations, grey literature and magazine articles, blogs, and other online publications. The Defiant Objects project, supported by SHERPA-LEAP and conducted at Goldsmiths, University of London, examined the challenges associated with depositing certain objects in IRs. The project aimed to simplify the deposit process for these defiant objects by providing a decision-making guide. Additionally, it led to the re-categorisation of research types in their IR. There are issues with the limited definition of research output in non-text-based research. In the academic context, the deposit of documents is mainly limited to a narrow range of document types. This approach ignores the relevant content that may not be considered scientific. (Nadim and Randall 2013, 8) IR managers recommended focusing on material that is outside the formal publishing realm because "there is so much happening at all of our institutions that would be valuable to share. The institutional repository is a fabulous vehicle for doing that."(Plutchak and Moore 2017, 31)

The National Irish Visual Arts Library's (NIVAL) IR and the physical collection provide information about Irish artists, designers, galleries, arts organisations and institutions, critics, and other related subjects. The unique feature of NIVAL is that it preserves a wide range of *Defiant Objects*. NIVAL collects documents that cover a wide range of ephemeral literature and may be helpful for further research: statements, price lists, images, floor plans, project proposals, catalogues, and material culture collections. In many cases, the artists themselves donate their material to NIVAL, often accompanied by information-rich documentation. "These works help to broaden and diversify the resources available to other researchers to access. They provide evidence of the regenerative potential of the library to both receive and give back to the arts community it serves." (Romano 2018, 15)

In the case of complex works, it is advised to give the depositor the freedom to choose the item type that best represents most of the work. Nadim and Randall provide the example of a sound installation: if it consists of devices and projections, the item type Sound and Music might be chosen. However, at the same time, the abstract should include descriptions of the other elements involved. They hypothesise that a specific element within the overall work can stand as a research output on its own. In that case, it can be deposited separately as a distinct item with the appropriate work type. In the abstract, the relationship between this separate element and the main work can be described. "For example, an algorithm that transforms weather data into music could be deposited as a separate digital object." (Nadim and Randall 2013, 15)

Evans and colleagues (University of Westminster) reached a similar conclusion when they discussed with the researchers what a practice research output would ideally look like. They learned that each research output could be a publication, research dataset, or non-text results. "These outputs then needed to be connected together into a collection (portfolio), and the underlying research methods needed to be documented by a narrative." (Evans, Watts, Mudd, and Reiner 2022, 5) In these instances, the researcher is typically left to decide what to deposit. However, the deposition of "process materials" is actively encouraged, as it enriches the understanding of research.

The concept of authorship also necessitates flexibility, primarily when works result from complex collaborations, which should also be represented in IRs. "Confusion remains where the depositor is not actually the (sole) 'creator' of the work deposited, such as with artist researchers depositing exhibition catalogues that feature their work but were not written/edited by them."(Nadim and Randall 2013, 7)

The output of the design discipline can often only be placed in the traditional academic category of "Other", and researchers of Defiant Objects' expected that the problematic works would be found there. On the one hand, using the term "supplementary" or "additional" media creates the misconception that the textual document represents the whole work, forgetting the importance of the accompanying material. Labelling these components as "supplementary" or "additional" reinforces their secondary nature, affecting the preservation of and access to these media. (Rodríguez 2019, 11.)

4.2 Terminology and context

Science aims to discover and share new knowledge with the wider community through diverse disciplinary approaches. The natural and social sciences, as well as the humanities have developed publication conventions, standards, and terminology. There can be marked differences between apparently related disciplines in these respects. One of the challenges involves seamlessly integrating the term *institutional repository* into the workflow of designers and researchers. Instead of strictly relying on library and scientific terminology, exploring alternative names for concepts is advisable. "Terms like 'curated exhibition' and 'documenting the process/journey' are more suitable than using 'repository-speak' language. It emphasises the need to consider the vocabulary and understanding of designers. The goal is to simplify and streamline the deposit process, minimizing data entry time and avoiding redundant work." (Gramstadt 2012, 2)

A different approach is taken in The Journal for Artistic Research (JAR) Research Catalogue, where the repository is envisioned as a tool that allows artists to create their own environment for their work by providing flexible and visual online space in the IR instead of the in-

flexible traditional journal article format. They suggest that instead of depositing peer-reviewed final outputs, artists should begin by depositing objects into the IR. "These objects can then be set in an individually designed context as they choose to 'expose' their work as research, designing 'expositions' which can then be peer-reviewed and published. This approach is designed to display artistic practice in a manner that 'respects artists' modes of presentation." (Gramstadt 2012, 3) By doing this, the Research Catalogue "represents a shift from object-centred repositories to a research-centred repository, which includes the peer-review process of the editorial board." Another perspective was presented by the visual artist Ruth MacLennan during the Kultivate Archiving and Curation workshop in 2011, where she presented an archive of her work using a workshop as a new context and as a new performance for her art. (Gramstadt 2012, 2)

Arguably the most cited barrier to depositing design works is their being of out-of-context in the IR. Cooke remarks that "context and presentation are often considered as part of the work by artists, and work is conceived for a particular context." (Cooke 2007, 4) Design works are placed in a different context when they become database records, where their content is reduced to the level of data, somewhat deprived of their original intentions, environment, and use. These works inevitably lose some of their original meaning and context when they are converted into digital documents.

Like the issue with completing the description, many aspects of design cannot be fully captured. We cannot experience what it is like to sit on a chair if we only rely on the 3D model; just as it is difficult to get a sense of the texture of a material experiment without touching it. "They are an essential part of what artefacts have to offer the historian and can be experienced with our senses - sight, touch, balance, hearing and smell. Such sensory engagements are also intellectual ones, and can provide vital information for our work." (Harvey 2009, 130)

Some digital content can be understood in a specific technological and use context. When displayed on other scientific platforms, they can be placed in contexts that would not otherwise be revealed under different circumstances. However, "what is understood through a publication may experientially be poorer but epistemically enriched in a way that a 'real' but discursively limited encounter may not be able to deliver." (Assis and Errico 2019, 35) Price translates the question of the IR context to the world of architectural models. For a long time we have been fascinated by architectural models: captivating micro representations of the real world. "The model presents a microcosm of structural elements and formal composition that permits one to imagine a building fully. The translation from two-dimensional plan, section, and elevation starts to take shape in the scale model, allowing one to fathom something that in full scale can rarely be taken in at

one glance. The model itself can take on sculptural qualities, adding to visual comprehension and delight." (Price 2020, 94)

4.3 Peer review and evaluation

The emergence of the art and design sector in the academic context inevitably implies the need for quality assessment and evaluation. Deposit of research results in IR ensures research ethics and funders' expectations are met. (Rieger 2007) "Institutional repositories can provide institutional stakeholders with valuable quantitative evidence for the reach and impact of research." (Meece, Robinson, and Gramstadt 2017, 23) According to Walhström, it is needed to demonstrate statistics, international interest, and good visibility in Google's search engine results. Another motivation for registering in an institutional repository is enhanced statistical visibility. (Wahlström 2021, 17)

In traditional academic fields, researchers' performance is most often assessed by the number and quality of their scientific publications and the number of citations they receive. Both journal ranking and bibliometric methods have evolved, as has the framework for the peer review process. Assessing quality is complicated, and the role and practices of peer review in the field of a&d are not established. As with artistic research, defining the framework is complicated. The researchers articulate their ideas through conventional academic publications and artistic mediums. It becomes imperative for academic infrastructures to accord these expressions the same level of respect and validity as they would to any other scientific discipline. There is debate whether art has a place in science at all; among the harshest critics are academics who consider artistic methods and procedures to be "obscure" and unscientific. Other critics are the artists themselves, who fear the academicisation of art and that only those artists who cannot succeed in the market will turn to academic research. (Lilja 2012, 6)

However, the Bologna reforms in higher education have inevitably affected art universities across Europe. They were also expected to adapt to their research funding systems as they entered academia. The allocation of resources for research is increasingly performance-based and often depends in part on the bibliometric indicators of faculty publications recorded in databases and repositories. For the outputs of a&d research and practice, the challenge remains how exactly to record outputs and set up a quality assessment model.

In Hungary, the Hungarian Science Bibliography (Magyar Tudományos Művek Tára, MTMT) has served as the comprehensive national bibliographic database of scientific publications and citations for academic publications since 2009. It is mandated by law to include publications that arise from public funding. The key operational principles of MTMT encompass the self-registration of publications by

authors and research-performing organisations. It enhances transparency by presenting statistical data on scientific output and facilitating access to articles hosted by publishers or institutional repositories.

MTMT was used to record data on traditional written works, but with the accession of art universities, the possibility of describing the results of the discipline became necessary. The Creation Working Group was established in 2009 with the participation of librarians from the major Hungarian art universities as part of the MTMT Bibliographic Committee. The group led by Klára Lévai (MOME) developed the Creation data type, which includes objects, images, space, music, literature, theatre, and performance art. This data type can be used to record publication data for works of artistic merit or significant technical works (e.g., exhibitions, concerts, and designs entered into competitions). Describing a specific image or object as a separate record is only necessary if the work is included in a permanent collection of recorded art.

The primary focus during development was to ensure that the broadest possible range of Hungarian art universities could use it. For this reason, the forms often allow for a free-text entry, giving users freedom to describe their work, and the Working Group decided not to provide predefined categories. The original concept was to develop it further by summarising the free-text entries and developing an extended a&d thesaurus based on the Getty AAT. Nevertheless, with this flexible approach, there is a potential risk of inadequate search precision, relevance, and system efficiency, and although it is not suitable for quality assessment right now, the development of the a&d thesaurus can solve these problems. The Creation datatype needs to be updated and refined, requiring closer joint professional work—despite the lack of art repository-dedicated expertise resources and funding. However, there have been several criticisms of MTMT's operation in the recent years, especially in terms of the user interface design: it is not user-friendly, difficult to use, and not visually appealing, which can be a deterrent to uploading in the field of a&d. (Duca, 2017)

The University of Gothenburg practice answered some of the abovementioned problems by identifying artistic works of peer review status for quality assessment. On the one hand, their evaluation system was extended to include publication types relevant to the creative arts, and, on the other hand, a committee determined which publications could be of peer review status. The University of Gothenburg formulated a bibliometric indicator to assess both scientific publications and artistic works. (Lundén and Sundén 2015, 27. "Bibliometric Analyses at Gothenburg University Library.") The model ranks faculty publications, including artistic works, based on established traditions within humanities, social sciences, and arts. The progressive nature of the indicator allows for fund redistribution based on the faculty's

bibliometric system development over a four-year period. The artistic works can qualify fpr two quality levels: refereed and non-refereed. The focus here is on the reviewers' criteria, and questions regarding interoperability and standards were not considered a priority in this context. They required metadata to give full and rich descriptions of the works and to capture their context. The key indicators are the question or problem underlying the work, its relation to other relevant works of art, the exhibition's context or place, documentation of the work and exhibition (including different pieces and environment), as well as documentation of reactions and responses such as reviews and debates.

This solution is still uncommon, especially for smaller disciplines and their institutions. As Walhström has noted regarding artistic research: in a new field, "it might take some years for a critical mass of experts to accumulate, and for reaching a paradigmatic consensus regarding what is quality." (Wahlström 2021, 14) However, quality is typically assessed by curators, art theorists, gallerists, producers, and critics, not by fellow artists. According to Lilja's proposal, higher education institutions would conclude cooperation agreements with artist-run or commercial forums for the public presentation of artistic research (art galleries, stages, concert halls, various media forums, forums, etc.) The agreements would regulate and guarantee the appointment of expert panels for the selection and presentation processes. Once the artwork has passed the peer review process, the presentation would be considered as a bibliometric representation. (Lilja 2012, 18) It is important for developing the field that institutions establish their quality assessment criteria, indicators, and procedures. (ibid.). This development has been the focus of a&d institutions for a few years now but is typically still rinconsistently applied (Wahlström 2021, 17)

5. FURTHER CHALLENGES

In addition to the issues presented and detailed in this paper, several questions still need to be answered, that are as essential to the successful operation of IR as those discussed earlier. However, these can only be briefly addressed here.

Nadim and Randall discuss the issue of versions that arise in the case of born-digital objects, such as software, a website, an application, or a computer game. When documenting digital objects, it is important to consider the potential for significant changes between versions. If a work is continuously updated and developed, it is something that is "likely to remain in perpetual beta state" (Nadim and Randall 2013, 15), which should be noted in the abstract. Regarding software versions or game platforms, including this information in the title is recommended. For complex digital objects like computer games created by a large

team, specifying roles in the abstract is advisable if it cannot be done in the creator field.

Copyright and intellectual property issues are closely intertwined with the highly collaborative nature of artistic and design research, involving multiple rights holders and diverse contributors (Sliger Krause 2018, 21; White, Wendy, and Clare Hemmings 2010). If the a&d sector considers IRs a platform to promote their research outcomes, this undoubtedly lead to discussions about intellectual property and access issues. (Garcia, 2019, 70; Lambaria, 2020, 15; Burgess 2021, 37)

IRs serve as showcases and personal archives for artists and designers, allowing others to explore research, collaborate, and access works. However, the visual display of files in repositories can be improved (Shelley, 2020, 5). Customizing repository software, like DSpace, enables a visually appealing interface that aligns with the institution's identity (Horová and Chvála 2010, 236). This flexibility enhances the user experience, promotes discoverability, and ensures accessibility compliance. Ultimately, these efforts aim to create a better showcase for artistic and multimedia research outputs.

6. CONCLUSION

For fields within the creative arts that do not rely heavily on journal articles as their primary means of communication and often lack formal digital publication of research outputs, the IR becomes crucial in achieving open access to research. However, the successful implementation of IR as a viable alternative relies on overcoming technological and conceptual challenges. Encouragingly, the last few years have seen a significant increase in the literature on the use of IRs in artistic research, while studies covering the field of design are still limited.

The projects discussed in this study face similar challenges, and they provided uniques solutions. In many cases, the projects remain isolated; cross-national cooperation and standard practices have not yet developed in the co-domains. Institutions that have not yet built a repository are in a more difficult position because, although practices are multiplying, there is no explicitly recommended "off-the-shelf" solution to fall back on.

The projects discussed here typically focus on revealing and highlighting connections between artists, works, or institutions, describing creations as richly as possible, and showing how the phenomenon that the developments focus on addresses the needs of creators and end users rather than meeting a standard. However, unconventional disciplines need unconventional solutions to present the values and results created in design.

REFERENCES

Allinson, Julie. 2008. "Describing Scholarly Works with Dublin Core: A Functional Approach." *Library Trends* 57, no. 2.: 221–43. https://doi.org/10.1353/lib.0.0034

Arvidsson, Sofia. 2009. "Modell för att hantera komplexa digitala objekt i öppna arkiv – med utgångspunkt i konst och design. Slutrapport." http://hb.diva-portal.org/smash/get/diva2:883795/FULLTEXT01.pdf

Assis, Paulo de, and Lucia D'Errico. 2019. "Artistic Research: Charting a Field in Expansion". https://www.academia.edu/41272368/Artistic_Research_Charting_a_Field_in_Expansion

Baca, Murtha. 2016. "Introduction to Metadata." Los Angeles: Getty Research Institute. http://www.getty.edu/publications/intrometadata

"Bibliometric Analyses at Gothenburg University Library." https://www.ub.gu.se/en/services-and-support/bibliometric-analyses

Burgess, Robin. 2021. "Getting to Grips with NTROs (Visual Arts Data): The Role of Repositories and Libraries in Their Management." *Against the Grain* 31, no. 5. https://doi.org/10.7771/2380-176X.8428

Callicott, Burton B., David Scherer, and Andrew Wesolek. 2015. *Making Institutional Repositories Work*. West Lafayette: Purdue University Press. https://doi.org/10.26530/oapen_626981

Clobridge, Abby. 2010. *Building a Digital Repository Program with Limited Resources*. Oxford, UK: Chandos Publishing.

Cooke, Jacqueline. 2007. "A Visual Arts Perspective on Open Access Institutional Repositories." https://research.gold.ac.uk/id/eprint/140/3/LIB-Cooke2007b_GRO.pdf

Duca, Daniela. 2017. "Does My Data Look Good in This?" *Research Infrastructure and Data*. https://researchdata.jiscinvolve.org/wp/2017/02/06/data-look-good/

Dupont, Christian. 2007. "Libraries, Archives, and Museums in the Twenty-First Century: Intersecting Missions, Converging Futures?" *RBM: A Journal of Rare Books, Manuscripts, and Cultural Heritage* 8, no. 1: 25. https://doi.org/10.5860/rbm.8.1.271

Evans, Jenny. 2020. "Taking a Holistic Approach to Practice-Based Arts Research." https://westminsterresearch.westminster.ac.uk/item/v050x/taking-a-holistic-approach-to-practice-based-arts-research-our-experiences-successes-and-challenges-at-the-university-of-westminster

Evans, Jenny, Nina Watts, Taylor Mudd, and Tom Renner. 2022. "From Legacy to next Generation: A Story of Collaboration to Push the Boundaries of the Open Source Haplo Repository from Cayuse" 35: 14. https://doi.org/10.1629/uksg.582

Garcia, Larissa. 2019. "Art, Rights, and Repositories: Contextualizing Information Literacy with the Institutional Repository." *Art Documentation: Journal of the Art Libraries Society of North America* 38, no. 1: 70–77. https://doi.org/10.1086/702892

Gramstadt, Marie-Therese. 2012. "Kultivating Kultur: Increasing Arts Research Deposit." *Ariadne*, no. 68. http://www.ariadne.ac.uk/issue/68/gramstadt/

Harvey, Karen (ed.) 2009. *History and Material Culture*. London: Routledge.

Horová, Iva, and Radim Chvála. 2010. "Non-Text Theses as an Integrated Part of the University Repository: A Case Study of the Academy of Performing Arts in Prague." *LIBER Quarterly: The Journal of the Association of European Research Libraries* 20, no. 2: 226–41. https://doi.org/10.18352/lq.7990.

Kun, Dorottya. "Újszerű Megoldások a MOME Repozitóriumában." 2016. In: *Könyvtárak a tudomány és a felsőoktatás szolgálatában: Tanulmányok* Kiss, Gábor (ed.) 60–65. Kaposvár: Kaposvári Egyetem.

Lambaria, Kate. "Considering Creative Activity in Institutional Repositories: An Exploration of Faculty Perceptions." 2020. *Journal of Librarianship and Scholarly Communication* 8, no. 1. https://doi.org/10.7710/2162-3309.2312

Lilja, Efva. 2012. "Konstnären som forskare. Om kvalitetssäkring av konstnärlig forskning och forskarutbildning." https://suhf.se/app/uploads/2019/07/Expertgruppen-f%C3%B6r-kvalitetsfr%C3%A5gor-2012-2013-bilaga-7-Konstn%C3%A4ren-som-forskare.-Om-kvalitetss%C3%A4kring-av-konstn%C3%A4rlig-forskning-och-forskarutbild.pdf

Lundén, Tomas, and Karin Sundén. 2015. "Art as Academic Output: Quality Assessment and Open Access Publishing of Artistic Works at the University of Gothenburg." *Art Libraries Journal* 40 (4): 26–32. https://doi.org/10.1017/S0307472200020496

Lynch, Clifford A. 2003. "Institutional Repositories: Essential Infrastructure for Scholarship in the Digital Age." *ARL Bimonthly Report* 226. https://www.cni.org/wp-content/uploads/2003/02/arl-br-226-Lynch-IRs-2003.pdf

Mandal, Sukumar. 2018. "Development of an Integrated VRA Core Framework for Libraries." *Library Philosophy and Practice*. https://digitalcommons.unl.edu/libphilprac/1890

Meece, Stephanie, Amy Robinson, and Marie-Therese Gramstadt. 2017. "Engaging Researchers with the World's First Scholarly Arts Repositories: Ten Years After the UK's Kultur Project." *New Review of Academic Librarianship* 23 (2–3): 209–32. https://doi.org/10.1080/13614533.2017.1320767

Moriarty, Catherine. 2016. "Monographs, Archives, and Networks: Representing Designer Relationships." *Design Issues* 32 (4): 52–63. https://doi.org/10.1162/DESI_a_00416

Nadim, Tahani, and Rebecca Randall. 2013. "Defiant Objects Project Report." Report. London: Goldsmiths, University of London. https://research.gold.ac.uk/id/eprint/8731/

Plutchak, T. Scott, and Kate B. Moore. 2017. "Dialectic: The Aims of Institutional Repositories." *The Serials Librarian* 72 (1–4): 27–35. https://doi.org/10.1080/0361526X.2017.1320868

Price, Rebecca. 2020. "A Square Peg in a Round Hole? The MARCH Thesis and the Institutional Repository." *Art Documentation: Journal of the Art Libraries Society of North America* 39 (1): 93–100. https://doi.org/10.1086/709661

"Research Catalogue - an International Database for Artistic Research." https://www.researchcatalogue.net/profile/show-work?work=790463

Řezník, Tomáš, Lieven Raes, Andrew Stott, Bart De Lathouwer, Andrea Perego, Karel Charvát, and Štěpán Kafka. 2022. "Improving the Documentation and Findability of Data Services and Repositories: A Review of (Meta)Data Management Approaches." *Computers & Geosciences* 169. https://doi.org/10.1016/j.cageo.2022.105194

Rieger, Oya Y. 2007. "Select for Success: Key Principles in Assessing Repository Models." *D-Lib Magazine* 13, no. 7/8. https://doi.org/10.1045/july2007-rieger

Rodríguez, Cristina Fontánez. 2019. "Archiving Art and Design Theses: Report on Institutional Repositories." https://assets.mica.edu/files/resources/ndsr_art_mica_fontanez_rodriguez_2019.pdf

Romano, Donna. 2018. "In the Service of Artists – Symbiosis and Creative Engagement in Collection Development Strategy at NIVAL: National Irish Visual Arts Library." *Art Libraries Journal* 43 (3): 127–36. https://doi.org/10.1017/alj.2018.17

Shelley, Anne. 2020. "It Takes a Village: Populating the Institutional Repository with Performing Arts Content." *Music Reference Services Quarterly* 23 (3–4): 130–41. https://doi.org/10.1080/10588167.2020.1786308

"Short Intro: CIDOC CRM." https://cidoc-crm.org/node/202

Sliger Krause, Rose, Andrea Langhurst Eickholt, and Justin L. Otto. 2018. "Creative Collaboration: Student Creative Works in the Institutional Repository." *Digital Library Perspectives* 34 (1): 20–31. https://doi.org/10.1108/DLP-03-2017-0010

Wahlström, Annika. 2021. "When Outputs of Artistic Research Meet Academic Infrastructures." https://urn.kb.se/resolve?urn=urn:nbn:se:hb:diva-26460

White, Wendy, and Clare Hemmings. 2010. "KULTUR: Showcasing Art through Institutional Repositories." *Art Libraries Journal* 35 (3): 30–34. https://doi.org/10.1017/S0307472200016515

Zorich, Diane, Günter Waibel, and Ricky Erway. 2008. "Beyond the Silos of the LAMs: Collaboration Among Libraries, Archives and Museums." OCLC Research. https://doi.org/10.25333/X187-3W53

SMART FACTORIES:
NEW PRODUCTION SPACES IN DIGITAL TRANSITION

Merve Pekdemir Başeğmez and Burak Asiliskender

ABSTRACT

Digital developments have affected humanity in industry and many areas in recent years. The new revolution, defined as Industry 4.0, is planned to ensure remote and digital machine–human collaboration for a new working life. Thanks to internet technologies, communication can be achieved in a digital network with the machines and robots used in production and the employees who manage and supervise them. In this new order, the possibility of people participating in the system remotely, leaving physical production to robots, and using smart production systems leads to factories turning into smart factories. While smart factories require a digital environment between humans and machines, they also bring humans and machines together for different functions.

As a result of the digital revolution, the transformation of factories into smart factories and innovations in the production space initiates a new discussion in industrial architecture. This study focuses on the spatial effects of the smart production model of the new factory revolution. The research aims to understand how digital production processes in smart factories change factory designs. For this reason, smart factory definitions were first researched in the literature, and future factory propositions were examined. Then, in this context, smart production spaces designed and built to produce new technologies since the day the new revolution was introduced were analysed. This study aims to present a projection for new production spaces with the morphological analyses performed. As a result, this study will form the basis for future studies as an architectural criticism of the transition process.

#industrial architecture, #digital production, #production spaces, #smart factory, #machine and design

https://doi.org/10.21096/disegno_2023_1mpbba

INTRODUCTION: FACTORIES IN DIGITAL TRANSITION

Factories are the reflection of industry, technology, economy, and the resulting business life of architecture. The changing production methods since the Industrial Revolution have also transformed production spaces. The most remarkable invention of the revolution, the steam engine, has now evolved into robots that can work unmanned in production. Displaying and exhibiting production has become the primary design approach of the factories of the new era. A new revolution has been experienced in production recently with Industry 4.0. This revolution aims to individualise product, service, and distribution processes, make production methods more flexible, and increase smart products and production. Innovations provided by information and communication technologies enable transformations and digitalisation in production processes. It is widely known that the digitalisation of production also leads to the digitalisation of labour and spaces.

The new digital world provides many opportunities for humanity. Thanks to internet technologies, many things in daily life can be done remotely. We can shop, watch a live performance anywhere, attend studies, training, and conferences, and continue working remotely. Especially in industry, a revolution is taking place with the new collaboration between machines and humans. A new distribution of tasks is being organised between humans in the digital production part of work and machines in the physical production processes.

Digital production, smart production, and even unmanned production technologies are also defined as the second machine age in industrial history. Monitoring the production system over a virtual network and discussing a flexible production process requires much new research in this field. Although the effects of the smart factory on production technology and the economy are more prominent, it is also thought that digital transformation will cause significant changes in the environment and society. The increase in the need for qualified labour, the possibility of managing production from a virtual environment, a decrease or change in working hours, and even industrial migration will undoubtedly cause transformations in and around production areas. Therefore, discussing current and future innovations and goals of production is the first step in understanding the architecture of this transformation.

This study mainly focuses on the revolution in factories; new and innovative production spaces. The impact of the digital transformation that started in the industry on production spaces, the spatial needs of new factories, unmanned production areas defined as smart factories or dark factories, and spaces designed for machines constitute the primary research topics of the study. In this context, the study question the use of architectural terminology in smart factories and new production areas. . The first part of the study examines the definitions and innovations of Industry 4.0 and smart factories in the literature. The concepts and adjectives invented by the new and smart production model are presented. In the second part, the proposed and imagined possibilities for the future factory during the digital transition phase are examined, and new factory definitions in the literature are investigated. The third chapter discusses the relationship between Industry 4.0 and architecture and the first and innovative factory examples to understand the production spaces of the new revolution. Smart production areas designed and built in the last decade are analysed morphologically, and the transformation on a spatial scale is also examined. The factories examined as examples of the study are handled independently of a location or sector, and how the factory, as a production space, responds spatially to new technologies and developments is investigated. The spatial diversity in new factories is presented by examining the functional differences in these examples. While the study focuses on transformations in production, it also investigates how factories aim to create new interactions with people. Ultimately, this study aims to provide a ground investigation and projection for future factories.

COMPREHENDING INDUSTRY 4.0 AND THE SMART FACTORY

Industry has experienced four significant revolutions. The first revolution started with the invention of the steam engine, which increased the use of machinery in production. In the second revolution, electrical energy started to be used in factories, and the mass production model was the most significant innovation of this period. The third revolution was the introduction of computer technologies. Communication and internet technologies provided faster and smoother production and prepared the background for smart systems. The fourth industrial revolution, which uses smart technologies in production, also came up with Industry 4.0. This concept was first introduced by the German National Academy of Sciences and Engineering (Acatech) at the Hannover Fair in 2011 (Lu 2017). While Germany defines this revolution as Industry 4.0, the United States works with the terms Industrial Internet of Things (IIoT), Advanced Manufacturing (AM), Re-industrialisation (RI), and Internet of Things (IoT). Japan's Industrial Intelligence concept draws attention to machine-to-machine communication and autonomously controlled machines (Ernst and Frische 2015).

Gorecky et al. (2016) have defined Industry 4.0 as a synonym for the production of tomorrow and summarised it as the digitisation of business processes, increased internal and external communication, and the modularisation of smart machines, products, and equipment. In the future, the production criteria are envisaged as mechatronic changeability, individualised mass production, and internal-external communication. The modular separation of the production lines in traditional factories will enable the system and space to be reduced and transported. However, in this whole process, production is only possible with an excellent virtual network.

The production space for the smart systems of Industry 4.0 is also defined as the smart factory. The smart factory technically ensures that all machines, robots, sensors, and production lines work interconnectedly and automatically. In addition, smart editing detects and prevents machine problems that exchange information for the entire system and manage the entire process (Gabriel and Pessl 2016). In factories that produce remote solutions to all the complexity in production, direct communication is provided between people and machines.

Yoona, Shin and Suh (2012) define the smart factory as the "Ubiquitous Factory (U-Factory)." Ridgway, Clegg and Williams (2013) use the title "Factory of Future" in their study about the new production areas and Industry 4.0. It is stated that future factories will enable better use of technologies; on the other hand, access, monitoring, and control of these technologies. In this context, the "Easily Reconfigurable Factory" is defined as a proposal for the future factories. The concepts for this factory are an open value chain, flexible production, human-centred manufacturing and crowdsourcing, anything-as-a-service, and symbiotic ecosystem business models. Wang et al. (2016) draw attention to the beneficial outcomes of smart factories, such as flexibility, productivity, resource and energy efficiency, transparency, promoting integration, profitability, and friendliness to staff.

Smart production is also defined as lights-out or dark production, a process led by machines without the need for any human being in the production process. For this reason, new production spaces are also called dark factories. The dark factory was built in Japan not only as a factory but as a production facility. The industrial park owned by FANUC consists of twenty-two factories and is used by robots. Robots can produce another robot without human intervention and do it nonstop (Hunt 2017). Similarly, Siemens Amberg Factory has created an efficient and error-free production ecosystem (Digital Transformation n.d.). Thanks to the digital twin created, the factory can be viewed online, and the systems can be viewed remotely.

Industry 4.0 affects the economy and societies globally, bringing innovations in many fields thanks to robotics, artificial intelligence, nanotechnology, and 3D applications. When robots are integrated this

much into life, the first question or problem that comes to mind is the unemployment that may occur due to their existence. However, this situation provides different and new job opportunities for people. In digital production, people are now completely on the labour-intensive side of production.

Digitalisation has been transforming business life and working environments, such as factories, for a while. Virtual participation interviews with applications such as augmented reality and holograms are now common and frequently used. Participants who are not in the same place as each other can conduct interviews, presentations, and discussions. Therefore, the space is expected to respond to virtual needs. Although remote work can often be done with a computer and phone, there is also a need for more flexible spaces that are planned with technological equipment and are prepared for instant and variable working conditions. The presence of wireless systems and cloud data, digital glasses that work with eye movements, digital walls, and virtual keyboards help transition to flexibility. Future workspaces will likely transform into spaces open to common uses, can be personalised for a short time, and offer alternatives.

These definitions and propositions lead us to the following questions: What will the production spaces of the future be like? Who will work in the factory, or where will humans work? In the smart production system, when the physical tasks are left to the machines, the employment of workers in the factory will decrease. For this reason, factories are thought to be working areas only for machines over time. Every place can be a working place for a worker who joins the system from a virtual network. In this context, Strozzi et al. (2017) point out that although new technologies and models of the Industrial Revolution have been defined, the available information for smart factories is insufficient. Kumar, Narkhede and Jain (2018) draw attention to human comfort, environmental problems, and industrial sustainability for changes in employee and workplace relations. Industry 4.0 and smart factories are fields of research that will require different disciplines to work together despite their short history. In addition to its technological, economic, and social transformations, the spatial transformation process is also exciting. For this reason, in addition to the research on the new revolution of the industry and smart factories, the new factory architecture is also fascinating and constitutes the focus of this study.

SEEKING NEW PRODUCTION SPACE IN THE DIGITAL AGE

It is fact that Fordism and Taylorism have shaped the production industry for decades. When computer technologies developed, changes began in the cooperation of machines and humans in the factory.

Workers tasked with using machines in mass production started to use machines that control the operation of machines, direct them, and detect problems in digital production. Workstations were installed on the production lines, and after the linear production lines in mass production, a piecewise and real-time production model was adopted. Nina Rappaport (2009) also draws attention to the changes in duties and definitions upon the change in the system, as workers are being called "partners" and "team players" rather than "workers." It can be said that mass-production factories have entered a transformation process both technically, spatially, and socially in the age of the smart industry.

Rappaport (2017) claims that factories are keys to unlocking the spatial logic of society. In the 200-year history of industrialisation and urbanisation, technology, capital, labour, and ultimately the factory have been constantly transformed. Rappaport associates modern factories with production and contemporary examples with consumption. For this reason, Rappaport describes the new revolution of the industry as consumption of production.

Rappaport (2019) looks for alternative areas in the city for future production areas with the idea of a Vertical Urban Factory. This proposition considers that production can be moved to multi-story buildings. In other words, vertical production will bridge between work and life with production settlement in high-density residential areas. Rappaport describes it as a "super-urban symbiosis" (Rappaport 2019). In addition, Rappaport (2022) also presents the Hybrid Factory/Hybrid City proposal, which is the future of flexible and innovative cities with a hybrid model of sustainable production, advanced production systems, and new technologies. In this study, participating researchers question mixed uses, including production, re-used factory buildings, and their potential in the near future.

While Industry 4.0 defines a flexible production system, some things that have changed with digitalisation are business organisations, the organisation of cities, and relations of people with the place where they work. Vicente Guallart (2021) emphasises that, due to the change in the traditional industry, spaces that make urban life easier with logistics and distribution dominated by robots have emerged. Gullart (2021) defines this as post-human architecture. In the first step, the digital world increased the number of freelancers, and shared working spaces began to emerge. As a result, there is a partnership in the production spaces. In Industry 4.0 technology, the same machine can produce a bicycle and a chair and be sold in the same environment.

For this reason, it is the digital age model that products are close to where they are consumed. Guallart (2021) has described this as from Co-working to Co-factory. He defines the digital post-industrial

city as a productive, ecologically self-sufficient bio city. He sees the city as a part of nature rather than growing against nature. Guallart's proposal, Local Digital Production, is also a model based on on-site and on-demand production. Guallart criticises the concentration of the traditional industrial model in large factories and the concentration of factories in a few regions and describes these areas as places where labour is cheap worldwide. It has led to a commitment to a place in the world and a company for almost everything. Local Digital Production aims to restore production to cities with medium-sized factories or workshops. With the innovations brought by this digital production model, it is thought that the factory will cause less noise and environmental pollution and be more easily integrated in cities.

Another innovation of smart production is the possibility of customising products. In the changing world, producing and purchasing products with personal preferences, not with the impositions of mass production, is attractive to consumers. Simulating the process makes it possible to produce different products on the same production line. The production of the planning before the physical production enables the detection of errors and deficiencies, and as a result, a non-problem production is ensured. Thus, the factory provides unique production services to more customers. In addition, this situation allows smart factories to meet people with production, unlike dark factories. Experience factories are also a new proposed scenario for future factories (Hüttenhain ve Kübler 2021). Until recently, only employees and managers could access factories. The factory has become a place that everyone can visit, and this has breathed new life into urban production. Besides the smart factories, experience factories result from Industry 4.0.

Revolutions also significantly affect the development of cities. Using digitalisation, artificial intelligence, and autonomous robots in production processes will bring a new order from production to consumption, and even urbanisation. Tali Hatuka (2021) discusses a model in which city industry dynamics are more integrated into her proposal, called "New Industrial Urbanism." Industrial urbanism is a socio-spatial concept that integrates production with the city. This proposal mainly targets the local economy and small and medium-sized producers and entrepreneurs. This proposal is linked to the concepts of Industry 4.0, industrial ecosystem, and industrial ecology.

Industry 4.0 and the innovations it provides directly affect production areas. Digital production methods and now unmanned production provide an error-free, fast, and economical process in industry. For this reason, factories, the workplace of machines, robots and humans, are now turning into production spaces where physical labour is absent and where robots actively participate. While the methods of unmanned production or robotic production are being discussed in factories dur-

ing this transition period, the factory is also looking for different ways to connect people. In this context, while searching for the new state of the factory in this study, a conceptual analysis was first made, and alternative names for the new production spaces were investigated. In addition to the smart or dark adjectives of the factory, it also gives an idea about its experience, urban and hybrid names, and the new relationships it will establish with the city and humans.

CONCEIVING A NEW PRODUCTION SPACE

While the research and development process for Industry 4.0 technology continues, this process undoubtedly affects production spaces. Although factories serve the transformation process of raw materials into products, they are planned according to different spatial needs according to product type, production method, and production process. Since the Industrial Revolution, factories have generally been buildings where large machines were housed, people worked in cooperation with the machine, and a group managed, planned, and controlled all processes. However, the smart production model carries the human and machine collaboration in the factory to a digital network. This innovation presents people with the opportunity to do their production work remotely.

The transition of the industry introduces a new division of labour between humans and robots. In this division of work, the production hall is left to the machines, while other work can be moved outside the factory. In this study, the production spaces planned and built after Industry 4.0 are analysed to understand the factory in the new order brought by the revolution. Morphological analyses were carried out in the factories subject to the study, and the spatial transformations of new-type factories in smart production processes were examined. Research has been done on how and for what purpose human beings meet again with production—the primary function of the factory. For this reason, the most important research criterion was that the selected samples included new production technologies and how they communicate with humans and naturally with the environment, regardless of the sector. In other words, the study questions the new spatial projection of production.

Wittenstein Innovation Factory, one of the first smart production spaces, draws attention due to its innovative space approach during the transition to Industry 4.0. Unlike the old ones, this factory combines development and production activities, but it has been designed flexibly with modular expansion options. Co-working space, offices, a production hall, and shipping are designed to be parallel in this factory, but the innovation division has grown significantly. Customers can access the production and project sections from the open gallery

("The Innovation Factory" n.d.). A flexible working environment has been designed next to a flexible production space, not only where production takes place but also as a co-working place.

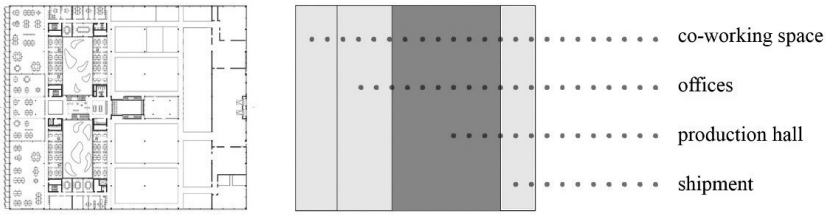


FIGURE 1. *Wittenstein Innovation Factory, 2014, Germany.*

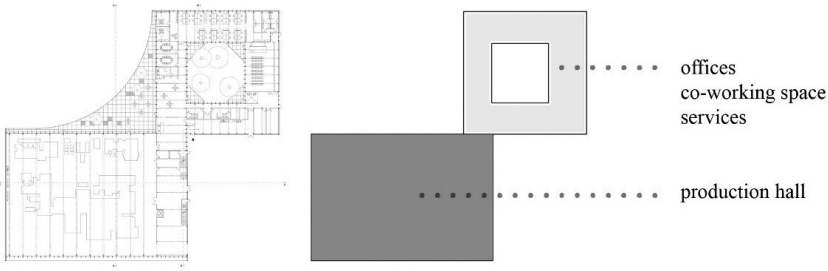
In a similar example, where the factory and innovation are combined, Arena 2036 is conceived as a research centre for the next generation of cars. A flexible and dynamic studio is envisaged to develop and produce innovative production technologies for this centre. Arena 36 aims to bring together different professional perspectives, working cultures, and approaches and bring innovations produced in collaboration with other disciplines to the industry. Another aim of the formation, whose focal point is the automobile industry, is to contribute to shaping the future production style in the digitalisation process (Arena 2036 n.d.). The building has a large production hall, offices, and a warehouse, similar to old factories. However, unlike old factories, the production hall is designed to provide flexibility and variability, can be adapted to the combination of humans and machines, accommodates various test equipment, and has mobile offices.

FIGURE 2. *Arena36, 2016, Germany.*

One of the first examples of a smart factory after innovation and research factories is Trumpf Smart Factory. Product design, production, and delivery processes are designed to comply with Industry 4.0 technologies. The production is digital, remotely controlled, and continues uninterruptedly. Thanks to the "skywalk" designed in the production hall, visitors can watch the production. In addition, in "control rooms," visitors are informed about critical real-time process indicators from ongoing production. In the other part of the factory there are offices, co-working spaces, an auditorium, and a café ("Trumpf Smart Factory" n.d.). This factory combines two functions: production and exhibition.

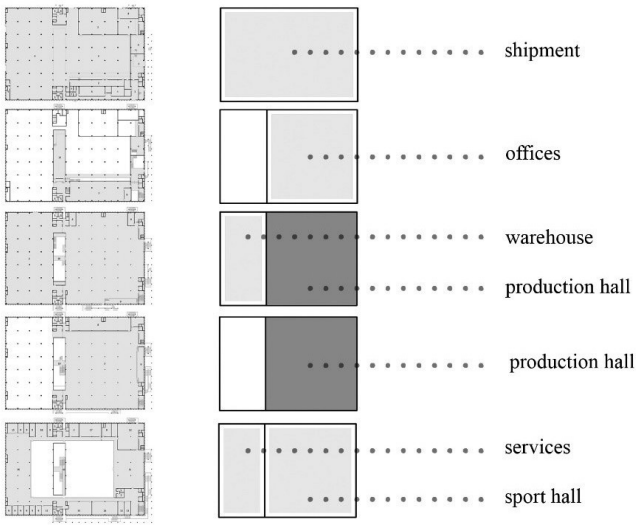
The fact that the factory can be visited and the production can be monitored and exhibited is the most significant innovation that distinguishes the future factory from traditional factories.

FIGURE 3. *Trumpf Smart Factory, 2017, USA.*



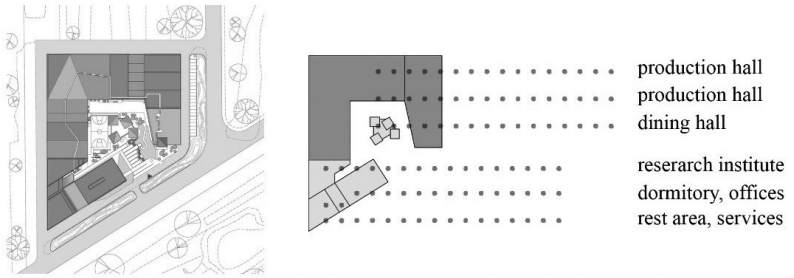
One of the places where smart technologies and smart production systems are used the most is undoubtedly China. The Future Stitch Smart Factory, built in the economic development zone in Haining, China, in 2018, is quite different from traditional factories. In the factory, where socks and sports equipment are produced, there are also places for sports events and artistic activities. The factory was designed to be multi-story, and visitor circulation was created to exhibit the product and production. In addition, this circulation was continued outside the building, and a temporary open area was created for the employees. The galleries in the interior provide an experience for both production and other activities. A basketball court and a roof terrace were designed in the section where production was not carried out. The factory entrance is common for employees and visitors ("Future Stitch" n.d.).

FIGURE 4. *Future Stitch Smart Factory, 2018, China.*



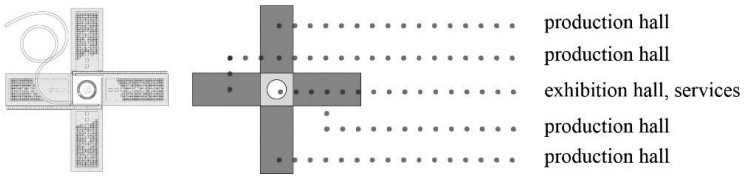
The number of industrial cities in China has been increasing in recent years, guided by the traditional economic growth model. Production organisation is effective for these production areas with low costs and high efficiency. In this context, Zhejiang Factory is attractive with its design approach. It creates a new order not only for the production area but also for the industrial workers who will work or even live there. The architect of the factory first created a courtyard to provide easy access to the space, surrounded by the production workshop, laboratories, offices, and living spaces. The dining hall and life service centre were designed at the centre of the site. In addition, the architect designed a stairway that continues inside and outside the building to connect all the units. Besides its primary function, the stairs serve as a break and rest area ("Zhejiang Perfect Production Factory" n.d.).

FIGURE 5. *Zhejiang Perfect Production Factory, 2019, China.*



The Plus Factory, built in Norway, is a new-generation factory that demonstrates how smart production technologies can be integrated with space. The furniture factory, which has a sustainable production, is designed with walking paths and camping areas in the forest. The factory consists of warehouse units, a colour workshop, a wood workshop, and an assembly workshop connected to the main space (The Plus for Vestre n.d.). There are offices and co-working spaces in the centre. The factory is an open workspace for robots and an exhibition space for visitors. In the factory where smart production methods were applied, sensor maps were made for robots on the ground. These colourful maps are also a guide for visitors. While flexible and remotely controllable systems provide flexibility in the space, the whole process has become experienceable for users.

FIGURE 6. *The Plus Factory, 2020, Norway.*



Machines have started to take a more active role in production processes, which has caused radical changes in factories. Innovations in production technology have enabled the restructuring of production stages and new alternative functions were added to the production function of the factory. Although smart production brings machines and people together in a virtual network, new production spaces bring people and production together in different relationships.

In its simplest form, the factory consists of a production hall specialised according to the product, offices, a management department where production is planned, and a storage area where raw materials and products are stored and shipped. The main space of the factory, the production hall, is designed following the physical conditions of the necessary machines and production line according to the product and production method. In the factories, infrastructures and installations for machines as important as the working comfort of humans. Nowadays, research and development, co-working spaces, exhibition halls, sports halls, rest areas and even dormitories have been added to the factories.

Although Industry 4.0 has provided the opportunity to work remotely, offices continue to exist in the first smart production factories. Especially in innovation factories, offices are designed as common working areas. Common working and common production suggest the possibility of common use for factory buildings soon. In this context, Guallart's common factory proposal, which promotes diversification of production in the same place, is probable for next-generation production areas.

New factories have functions that are not significantly related to production, apart from their primary function. As in Trumpf and Plus Factory, the production process has become observable, experienceable, and exhibitable. This relationship between factories and people is a step for the industry to return to the city. It is seen that each function added to the production will bring the factory closer to the city, and industrial environments may have been formed before Tali Hatuka's industrial urbanism proposal. Similarly, Future Stitch Smart Factory has brought together daily activities such as sports with production to find a place in the city. In addition, the architecture specific to its location has been conserved, and the factory was built as a multi-story building. It can be said that Nina Rappaport's idea of the Vertical Urban Factory is a viable alternative to bring production to existing cities consisting of multi-story buildings.

One of the most significant innovations of this digital transformation is the relationship that humans establish with the machine and space. After innovative research and experience examples, Zhejiang Perfect Production Factory draws attention to bringing production directly to life. While Industry 4.0 aims to move people away from the factory and to communicate in a virtual network, a new relationship emerges between production and daily life.

Although Industry 4.0 and the smart factory are still very new, when the examples are examined, functions that are not directly related to production, such as exhibitions and sports activities, are seen in addition to common work areas. Under the leadership of new technologies, factories have gained new functions besides production and enabled production to establish different relations with people. While production continues unmanned only with machines, the process is still available for humans to experience. Far from the city and the social environment, the factory has become a part of daily life again. People are invited to the factory and are asked to experience the production process and spend time with different activities.

In the first factory examples of Industry 4.0, researching and co-working spaces draw attention, while in more recent ones, the functions are diversified. In addition, the boundaries within the space are reduced, and the primary functional areas of the factory, such as production shipping, are gathered in a single space, and this space becomes exhibitable. The increase in mixed-use area independent of the product and production of the factory is transforming the factory both architecturally and intellectually.

Examined examples indicate that new functions may soon be added to the factory. Smart production has transformed the factory into a place that produces, and exhibits, and where we shop, study, research, and, most importantly, experience. The factory has become a new show-off space, and architectural aesthetic concerns have increased again. In this respect, the factory looks quite different from the twentieth century Fordist image. Tatiana Mazali (2020) says that, for this, "*Production chains are established that look like showrooms, where even the machines become beautiful*."

The dominance of the machines in production has also caused the users coming to factories to change. In this case, the factory is not just where production takes place, or production is no longer done only in the factory. The factory is designed for different functions at the same time as production. New users can visit the factory not only to produce or participate in production but also to experience it.

CONCLUSION: IMAGINING THE FACTORY IN THE FUTURE

Industry 4.0 is not only the revolution of industry but also the alteration of the machines and production spaces. In addition to the physical aspects, the labour, knowledge, and power that create the factory are also transforming. The relationship of production with time, people, and space is being re-established. Production actors are transitioning from humans to machines, from machines to digital screens, and from digital screens to robots. This transition introduces humanity to a digital culture.

New production spaces are defined as smart factories consisting of machines. However, after the smart factory, suggestions such as innovation factory, factory of the future, vertical urban factory, hybrid factory, green factory, and co-factory are included in the smart production areas. The new revolution in industry brings humans and production together in different relationships.

As a result of the many opportunities offered to humanity by the digital revolution, a new order is expected in working life, production spaces and social environment. Remote working, involvement in smart production and virtual connections between machines and humans have transformed the factory. While it was thought that the factory would be left only to machines in this revolution, many people who were not directly related to production became the new users of the factories. On the one hand, production can be experienced, on the other hand, a new relationship is established between the product, the producer and the consumer. In this way, the factory and production are looking for ways to back to the city.

As a result of the comparative analyses carried out in this study, it is seen that while factories provide spatial solutions to new production methods, a new factory typology also emerges. In this state, the factory is trying to become a part of daily life again. It is seen that the factory architecture of the twenty-first century has transformed into hybrid or hi-flex production areas where other functions besides production are included in the design. Therefore, the results of the study provide a basis for future studies in the design of production areas and processes.

In summary, while the digital transition in production technology brings together people and production in a digital environment, factories are turning into places where these new production methods are experienced, exhibited, and even used for other functions. Not only the production methods in the factory change, but also the technical structure of the factory required for these methods, its relationship with its user, environment and city. In this respect, the study initiates a new discussion about the factory architecture of the future by drawing attention to the spatial diversity of new production spaces.

REFERENCES

Arena 2036 (website). n.d. https://www.arena2036.de/en/

"Digital Transformation: Leading by Example." n.d. *Siemens* (website). https://www.siemens.com/global/en/company/stories/industry/electronics-digitalenterprise-futuretechnologies.html

Ernst, F., & Frische, P. (2015). Industry 4.0 / Industrial Internet of Things - Related Technologies and Requirements for a Successful Digital Transformation: An Investigation of Manufacturing Businesses Worldwide. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2698137

"Future Stitch Smart Factory / AZL Architects." n.d. Arch Daily (website). https://www.archdaily.com/915654/future-stitch-smart-factory-azl-architects

Gabriel, M., and E. Pessl. 2016. "Industry 4.0 and sustainability impacts: Critical discussion of sustainability aspects with a special focus on future of work and ecological consequences." *Annals of Faculty Engineering Hunedoara: International Journal of Engineering* 14 (2): 131–36.

Gorecky, Dominic, Stephan Weyer, André Hennecke, and Detlef Zühlke. 2016. "Design and Instantiation of a Modular System Architecture for Smart Factories." In *IFAC – PapersOnLine* 49 (31): 79-84.

Guallart, Vicente. 2021. "The Digital Reindustrialisation of Cities." *Architectural Design* 91 (5): 24–31.

Hatuka, Tali. 2021. "The New Industrial Urbanism." *Architectural Design* 91 (5): 14-23.

Hunt, Joshua. 2017. "This Company's Robots Are Making Everything—and Reshaping the World." *Bloomberg* (website), October 18. https://www.bloomberg.com/news/features/2017-10-18/this-company-s-robots-are-making-everything-and-reshaping-the-world#xj4y7vzkg

Hüttenhain, Britta, and Anna Ilonka Kübler. 2021. "City and Industry: How to Cross Borders? Learning From Innovative Company Site Transformations." *Urban Planning* 6 (3): 368–381. http://dx.doi.org/10.18419/opus-11717

"The Innovation Factory Is Shaping Our Future." n.d. *Wittenstein* (website). https://www.wittenstein.de/en-en/company/production-of-the-future/innovation-factory/

Kumar, Shashank, Balkrishna Narkhede, and Karuna Jain. 2018. "Industry 4.0: Literature Review and Future Research Directions." Paper presented at Rotre of Industrial Engin. in Industry 4.0Paradigm. Bhubaneswar, Odisha, India, September 2018.

Lu, Yang. 2017. "Industry 4.0: A survey on technologies, applications and open research issues." *Journal of Industrial Information Integration* 6: 1–10. https://doi.org/10.1016/j.jii.2017.04.005

Marsh, A. 2019. The Factory: A Social History of Work and Technology. Santa Barbara: Greenwood.

Mazali, Tatiana. 2020. "Industry 4.0: A New Relationship Between Factory and Society." *Arch Daily* (website), 12 July. https://www.archdaily.com/943501/industry-a-new-relationship-between-factory-and-society

Rappaport, Nina. 2017. "Factory Architecture in the Age of Industry 4.0." *Metropolis* (website), 19 April. https://metropolismag.com/viewpoints/factory-architecture-age-industry-4-0/

Rappaport, Nina. 2022. *Hybrid Factory, Hybrid City*. New York: Actar Publishers.

Rappaport, Nina. 2009. "Real Time/Implication for Production Spaces." I*n ACADIA 09: ReForm(): Building a Better Tomorrow - Proceedings of the 29th Annual Conference of the Association for Computer Aided Design in Architecture*, 186–93.

Rappaport, Nina. 2019. *Vertical Urban Factory*. New York: Actar Publishers.

Ridgway, Keith, Chris W. Clegg, and D. J. Williams. 2013. *The Factory of the Future A Study for the Government Office for Science*. Rotherham: The National Metals Technology Centre, University of Sheffield AMRC.

Stearns, Peter N. 2013. *The Industrial Revolution in World History*. Colorado: Westview Press.

Strozzi, Fernanda, Claudia Colicchia, Alessandro Creazza, and Carlo Noè. 2017. "Literature Review on the 'Smart Factory' Concept Using Bibliometric Tools." *International Journal of Production Research* 55 (22): 6572–91. https://doi.org/10.1080/00207543.2017.1326643

"The Plus for Vestre / BIG." n.d. *Arch Daily* (website). https://www.archdaily.com/982957/the-plus-for-vestre-big

"Trumpf Smart Factory." n.d. *Trumpf* (website). https://www.trumpf.com/en_CA/solutions/smartfactory/our-smart-factories/chicago/

Wang, Shiyong, Jiafu Wan, Li Di, and Chunhua Zhang. 2016. "Implementing Smart Factory of Industrie 4.0: An Outlook." *International Journal of Distributed Sensor Networks*: 1–10. DOI:10.1155/2016/3159805

Yoona, Joo-Sung, Seung-Jun Shin, and Suk-Hwan Suh. 2012. "A Conceptual Framework for the Ubiquitous Factory." *International Journal of Production Research*: 2174-2189.

Young, Liam. 2019. "A Place of Evertything." *Architectural Design* 89: 43–47.

"Zhejiang Perfect Production Factory." n.d. *Arch Daily* (website). https://www.archdaily.com/925151/zhejiang-perfect-production-factory-phase1-gad-star-line-plus-studio

CITYSCAPES TRANSFORMED:

IMMERSIVE EXPLORATION AT THE INTERSECTION OF CULTURE, COMPUTATION, AND CURATORIAL PRACTICES

Iacopo Neri, Darío Negueruela del Castillo, Pepe Ballesteros Zapata, Valentine Bernasconi, and Ludovica Schaerf

ABSTRACT

Designing a novel approach to existing art collections requires a shift in perspective. Computational approaches allow for an agnostic approach to cultural assets—akin to distant reading—,affording a capacity for embracing estrangement as a fertile design strategy. This paper investigates the potential convergence of these fields through the lens of machine curation and audience engagement, specifically examining the influence of contemporary machine learning models on curatorial methodologies. This investigation takes the form of a project conceived for the 2023 Helsinki Art Biennial and as a collaboration between the Centre for Digital Visual Studies (MPG, University of Zurich) and the media artist Yehwan Song, aptly titled Newly Formed City. Exploring the art collection of the Helsinki Art Museum (HAM), we seek to reinterpret the cityscape of Helsinki through a machine-oriented perspective. Utilising visual-textual models, we relocate unexhibited artworks to public locations, where, through the creation of context-based computer generated 360-degree panoramas, artworks are placed. Consequently, the outdoor sites are changed by the presence of the artworks, creating a new speculative geography where the city and its art collection are visually fused together. Interaction is achieved through a web interface, offering visitors the opportunity to move through an alternative version of the city and interact with its cultural heritage on a large scale, exploring the capacities for creativity located at the crossroads of a reflective exchange between vicinity and ignorance, machinic analytical prowess, and the uncanny and the unexpected.

#digital humanities, #computational art, #urban cultural ctudies, #machine learning, #curation

https://doi.org/10.21096/disegno_2023_1inetal

1. INTRODUCTION

The present paper describes the computational-based curatorial work: *Newly Formed City*, presented at the 2023 Helsinki Art Biennial as a collaboration between the Centre for Digital Visual Studies (MPG, University of Zurich) and the media artist Yehwan Song. Holding under the biennial motto: New Directions May Emerge[1] it aims to design a curatorial AI agent to find alternative ways to experience artworks using the Helsinki Art Museum (HAM) digital collection. Our approach is rooted in the hermeneutical premise that there exists a profound interconnection between public monuments, such as statues and memorials, and the public spaces that encompass them. The reciprocal dialogue between the public artworks and their public spaces, similarly to the dualism of content and form, or stage and piece, acts as a city's unique cultural repertoire. In this regard, we consider the question of how digital technologies can support us in the creation of new media to experience art? And more precisely, how can a city be used as a platform to see a digital art collection? What will be left of our mental image of the city afterwards? The proposal places unexhibited artworks in urban settings, setting them free to digitally re-interpret the physical location in their surroundings and to render a hybrid city space of Helsinki where recognisable features blend into surprising ones. It offers not only an engaging platform to discover the city and its paintings, but also to discuss novel approaches and aesthetics in design, supported by data and computation. In this regard, our project embraces the ethos of speculative design as a method, "to create spaces for discussion and debate about alternative ways of being, and to inspire and encourage people's imaginations to flow freely," and where "design speculations can act as a catalyst for collectively redefining our relationship to reality." (Dunne and Raby 2013, 2)

From the theoretical, computational and curatorial point of view of the design process, this work stems from the hypothesis that machine perception offers a fruitful estrangement and re-contextualisation of artistic data. We use deep learning models to learn visual and textual attributes from the public monuments of the city of Helsinki. These attributes are used to feed predictive similarity-based models that place unexhibited paintings within the city, based on the location of semantically similar public artworks. Through the extraction of 360-

[1] *See https://helsinkibiennaali.fi/en/story/helsinki-biennial-2023-brings-together-29-artists-and-collectives/.*

degree panoramas for each location, we use diffusion-based models to imagine the machinic space they inhabit according to their semantic and stylistic attributes. Secondly, as an interface to such a collection of spaces, the project sees the development of a web-based navigation tool by Yehwan Song, where the user is able to experience the curatorial process, interact with the works of art in the city of Helsinki at scale, and explore an alternative arrangement and view of the city through the lens of machine perception.

Drawing inspiration from a semantic field delineated by the concepts of "vnenakhodimost'" (outsideness) by Viktor Shklovsky and "ostranenie," (estrangement) by Mikhail Bakhtin (Emerson 2005, 642). which emphasises estrangement and cognitive awakening in artistic endeavours[2], the project employs a deliberate strategy of distancing to awaken the potentials of art. It provides for an exploration that is both remote and immersive, engaging in an operation of estrangement that is proposed as an explicit modus operandi in designing data intensive cultural interfaces for our globalised and largely machinic world. Additionally, it actively contributes to the ongoing discourse on generative AI, creativity, and its role within artistic and aesthetic practices. By inhabiting the uncanny valley (Mori [1970] 2012) that has been identified as one of the most interesting and fertile effects or outputs of generative AI models (Hazan 2023), it questions the capacities of state-of-the-art generative machine learning models to produce something which is simultaneously a familiar place (with a clear connection or kinship to the original artworks and the real location's geometries and spatial configuration) and somewhere radically other.

In the following sections, the work is presented as an intertwined process of data—as a multidimensional entry point, spacing from semantics to geography—and design—as its creative structuring practice and tangible interface. Rather than seeing them as separate entities, their productive collaboration in the formation of novel platforms to support Digital Humanities studies is emphasised. A detailed exploration of the technical aspects behind the machine learning models involved is covered extensively in a separate paper (Schaerf et al. 2023).

2. DATA: THE HAM DATASET

The project uses as a primary source the digital collection of the Helsinki Art Museum (HAM)[3]. The museum owns predominantly Finnish artworks, spanning the city of Helsinki, as they define themselves as "a city-wide art museum." In total, HAM holds about 10,000 artworks, around 2,500 of which are publicly accessible throughout the city, while the remainder are exceptionally on exhibition inside the museum if not stored at the depot. We divide the collection in two types: the public artworks, located mostly outdoors in public spaces, and the indoor unexhibited collection, of the works within museum walls.

[2] *These two concepts arguably belong to different frameworks, formalist for Shklovsky, and dialogic for Bakhtin, but we consider the common element of distancing or estrangement as discussed by Emerson.*

[3] *See https://ham.finna.fi/?lng=en-gb for the full collection*

In order to take into account the spatial and urban factors related to the public artworks, we compute geographical information (latitude and longitude) of 488 outdoor public artworks.

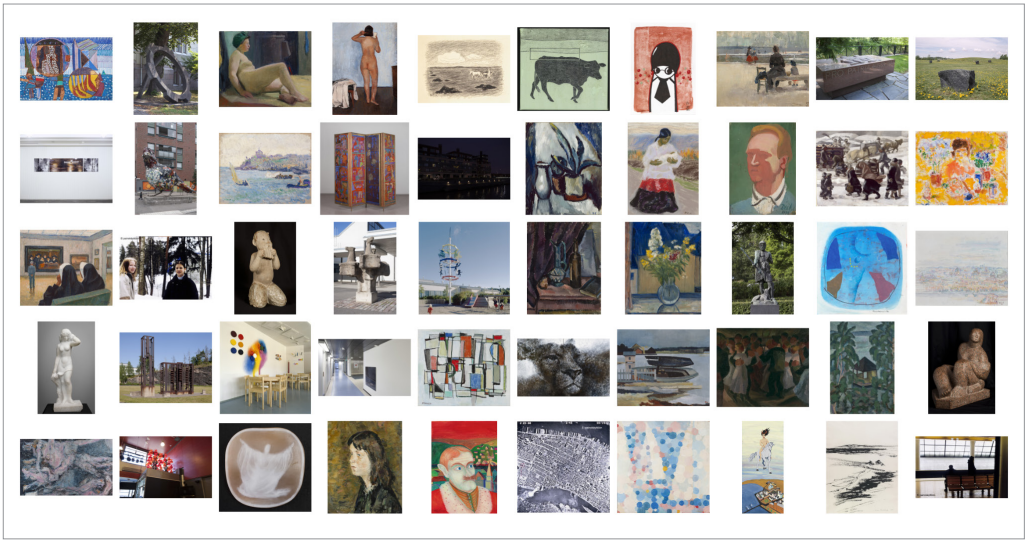


FIGURE 1. *Random subset of the accessed HAM collection*

Additionally, we selected 1,744 artworks from the indoor collection (fig.1) to be placed around the city. Each selected artwork has the following information: title, date of creation, name of the artist, keywords in English, Finnish, and Swedish describing the piece, and the object ID in the official collection.

3. DESIGNING DATA-STRUCTURES: A WAY TO REINVENT THE CITY AND ITS ARTWORKS.

The aim of the first part of the project is to simultaneously provide contextualisation and recontextualisation of the artworks. Firstly, this entailed assigning a physical location to the artworks of the indoor collection that currently are not displayed. Thus, we first address the problem of fictional localisation of the artworks. We approach this task by first creating a machinic representation of the artworks using an image-to-text model which extracts a compressed representation of both the outdoor and indoor artworks. We exploit this representation to identify the most similar outdoor public artworks to each unexhibited indoor artwork, assigning a fictional coordinate to the indoor collection item that indexes a location between the most similar publicly accessible works. Once the locations for all artworks are available, we can finally induce the artworks to embody their surrounding space: we obtain the panoramic 360-degree view of each artwork from its corresponding location and use diffusion-based models (Rombach 2022) to turn the

panoramas into an immersive space representing it. The text-to-image models then use the text extracted by the image-to-text model previously used on the original artworks and the depth map of the 360-degree views to generate a final work representing the original artworks guided by the depth of the scene at its fictional location (fig.3).

[4] *See https://github.com/pharmapsychotic/clip-interrogator*

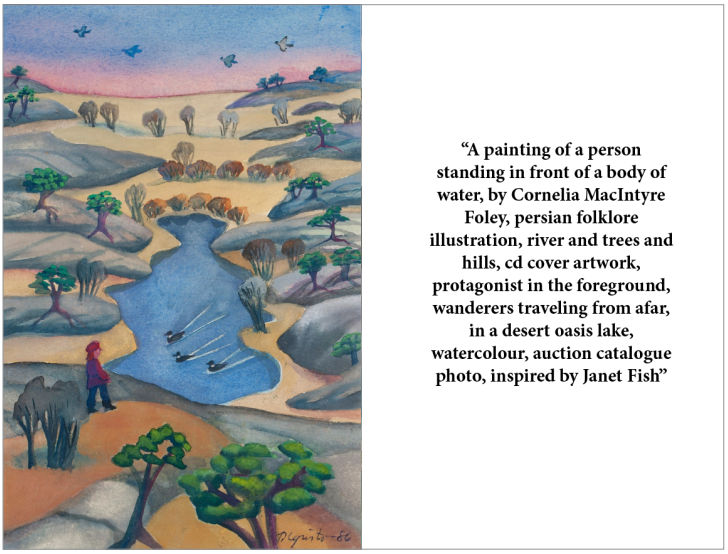


FIGURE 2. *Example artwork with CLIP extracted prompt. Courtesy of Schaerf et al. (2023)*

4. PLACING ARTWORKS IN THE CITY VIA CLIP REPRESENTATIONS

To analyse the artworks, we use the CLIP-based model (Radford et al. 2021) CLIP-Interrogator,[4] which extracts visual and textual features from images (fig.2). We store the model's outputs, including prompts and embeddings. Each image is mapped to an image embedding using the ViT-L-14 model, consequently mapped to text embeddings and further decoded into text prompts. Therefore, by combining linguistic and visual information, we represent each artwork as a concatenation of its visual and textual representation. Next, we determine fictional coordinates for the indoor artworks using the known geolocations of public artworks and the feature vectors obtained in the previous step via a similarity-based method inspired by GPS technology. Once we estimate these fictional locations of the indoor artworks, we examine the local conditions of each location using Google Street View panoramas. We use the Google Street View API to gather the street view panorama at each predicted latitude and longitude. Because some locations do not have a street view available, we iteratively query the API with increasing radii to find a nearby panorama while allowing for local adjustments.

5. GENERATING ART PANORAMAS FROM CLIP PROMPTS AND 360-DEGREE IMAGES

Finally, using the panorama views of each location as depth maps and prompts, we generate landscape artworks that semantically depict the original art piece but use the real context as the canvas. To this end, ControlNet[5] (Zhang 2023) plays a key role in guiding the generation with an input depth map, computed via MiDaS (Ranftl 2020) from the panorama views. Through their combination—assisted with asymmetric tiling[6]—we influence the Stable Diffusion generation towards pertaining visual consistency between the real and the imagined landscapes. Additionally, the resolution of the artwork is increased fourfold by using ESRGAN (Wang 2018), leading to the resulting art panoramas (fig.3).

[5] *We use the code from the official release on https://github.com/lllyasviel/ControlNet, v1.0.*

[6] *See https://github.com/tjm35/asymmetric-tiling-sd-webui*

[7] *See https://newlyformedcity.net/*

FIGURE 3. *Images involved in the immersive panorama generation of figure 1 (left). Panorama of predicted location (top right), depth map (middle right), art panorama using depth map and CLIP prompt (bottom right). Courtesy of Schaerf et al. (2023).*

6. DESIGNING INTERFACES: AN IMMERSIVE TOUR IN A QUASI-REAL SPACE

Once the panorama generation process is over, an equally important design phase addresses the rendering of the now-enriched HAM collection as an artistic digital installation. 1,744 four-dimensional objects constituting the image of the original artwork, the CLIP extracted prompt, the generated 360-degree panorama and the geographical location are displayed on a website[7] for the visitors to imagine—and question—the city of Helsinki. Avoiding a unique rigid structure to the HAM collection becomes a prerogative of the interface, which challenges principles of user-friendly design to trigger a subtle sense of confusion in the eyes

of its viewer and reveals only bits and pieces of information as more interaction takes place. Entering the website is the start of a journey in a quasi-real space, only recognisable from the coastline of the city of Helsinki and a series of spheres emerging from the land towards the viewer's point of view, up in the sky (fig.4). The resulting feeling is the one of landing in Helsinki from a different planet, alienated from any preconceived knowledge about the city and with only our motion skills at disposal for discovery (the visitor is invited to fly over the city with a joystick). In this regard, geography emerges as the preferred dimension to introduce the database, providing a distant yet understandable medium to engage with the installation: a map and an external angle.

Technically, we organise the interface into two distinct virtual spaces: an outer point of view, which includes three sub viewpoints, and an immersive perspective (one for each artwork). Both spaces exploit geography to organise data, but with a crucial difference: the former suggests a reading from the general to the specific via a map, allowing for comparisons and ad-hoc selection, the latter favours the opposite approach, stimulating the viewer to find their way up from the specific to the general and forging the image of the city one 360-degree panorama at a time.

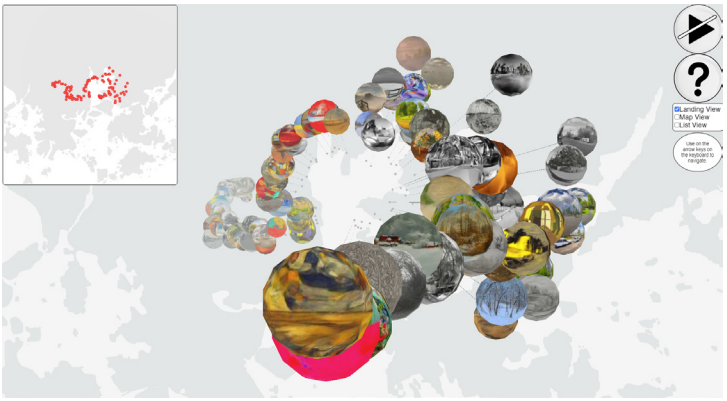


FIGURE 4. *Homepage of the NewlyFormedCity website showing the Landing view and the machinic path.*

7. SEEING THE CITY FROM AFAR

The first encounter with the digital installation (the outer point of view) showcases the data from its collective aspect and presents a *metaform* of the enriched dataset as a geometrical expression of its metadata. A multitude of spheres wrapped with the generated panoramas are placed in space not only according to the inferred geographical location, but to a vertical factor identifying a journey through a selection of artworks. This route undergoes daily changes through a process of programming. It begins from an arbitrarily selected artwork and is drawn by connecting it to its closest neighbouring location in an

iterative manner. The process continues until a specific number of locations have been visited, and with each iteration, the route gains elevation so that starting and ending points represent its highest and lowest peaks. Randomly selecting starting points permits the map to never show the same data twice, while the increasing number of stops (artworks) for the path contextualises it within the Biennial, reaching completion only at its end when all artworks have finally been visited. To further enable alternative readings, the outer point of view presents three viewports to its map and path. First is the previously mentioned landing view, which constitutes the homepage of the website as well as the main lens of this section with its flying animation and textual introduction, followed by two other viewports: the map view and the list view, where XY and Z coordinates are kept separate, respectively on a flat map or in an elevated axonometry. Immersion and further inspection of the panoramas is enabled by clicking on the spheres, independently of which view the visitors find themselves in.

8. SEEING THE COLLECTION FROM WITHIN

While the outer point of view favours a general overview of the dataset contrasted only by the unpredictability of the path that undercuts its conclusive understanding, an opposite situation exists in the immersive perspective. Here, the spectator is free to navigate the plethora of artworks from a situated lens, absorbed within each generated panorama and with only a selection of the neighbouring artworks to build their journey. Serendipity, taste, and intuition, as opposed to the above mentioned machinic distance criteria, are the only guides for discovering the collection, as interactive bubbles of the closing artworks float in the viewport waiting for a click to move ahead (fig.5). In this regard, the selections are collected as visitors navigate the installation to build a collective database of human paths for future curatorial art studies.

FIGURE 5. *Immersive perspective showing an example of a generated 360-degree panorama, alongside the map location (top left), its metadata and original artwork (bottom left) and the extracted CLIP prompt (bottom right). In the centre a bubble invites the spectator to the next neighbouring artwork.*

Additional elements reveal the process behind the 360-degree panorama generation allowing the user to question the machine learning models involved in the process. At the bottom, a banner showcases the original artwork linked to the HAM website for further inspection and, more importantly, the CLIP prompt describing it. Having the two extremes of the process at hand, the visitor is called to ponder on the legitimacy and depth of the machinic interpretation of the work of art, similarly speculating on both interpretation and representation in a multimodal manner.

9. DISCUSSION

In this paper, we presented a multi-faceted process, combining deep learning models and diffusion-based methods within the context of an AI curatorial exercise. Deep learning models were employed to learn visual and textual attributes from public monuments in Helsinki, forming the basis for placing indoor paintings based on similarity measures. Consequent to the gathering of panoramic 360-degree views for each location, diffusion-based models imagined the machinic space that these artworks inhabit, using the artistic attributes as generation seeds. Such explorations culminated in a web interface, enabling users to navigate the HAM collection within the city of Helsinki at large. Initially producing an intentional sense of disorientation, the interface gradually reveals information as it fosters a deeper connection between the user and the artworks by autonomous discovery. Human choices as opposed to programmed ones are central to the artwork, which collects visitors' journeys as data for future art curatorial studies.

Geography plays a pivotal role as an intermediate dimension between Helsinki and its art, now so entangled that we inevitably wonder whether one predominates on the other. On the one hand, the panoramic views perform a seamless fusion of the artworks and their physical surroundings, exploiting the city as a canvas. On the other hand, the digital collection offers an unconventional lens through which we perceive and interact with the city that transcends traditional physical boundaries, making the artwork a gateway. These intertwined perspectives raise profound questions about the nature of perception, representation, and the relationship between physical and digital as they invite us to reflect on if it is the city transformed and reinterpreted by the presence of the digital collection, or it is the digital collection that relies on the physical space as a contextual framework. Through this conversation, the project reminds us that a city and its culture are not separate entities, but rather interconnected dimensions of a larger cultural and social narrative.

Parallelly, another concept important to the project concerned the intricate interplay between data and design at the intersection of technology, humanities, and art. We approach the HAM collec-

tion as data, being the primary material under study, while both the website and the computational pipeline with its resulting 360-degree generated panoramas are considered as design in a twofold manner, respectively being the interface and the conceived generation process. It is worth noting how the latter, and more specifically the panoramas, could be seen as a starting point for further exploration, rather than a final solution. Challenging the data-design dichotomy, the project highlights the autopoietic nature of artistic research, where what acts as design in one instance plays the role of data in a future iteration.

Lastly, the paper reflects on the ephemeral nature of the Biennial and contemplates what remains after its conclusion. The non-hierarchical approach to the HAM digital collection and the emphasis on the specific moment in time and space situates the project within a precise context. While machine learning models will continue to advance and experiments may evolve, the significance of this exercise lies in its current manifestation and in the questions that it triggers. It represents a unique exploration of the intersections between art, data, and design, providing valuable insights into the dynamic nature of digital humanities.

ACKNOWLEDGEMENTS

Digital Visual Studies is a project funded by the Max Planck Society. Furthermore, we would like to thank the curator of the Helsinki BIennial 2023, Joasia Krysa. We would also like to mention Yehwan Song and the team behind the organisation of the 2023 Helsinki Biennial as well as those responsible for the Helsinki Art Museum collections for their collaboration and assistance. We would also like to thank the artists featured in the HAM collections whose artworks constitute the source materials for the project.

REFERENCES

Dunne, Anthony, and Fiona Raby. 2013. *Speculative Everything: Design, Fiction, and Social Dreaming*. Cambridge: MIT.

Emerson, Caryl. 2005. "Shklovsky's *Ostranenie*, Bakhtin's *Vnenakhodimost'* (How Distance Serves an Aesthetics of Arousal Differently from an Aesthetics Based on Pain)." *Poetics Today* 26 (4): 637–64.

Hazan, Susan. 2023. "The Dance of the Doppelgängers: AI and the Cultural Heritage Community." In *Proceedings of EVA London 2023*, 77–84. London: BCS Learning & Development.

Mori, Masahiro. (1970) 2012. "The uncanny valley." Translated by Karl F. MacDorman and Norri Kageki.*IEEE Robotics and Automation* 19 (2): 98–100. doi:10.1109/MRA.2012.2192811

Radford, Alec, Jong Wook Kim, Chris Hallacy, Aditya Ramesh, Gabriel Goh, Sandhini Agarwal, Girish Sastry, et al. 2021. "Learning Transferable Visual Models From Natural Language Supervision." https://doi.org/10.48550/ARXIV.2103.00020

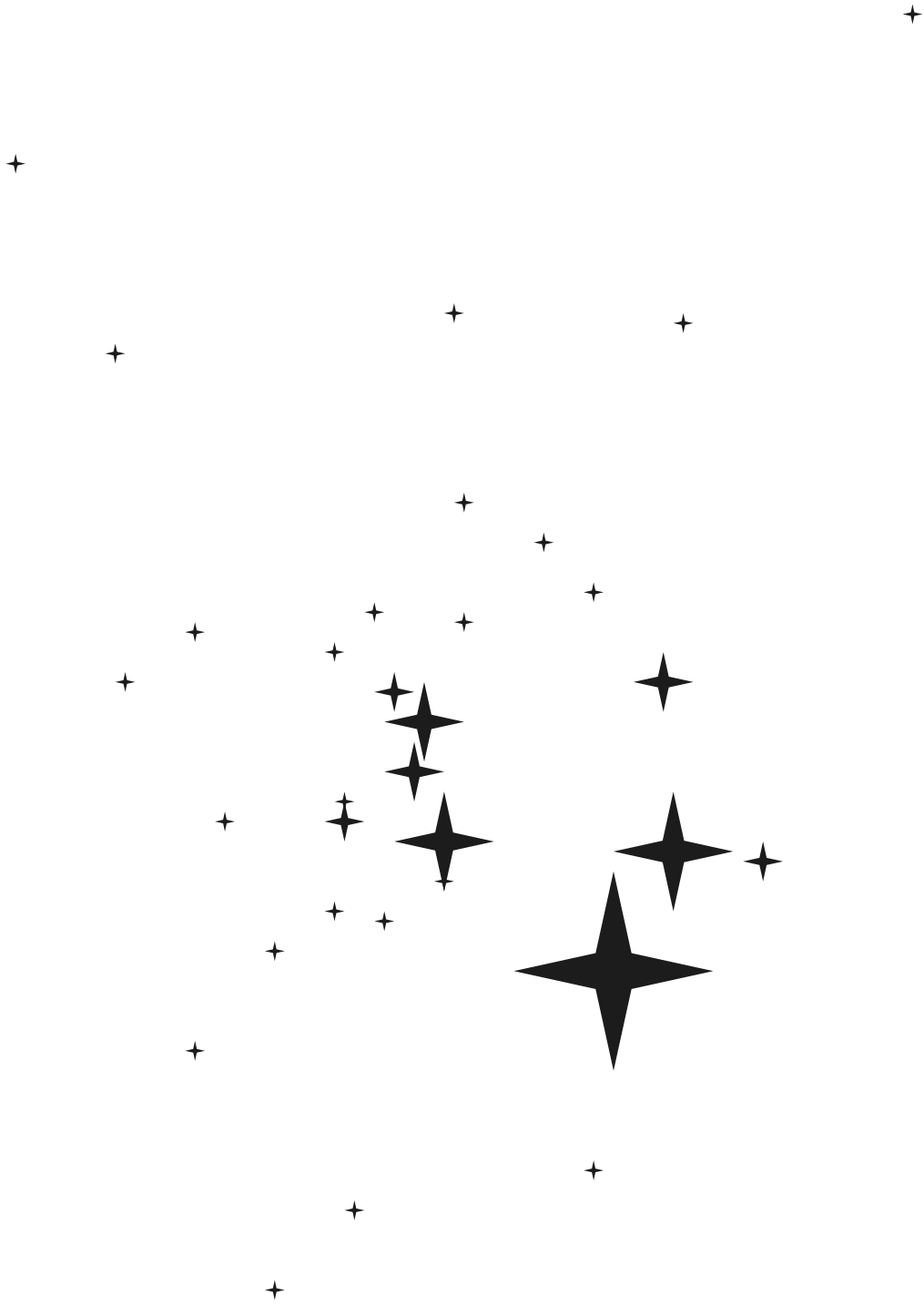
Ranftl, René, Katrin Lasinger, David Hafner, Konrad Schindler, and Vladlen Koltun. 2019. "Towards Robust Monocular Depth Estimation: Mixing Datasets for Zero-Shot Cross-Dataset Transfer." https://doi.org/10.48550/ARXIV.1907.01341

Rombach, Robin, Andreas Blattmann, Dominik Lorenz, Patrick Esser, and Björn Ommer. 2021. "High-Resolution Image Synthesis with Latent Diffusion Models." https://doi.org/10.48550/ARXIV.2112.10752

Schaerf, Ludovica, Pepe Ballesteros Zapata, Valentine Bernasconi, Iacopo Neri, and Darío Negueruela del Castillo. 2023. "AI Art Curation: Re-imagining the city of Helsinki in occasion of its Biennial." https://doi.org/10.48550/ARXIV.2306.03753

Wang, Xintao, Ke Yu, Shixiang Wu, Jinjin Gu, Yihao Liu, Chao Dong, Chen Change Loy, Yu Qiao, and Xiaoou Tang. 2018. "ESRGAN: Enhanced Super-Resolution Generative Adversarial Networks." https://doi.org/10.48550/ARXIV.1809.00219

Zhang, Lvmin, and Maneesh Agrawala. 2023. "Adding Conditional Control to Text-to-Image Diffusion Models." https://doi.org/10.48550/ARXIV.2302.05543



THE DODECAHEDRON AND THE BASKET OF FRUIT

ARCHITECTURE IN THE AGE OF ARTIFICIAL INTELLIGENCE

Stefano Corbo

ABSTRACT

Starting from the late 1980s, the advent of digital design—the possibility to ideate, develop, and generate projects via computers—has progressively pushed the disciplinary discourse to rethink architecture's role in society, as well as its formal manifestations. The contemporary evolution of digital architecture has taken different directions, which are sometimes contradictory and ambiguous in their intents. This paper especially focuses attention on one of those directions—the opportunities that artificial intelligence can offer in the future production and communication of architecture. Recent episodes are analysed and contextualised within the historical antinomy between two diverging worldviews that, since the fifteenth century until the end of the twentieth century, have informed the architectural discourse. These worldviews can be exemplified in the dichotomy between the dodecahedron and the basket of fruit.

#artificial intelligence, #digital culture, #architecture, #form, #process

https://doi.org/10.21096/disegno_2023_1sc

When analysing the general relationship between ideation and production in his recent *Beyond Digital*, Mario Carpo (2023, 3) identifies three fundamental eras that have chronologically characterised human history: "the age of hand-making, which was the universal human condition before the invention of machines; the age of mechanical machine making, when hand tools became actual machines; and at the end, the age of digital making, when machines became electronic and started to function with a new technical logic, different from and in many ways opposite to the analogue logic of yesterday's mechanical or electromechanical machines." According to Carpo, such a differentiation in the way of making implied three different technologies: that of the artisan, the factory, and computation.

If we focus on the age of digital making—on the role played by computation in offering new formal and expressive opportunities—we might say that its impact on the architectural discourse can be better understood within the context of the tension between two worldviews that, since the fifteenth century until the end of the twentieth century, have informed the conceptualisation of architecture, its production, and its dissemination. These worldviews have not only shaped the architectural imagery, they have largely anticipated the questions and challenges that today, in radically different forms, computer-driven robotic design and artificial intelligence are posing to the architectural discipline. These two worldviews are exemplified in the dichotomy between the dodecahedron and the basket of fruit.

The first position is paradigmatically described by Jacopo de' Barbari's *Portrait of Luca Pacioli* (ca. 1500, fig. 1). Pacioli, a Franciscan friar and mathematician, was the author of the seminal book *Summa de arithmetica, geometria. Proportioni et proportionalita*, and collaborator of Leonardo da Vinci for around ten years. In this painting, he demonstrates a Euclidian theorem. On the table are Pacioli's privileged tools: a book, slates, chalk, compass, and a dodecahedron model. The presence of these geometrical instruments recalls his interest in proportions and the golden ratio but, above all, invites us to reflect on the role played by geometry in envisioning a new system of values, and reconsider the traditional relationship between man and God.

Pacioli's painting also indirectly illustrates a new socio-economic milieu which involves the role of the architect and their relevance;

FIGURE 1. *Jacopo de' Barbari's, Portrait of Luca Pacioli (ca. 1500). https://it.wikipedia.org/wiki/Ritratto_di_Luca_Pacioli#/media/File:Pacioli.jpg Copyright: Wikimedia Commons*

geometry becomes a self-reflective medium to investigate and communicate architecture as an abstract system of signs. In fact, a few years before Jacopo de' Barbari painted the portrait Leon Battista Alberti officially institutionalised the profession of the architect by proposing the systematic introduction of notational codes. In his treatise *De re aedificatoria* (1450), Alberti paved the way for a theory of architecture as an art of design—an authorial, allographic, notational art. His theory contributed to defining how architects would operate in the Western world for the following 500 years. For Alberti, any new building must be conceived and represented on paper before construction starts, through a series of scaled drawings—plans, elevations, and side views. Construction, consequently, follows the architect's indications without any changes. The building becomes the exact manifestation of the designer's drawings. By systematising the design process, Alberti operates an ideological distinction between ideation and construction. These are conceptually and practically separated: the architect is an intellectual who works on ideas; the act of building is on the contrary mechanical, manual, almost a servile process made by others.

Jumping to the twentieth century, we might say that the project of modernity developed an accentuated tendency towards reduction and abstraction, both in its avant-garde movements and in its most heroic architectural episodes, as dramatically expressed by Piet Mondrian's Neoplatonic compositions or by Mies van der Rohe's search for truth. Despite their obvious differences, in all these historic precedents geometry worked as an introspective and absolute tool, in the sense

of a radical disconnection from any reference to external conditions. Geometry was a vehicle for a progressive process of dilution, where any initial design gesture was absorbed into a general logic, aimed to investigate reality, spirituality, or the universe until its physical disappearance.

Opposite of the dodecahedron position is Caravaggio's *Basket of Fruit* (*La canestra di frutta*, ca. 1600, fig. 2). The geometric construction of the painting is irregular, asymmetric, apparently arbitrary. Fruit is presented in a decaying condition, each element of the composition has its own independent shape and features: some leaves are dying, others are crumpled up, the apple is infested by worms. Caravaggio's painting is a metaphor of life and death, achieved through the exaggeration and deformation of natural elements according to a cultural perspective: that is, through the transformation of nature into a human-made process.

When it comes to architecture, one may refer to the famous legend of the birth of the Corinthian capital: Callimachus, in passing one day by the tomb of a young Corinthian girl, observed a basket placed on top of an acanthus plant, containing those items she had particular affection for when alive. Interested in its form, the sculptor translated that ensemble into an architectural element, associating it with a column according to arranged proportions.[1] This legendary anecdote served not only to corroborate the idea that arbitrary gestures can generate a form and then an architecture but, also, to demonstrate how, throughout the centuries, architects and artists have been struggling in defining a new dialogue between nature and culture, authenticity and artificiality, and purity and hybridisation.

[1] *See Rafael Moneo (2005) on the notion of arbitrariness in architecture.*

FIGURE 2. *Caravaggio, Basket of Fruit (ca. 1600). https://nl.wikipedia.org/wiki/Bestand:Canestra_di_frutta_(Caravaggio).jpg Copyright: Wikimedia Commons*

In 1634, for example, Francesco Borromini accepted the commission to build a church and a monastery for the Spanish order of Trinitarians on the Quirinal Hill in Rome: *San Carlo alle Quattro Fontane*. Borromini's design efforts addressed the cloister first—an anticipation of his real intentions. Here the Italian architect operates a spatial turn through deformation: by pushing the corner columns towards the centre, he transformed a rectangular plan into an elongated octagon.

Different geometrical signs overlay: linear balustrade, flat surfaces, round columns, curved corners. Complexity is achieved through the exuberant exhibition of heterogeneous elements that generate an unstable and fragmented collision. Borromini's interest in manipulation, assemblage and heterogeneity can be associated with other contributions from different eras: Rococo architecture, Antoni Gaudí's personal obsessions, or Enric Miralles' petrified landscapes. What all of these different figures share is the same concern with geometry in the sense of its philological root: geometry as γεωμετρία; *geo-* "earth," *-metron* "measurement." For these architects, geometry becomes a medium to interact with physical and external agents to pursue an alliance between nature and architecture, design and topography, and city and landscape. Any geometrical operation—distortions, rotations, displacements—is exacerbated and celebrated as an exploration of the possibility of a natural history.

FIGURE 3. *AI-generated image, achieved by morphing all the projects mentioned in the paper.*
Copyright: Stefano Corbo (source: Midjourney)

The way architects have looked at geometry and, consequently, have approached the problem of form in architecture obviously changed with the introduction of the first computers and the proliferation of computer-driven design processes. The scope of such a technological shift has not only produced what historians and theoreticians called the digital turn but has also allowed us to reinterpret the simplified separation of the dodecahedron and the basket of fruit—to reformulate it under different premises.

While it was only in the 1980s that computers reached a wider public (the IBM PC, based on Microsoft's disk operating system (MS-DOS) was launched in 1981, Steve Job's first Macintosh in 1984, and the first AutoCAD software was released by Autodesk in December 1982), the initial attempts to introduce machines in architecture can be traced back to the 1960s, when designers and scientists worked together to envision future scenarios that could influence what we design, the process through which we design, the role of the architect in the process, and the degree of participation or engagement of the users in the same process. One specific example of these attempts is cybernetics.

As Georg Vrachliotis (2022, 38) has pointed out, "cybernetics transformed the notions of the machine as a physical, functional, concrete object into an operative conceptual model detached from specific functions: a symbolic behavioural machine." This transformation was carried out by different protagonists and in different forms: among them, a key role was played by Gordon Pask. In September 1969, the British magazine *Architectural Design* published an essay by Pask titled "The Architectural Relevance of Cybernetics," in which he tried to describe the possible impact of cybernetics on environmental design. Over the years, Pask's interests did not simply remain on paper, they were translated into various installations and spatial interventions.

In one direction, Pask was directly involved in projects such as *Musicolour* or *Colloquy of Mobiles*. *Musicolour* was an interactive device consisting of a microphone and a lighting system, which was associated to the microphone's circuits and projected coloured light determined by the sounds. Thanks to a learning algorithm, *Musicolour* was able to react to the users' behaviour and to change sound and colour effects accordingly. Ten years later, Pask transferred what he learnt with *Musicolour* to a different machine: *Colloquy of Mobiles*. *Colloquy of Mobiles* represented the evolution of the previous project, as it consisted of a series of devices integrated by small mirrors that could reflect and redirect the rays of light produced by those devices. The overall goal of this installation was to establish a more direct dialogue between users and the machine, by introducing a loop of communication in the perception of space.

In a different direction, Pask collaborated with architects on other large-scale projects such as Fun Palace (1961), an unbuilt proposal

derived by the partnership between the theatre producer Joan Littlewood and Cedric Price. Fun Palace was to be more than a building, it was to be an interactive dispositive—an ever-changing architecture that worked according to cycles of assembling and destruction. As a designer, Price believed that his task was to implement buildings' performance, their functioning, and their temporal-programmatic configuration. For this reason, during Fun Palace's design process, Price collaborated with Pask to investigate the forms in which social, biological, and mechanical systems self-organise, self-regulate, and evolve. Pask's contribution to the project consisted of instituting a Cybernetic Commission, whose main objective was to define new environments capable of adapting to the needs of the users and stimulating different modalities of participation within the building. To achieve these goals, the main preferences of users would have been recorded via electronic sensors, and an IBM 360-30 computer would have processed this data to extract general principles that could eventually lead to define criteria of spatial modification.

The Fun Palace program, rather than in its conventional correspondence to fixed architectural spaces, was therefore a set of algorithmic functions that were supposed to control events and processes. By doing so, the dream of a virtual architecture came true for the first time. The environment envisioned in the Fun Palace by Price (and Pask) was a world in flux, in which time and performance shaped an (open) notion of form. Such a notion implied the redefinition of traditional disciplinary categories. The interior-exterior dialectic was replaced by an undefined infrastructural framework that rejects any idea of formal tension among its constitutive elements. Interior and exterior merge into an atmospheric process of flows: within the building, different flows interact with each other and can produce infinite configurations.

What emerges from this specific project and from other similar contributions is the role played by the computers: the machine is a tool to deal not only with space, but mostly with the time of architecture, by looking at its materials as something with emerging, vibrant, and evolving properties. In other words, the idea of form generated by the machine reaches beyond the dichotomy between the dodecahedron and the basket of fruit to propose an idea of space shaped by communication and data.

A similar attempt to integrate machines and architecture is the work of Nicholas Negroponte and Yona Friedman. Negroponte founded the Architecture Machine Group at MIT in 1968: his ambitious goal was to develop machines that would not only make architects' work easier, but even replace them completely. Negroponte questioned the architect's traditional tools as well as their effectiveness in translating users' desires into actual space. The machine Negroponte had in mind would have ceased to be a passive device and would have been a gen-

erative interface, able to envision new futures. In 1970 Yona Friedman developed the design concept *Flatwriter: Choice by Computer,* which he originally conceived for an IBM pavilion at the Osaka World Expo. *Flatwriter* was a machine designed to involve future inhabitants in the planning of their own homes and help them automatically generate an apartment unit in just a few steps, by simplifying the design process and assimilating it to a scientific method. For Negroponte, "the architect was to be replaced by the universality of a learning machine, for Friedman by the participation of occupants. Friedman's idea of direct feedback from the user was covered by Negroponte's concept of the individual designer." (Vrachliotis 2022, 207) The ultimate goal for both Friedman and Negroponte was the elimination of the designer according to the slogan "architecture without architects" that gained attention in those years (Rudofsky 1964). With these doubts about the role of architecture in general and, more specifically, about the form/function formula typical of certain functionalist culture, Friedman and Negroponte proposed alternatives: Negroponte's was characterised by the assumption that architecture should be close to science, and Friedman's was permeated by user participation as a sociological and ethnographic dimension. However, despite their efforts neither position found widespread application in architectural design, nor systematically addressed the question of form generation in architecture.

The case machines informing computer-driven design processes is different. In 1963 a PhD student at MIT, Ivan Sutherland, presented Sketchpad, an interactive CAD software which used a light pen, or stylus, to draw geometrical lines directly on a CRT monitor. While the light pen had already been in use by radar operators since the 1950s, what made Sketchpad innovative was the program allowing it to define planar objects—to cut, past, and resize them. A pioneer of CAD and other similar software, Sutherland laid the foundation for a paradigm shift that drastically affected the way architecture is conceived and produced.

The progressive rise of a digital culture in architecture cannot be understood, therefore, without acknowledging the role of CAD in influencing the daily activities of practitioners all around the world. Thanks to digital and technological advancement, architects have been able to test new expressive possibilities as well as to experiment with new methodologies to pursue their design choices.

In this context, Frank O. Gehry represents an interesting case study: his use of geometry, in fact, has been for a long time ambiguous and ambivalent, especially after the immediate proliferation of CAD programs. As is well-known, Gehry's formal explorations begin with a handmade sculptural model. The use of specific software (CATIA, for example) helped him translate his visions into architectural drawings and to control the evolution of the entire design process. The initial

separation between a first, individual moment of manual ideation, and its subsequent translation into complex computer-driven geometries, emerges somehow in most of Gehry's projects under the antinomy between classical and rational plans, and irregular, dynamic, and complex facades, whose realisation is only possible due to digital technologies—see, for example, his Peter B. Lewis Building in Cleveland (2002).

Whereas Gehry is considered among one of the first to use computer-driven processes in his projects, it is in the 1990s that a sort of new digital avant-garde took the scene: emblematic of this period was the Spring 1993 issue of *Architectural Design*, titled *Folding Architecture* and edited by the then twenty-nine-year-old Greg Lynn. Lynn was part of a wide group called Paperless Studio, created at the Graduate School of Architecture, Planning, and Preservation at Columbia University. Since then, a heterogeneous series of design proposals has emerged—different in scope, formal articulation, and materiality. Architecture began to look first at the world of biology, and later at geology, to borrow concepts and symbolic associations. The result of those extra-disciplinary or multi-disciplinary approaches was a constellation of phenomena such as datascapes, landform buildings, mega-forms, and vast interiors. All these different episodes expressed the multiple possibilities offered by digital technologies, which accomplished an increasing level of formal complexity and changed the role of geometry via specific spatial operations: folding, manipulating, moulding, perforating, etc. At the same time and by focusing on hyper-complex formalisations and audacious translations, the use of geometry was aimed to pursue a certain idea of innovation or creativeness, rather than to act as a critical medium to interrogate the relationship between space and society.[2]

Digital design has therefore been around for more than thirty years. Its evolution has recently developed across two different directions, which is still unclear what kind of repercussions they might produce in the territory of architecture: computer-driven robotic assembly and artificial intelligence. In reality, both robotic automation and artificial intelligence were already in the public domain in the late 1950s; however, they have only recently been consistently applied to architecture. Also, while in the past both robotic automation and artificial intelligence emerged out of the same preoccupations and ambitions, today they do not have much in common. In the specific case of artificial intelligence, there are many current attempts to look at machine learning as an instrument to optimise the performativity of architecture, to suggest design decisions, or to formalise architecture's appearance. Among these possible applications, one in particular, the so-called generative adversarial networks (GAN), is used as an image processing tool, and has retained the attention of computational designers. One of the main machine learning models developed for image

[2] *See the debate on critical and projective cultures outlined in Somol and Whiting (2002).*

synthesis—along with variational autoencoders (VAEs), flow models, diffusion models—GAN was first presented by Ian Goodfellow et al. (2014) in "Generative Adversarial Network." GAN works by recognising patterns: out of a conspicuous body of images, it utilises parameters such as visual similarity or resemblance to extrapolate common traits that can then drive the generation of new images.

Today the main players in text-to-image generative AI are Midjourney, Dall-E, and Stable Diffusion. All have partially employed GAN at the beginning before migrating towards other models. Nevertheless, what Midjourney and the other platforms can currently do is also symptomatic of the relevance of these technologies for contemporary architectural design as, to date, their impact is mainly limited to imaging or design process optimisation (fig. 3).

In this respect, the work of Matias del Campo and Sandra Manninger is an exception. Their office, SPAN, has collaborated with AI experts since the 1990s, and has variously employed GAN models to produce a wide range of experiments: datasets turned into 3D models or built projects like *Robot Garden* (2019–21), in which each step of the design process was fully informed by artificial intelligence. Overall, SPAN questions the possibility for AI to inform new design sensibilities, and investigate the creative potential of imitation intrinsic to AI.[4]

Whether artificial intelligence will get to influence design language and formal expression in a more incisive fashion is hard to tell. For now, what we can say is that the differentiation between the dodecahedron and the basket of fruit, which apparently evaporated throughout the centuries, has actually latently accompanied the evolution of architecture and its vocabularies: as a constant dichotomy between the smooth and the rough, the assemblage and the fusion, the collage and the morphing, or, in today's vernacular, between the pixel and the voxel. It is very likely that this differentiation will also inform the digital architecture of the future. The technological shift operated first by CAD and then by robotic automation and AI then is, by different means and under different premises, posing the same problem: the problem of what form does for architecture and what meaning it aims to convey.

[3] *For more information on SPAN, see https://span-arch.org/.*

REFERENCES

Carpo, Mario. 2023. *Beyond Digital. Design and Automation at the End of Modernity*, Cambridge, MA: MIT Press.

Goodfellow, Ian J., Jean Pouget-Abadie, Mehdi Mirza, Bing Xu, David Warde-Farley, Sherjil Ozair, Aaron Courville, and Yoshua Bengio. 2014. "Generative Adversarial Networks." Preprint, submitted in June. https://arxiv.org/abs/1406.2661

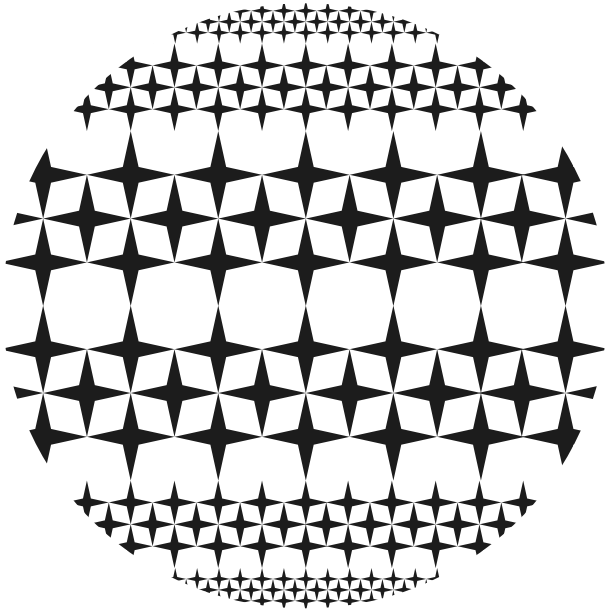
Moneo, Rafael. 2005. *Sobre el concepto de arbitrariedad en arquitectura*. Inaugural speech at the Real Academia de Bellas Artes de San Fernando, January 16. http://www.realacademiabellasartessanfernando.com/assets/docs/discursos_ingreso/moneo_rafael-2005.pdf

Pask, Gordon. 1969. "The Architectural Relevance of Cybernetics." *Architectural Design* 37 (6): 494–96.

Rudofsky, Bernard. 1964. *Architecture without Architects, an Introduction to Nonpedigreed Architecture*. New York: MOMA.

Somol, Robert, and Sarah Whiting. 2002. "Notes around the Doppler Effect and Other Moods of Modernism." *Perspecta* 33: 72–77.

Vrachliotis, Georg. 2022. *The New Technological Condition. Architecture and Design in the Age of Cybernetics*. Berlin: Birkhäuser.



AI? PREDICTIVE MEDIA. ART.

Zsolt Almási

ABSTRACT

In this paper, I shall explore the relationship between predictive text2image technology and art. To do this, I shall navigate the discursive landscape that facilitates the consideration of this cultural phenomenon within a rational framework. This is necessary because public discourse is mostly dominated by unrealistic expectations resulting from identifying this technology as "Artificial Intelligence." The theoretical frame is posthumanism, which affords us the necessary intellectual tools to scrutinise the genesis of what Manovich calls "predictive media." Equipped with the appropriate terminology, I will explore the process of the creation of images with a special focus on prompt engineering and curation to showcase the collaborative effort of the artist and the application. Furthermore, I shall refer to the competitions (Sony, Főfotó) wherein this technology plays a consequential role, to traditional art forms that share some crucial features with this technology, and some concerns related to predictive media will be raised. Through this analysis, I argue that contrary to early responses, predictive media applications bear the hallmark of art, and their creators rightfully merit the designation of artists.

#predictive media, #T2I, #prompt engineering, #posthumanism, #visual culture.

https://doi.org/10.21096/disegno_2023_1zsa

INTRODUCTION

In this paper I explore the realm of text-image generation from the perspective of whether the creations may be seen as artworks. Applications such as DALL-E, Midjourney, Stable Diffusion, Nightcafé Studio, and others, made publicly accessible since 2022, serve as crucial reference points in this exploration. I begin by presenting Hungarian reactions to these applications and show that these discourses problematise the relationship between image generation and the more conventional forms of artistic expression, probing into the ethical dimensions. Then I shall cast light on a possible theoretical framework in which this new phenomenon can be described, which will be followed by the presentation of the creative process.

When describing T2I applications, I avoid using terms such as "Artificial Intelligence" to ensure clarity and precision, as this expression can be misleading. The applications under discussion do not rely on genuine intelligence but rather enable predictive generation of pixels. These applications statistically predict the next pixel without understanding the composition of pixels into complex entities like humans, cages, or birds. This avoidance of anthropomorphism aligns with the goal of fostering a discourse suitable for understanding this new phenomenon. Lev Manovich, a proponent of the predictive methodology as a paradigm shift in contemporary text-to-image applications, suggests the term "predictive media" (Manovich 2023, 9) as the most precise descriptor, a phrase with which I agree. In this context I shall argue that it is possible to find room for predictive media, synthetic image generation in the artworld. It is imperative to note, however, that I drafted this paper in November 2023. Given the rapid developments in the field of synthetic image generation during this interim period, this paper strives to capture and elucidate an evolving process..

ARTISTS' REACTIONS

As is customary with new phenomena, the advent of predictive media naturally sparked various associations, including the rhetoric of fear. In the public discourse, akin to the advent of photography, initial concerns arose, questioning its artistic merit and the role of artists in

visual culture. In the next part of the essay, I shall consider reactions of Hungarian artists to the emerging technology.

To begin, let us consider István P. Szathmáry's view that artificial intelligence is killing art:

Of course, the useful idiots of misguided progression can now raise their flags high about what a democratisation it is to be Picasso or Basquiat with a few clicks. But there is one small beauty spot here: without the life stories of the real Picasso, Basquiat and Kim Jung Gi, full of struggles, not to mention tragedies and countless hours of work sacrificed to the pursuit of mastery, the masses who rely on AI would wait in vain for the stolen beauty to be embodied on their screens. (P. Szathmáry 2023)[1]

This article was not published in a tabloid or private blog but in a reputable online newspaper, underscoring its gravity. The publication date, January 2023, approximately three quarters of a year after the public unveiling of predictive media platforms, is crucial. Upon initial perusal, the reader is struck by the evident vehemence pervading this excerpt. While the article maintains a more balanced tone elsewhere, the anger here is undeniable. The author perceives a looming threat to the venerable traditions and exceptional talents of international and Hungarian graphic art and painting. The concern in the rest of the article is that generating illustrations, for instance, for a book, might become a more economical alternative to compensating serious artists. Though this is a legitimate concern, the quotation above is radically different in tone than the rest of the paper.

This indignation is further fuelled by the notion that the democratisation of artistic practice allows the creation of an artistic product devoid an authentic life trajectory. Generative platforms seemingly subvert this necessity, enabling art to manifest without the expected life trajectory, preparation, experience, or knowledge. This paradigm shift raises ethical concerns, suggesting that artists can be supplanted by synthetic technology with a click or two. However, the very construction of artistry implies the implausibility of this theoretical substitution, for algorithms lack the essence of an artist-concept, rendering their products ineligible for the esteemed status of true art.

Moreover, the phrase "stolen beauty" not only implies that non-artistic creations are not artworks but that they are not genuine intellectual products of their supposed creators. They are perceived as stolen from the authentic artistic realm because generative models have learned everything from real, human artists. So, what really happens when a synthetic image is created is really theft.

Leaping forward in time to the July-August 2023 edition of *Digital Photo* magazine, published approximately six months after P. Szathmáry's article, image generation emerges as a prominent topic

[1] *All translations of Hungarian sources are mine unless indicated otherwise—Zs. A.*

of discussion. The editors engage photographers in insightful interviews on this subject. The photographers each express their opinions in a short paragraph, and it becomes evident that outright rejection is not the prevailing stance. One speaker whose insights I identify with is Flora Borsi, a highly acclaimed and internationally recognised photographer with a notable impact in the realm of technological advancement and digital editing (Szemerey 2021).

Expressing her views on predictive media, Borsi pinpointed a critical concern: the provenance of the images and the corpus on which AI has been trained. In her words,

my biggest problem is the source of the images, and what AI has been trained on, the images based on that are all stolen, and no one has been asked to use them, no permission has been sought. Because for me this is an ethical boundary that I never want to cross, so as exciting as it is, I don't want to touch it. (Bánkuti 2023, 3)

Essentially, Borsi echoes P. Szathmáry's discourse of theft, akin to, albeit from a different vantage point.

In so doing, Borsi shifts the identity of the transgressor from the individual creator to the application's developers. She alleges they illegally trained AI, and in the process stole intellectual property. Through the metaphor of touch, she elucidates her personal stance on the matter, highlighting the impossibility of embracing this technology in her creative practice. This perspective offers a captivating glimpse into the evolving ethical landscape, where the debate has expanded beyond questioning the essence of art to critiquing the practices of those who construct such applications. In this light, Borsi's position underscores a nuanced critique of unethical actions without negating or mentioning for that matter the essence of art itself.

In the current landscape, exemplified by Péter Szalai's October 2023 article in *Forbes* profiling Hungarian creator Dávid Szauder, a discernible shift in rhetoric has unfolded. Szauder, lauded as the one "who has mastered the art of manipulation and has perfectly found the place of artificial intelligence in conscious creation" (Szalai 2023), highlights this transformation. Essentially, within the space of less than a year, it appears that the narrative has shifted in favour of predictive media assuming its rightful position. However, it should be noted that the rhetoric of fear still prevails in October 2023.

In approaching the applications crafted for the creation of predictive media, widely accessible to all, one must adopt a historical lens and embrace a precise vocabulary intertwined with a comprehensive and theoretical framework. This endeavour becomes imperative as the prevalent rhetoric, while often justified and occasionally amplified, accentuates the inherent tensions defining a discourse entrenched in

the dichotomy of humanity versus technology. It is through grasping the essence of this tension that we unlock the potential for a discourse that transcends the confines of the still prevailing rhetoric of fear.

POSTHUMANIST PREMISES

It is evident that, until this point, the narrative, whether enveloped in fear or acceptance, has located the human being, particularly the artist, at the centre of contemplation. This perspective naturally culminates in a scenario where the position of the human/artist is tenuous and imperilled, weighed down by the escalating influence of technology in the dichotomy of the human/artist versus technology. However, the centrality of the human/artist is not an obligatory assumption, and it is precisely this assumption that the posthumanist approach seeks to problematise.

While acknowledging the truth in Nemes' (2018, 377) assertion that "in the case of posthumanism we cannot speak of a definite and coherent system of thought," it is feasible to discern three overarching and abstract common denominators within this diversity: "post-humanism," "post-anthropocentrism" and "post-dualism" (Ferrando 2020, 77). Drawing from these principles elucidated in Francesca Ferrando's *Posthumanist Philosophy* while problematising anthropocentric theories, posthumanist thought endeavours to place all other entities in their appropriate context by displacing humanity from the centre of attention. The objective of posthumanism, then, is to perceive the human being not as an exceptional, universalisable entity, but to comprehend humans through their interactions and collaborations with other entities, interconnected and interdependent, rather than existing in isolation. The posthumanist perspective provides a lens through which we can perceive the human/artist not merely as an operator of technology, but to comprehend human activity within the intricate web of technology interactions.

In the context of this paper, this implies that cooperation and interaction transcend the mere use of tools. It signifies a process where two entities in harmonious collaboration contribute to the creation of an artistic product. This collaboration entails the construction of a unique visual realm through the intertwining of one's own vision (human/artist) and that of the other (application), leading to the creation of a unique, special, and shared visual language.

PREDICTIVE MEDIA AND ART

This entails an exploration of the interplay between human creators and algorithms, harmoniously labouring to craft a genuine work of art. While investigating this collaborative process, it is worth drawing insights from artistic traditions akin to activities conceived as a symbiosis of human and technology—an examination of how

predictive-generative imaging finds its place within recognised artistic paradigms. Once I have charted the contours of creative collaboration and identified established artistic traditions, we can proceed to consider the matter from the vantage point of the resultant product of artistic endeavour.

CREATIVE COOPERATION

Considering art through the lens of artistic practice underscores the essence of creative collaboration. This collaborative process encompasses the construction of the prompt, the textual command, the nuanced adjustments within the application, the curation of the final images and editing of the images. The prompt initiates the image generation, and its formulation determines the course of the process. The construction of this input, often termed "prompt engineering" in academic discourse, serves not only as the objective of the artistic process but also as an understanding of what the machine can interpret from the text, enabling appropriate image generation procedures.

An adeptly crafted prompt constitutes a vital facet of the artistic process. Jonas Oppenlaender succinctly encapsulates this by stating that:

together, this knowledge and the skills constitute the practice of "prompt engineering"—that is, the creative practice of writing effective textual input prompts for text-to-image generation systems. […] For instance, knowledge of which aspect ratio to choose for a specific subject and an understanding of the system's training data and configuration parameters is key to produce high-fidelity images. (Oppenlaender 2022, 198)

However, the resulting image from a textual prompt may not always align with the artist's original intent. Thus, further refinement becomes imperative, a stage described as fine-tuning. This fine-tuning of the application may hinge on configuring filters or issuing supplementary text prompts, underlining the necessity of the hermeneutics of the medium, constituting an indispensable trait for effective co-creation.

It's important to acknowledge that even after formulating the appropriate prompt and refining it meticulously, the artist does not immediately obtain the final artwork. In truth, numerous iterations need to be generated before the artist attains an image deemed satisfactory. Essentially, by the time the artist reaches the final artwork, they must navigate through and discard a multitude of images, underscoring the significance of curation as an integral facet of the artistic endeavour.

Moreover, the creative process frequently extends beyond this point, often transitioning into a phase akin to what photographers term "post-production." This entails increasing the image's resolution and subsequently editing it. The journey towards creating a work of

art encompasses expertise, a creative trajectory, and a multitude of artistic decisions. It is essential to recognise that the algorithm serves as a collaborative partner throughout this process, augmenting and enriching the artistic outcome. As Cetinic and She (2021, 12) put it:

From the artist's perspective, the latent space is neither a space of reality nor imagination, but a realm of endless suggestions that emerge from the multi-dimensional interplay of the known and unknown. How one orchestrates the design of this space and what one finds in it, eventually becomes the major task and distinctive "signature" of the artist.

Within the workflow, even when considering the image-generating application as a cooperative and equal partner, a pertinent question emerges regarding the algorithm's substantial involvement in the image generation process, a facet that surpasses the creator's direct influence. It appears that the algorithm possesses some autonomy, as deploying the same prompt and parameters can yield diverse images. Consequently, a notable segment of the workflow operates beyond the artist's purview, defying their control and seemingly challenging the prospect of genuine collaboration. One might, however, argue that this dynamic is inherent in interactions between equals, where neither entity exerts dominion over the other.

PREDICTIVE MEDIA AND THE PRODUCT OF ARTISTIC ACTIVITY

When delving into the "autonomy" of the algorithm, specifically its indeterminate nature, within the present framework, we encounter two core inquiries pertinent to the resulting product: the matter of technological exposure and the matter of tradition.

On the one hand, a fundamental concern revolves around technological exposure—the artist, in a sense, operates under technological bondage, lacking insight into the internal machinations of the algorithm post-prompt issuance. While this holds a measure of truth, it is a truth explored through an attempted act of creation even when veiled in ignorance. This scenario parallels the notion that randomness, such as a cat walking across a keyboard, could potentially result in art. However, it is vital to acknowledge that exposure to technology has always been entwined with artistry. Art invariably takes shape in concert with the chosen materials and mediums—an interactive interplay where the artist assumes a role beyond the realm of an absolute master, engaging with the paint, materials, and tools. This essence holds true in photography, where the photographer need not possess exhaustive knowledge of every algorithm or file type contributing to the digital image.

Throughout art's evolution, a "black box" of technology has always been present, interwoven with the creative process rather than standing apart from it. This technological enigma is inherently part of artistic practice, and coexisting with it is an integral facet of artistic activity. Yet, as previously underscored, the artist's role does not dwell in complete ignorance but thrives within the realm of comprehensible knowledge. Just as artists possess a grasp of the materials and tools within certain confines, they incorporate these known elements into the creative process. As Caramiaux and Alaoui (2022, 15) claim "the complexity of AI as a material, and the difficulty of predicting its outcome, seems to be a fundamental element of the expressiveness of the technology."

Exposure to technology opens another interesting perspective. One problem, characteristic of predictive image generation, is that no matter how many times the same prompt is fed into the application and all other parameters are kept, the application always generates different images. A kind of indeterminism thus characterises image generation, which, like technological exposure, can be a problem in terms of curtailing the creative power of the artist. However, artists working with imaging applications see this phenomenon differently. In their interviews with artists, Caramiaux and Alaoui (2022, 15) point out that "the non-deterministic nature of AI leads to errors and accidents that can have a critical role in the creation of an art piece." Thus, indeterminism emerges as a liberating force for creators rather than evoking regret for the lack of absolute control over the creative process. Within this interplay, the artist and the algorithm stand as equal collaborators in crafting the artistic product.

To comprehend this, let us turn to the insights of Kieran Browne, who elucidates referring to Levi-Strauss's concept of the bricoleur, who "need not understand or make their tools, they redefine them for their own purposes. For most artists working with contemporary AI, this is standard practice" (Browne 2022, 132). The crux therefore lies in recognising that within creative collaboration, exhaustive knowledge of every facet of the Other is not a prerequisite. Rather, the essence of art is found in the creativity imbued within collaboration and the judicious application of art for one's distinct objectives.

The judicious application of technology, avoiding absolute dominance, holds significance from another vantage point. In terms of the product's non-deterministic design, a connection can be drawn to well-established artistic traditions that inherently integrate this characteristic. One notable instance is stochastic art, an artistic approach where randomness and indeterminism form foundational artistic principles. Numerous concrete examples within this artistic realm exist, but I shall highlight only one. The exceptional aleatoric conceptual paintings by András Wolsky, a Hungarian artist, painter, exemplify this emphasis on randomness. In essence, chance and indeterminism need not stand in opposition to art; rather, they can coalesce to enrich its essence.

PREDICTIVE MEDIA AND THE ARTISTIC COMMUNITY

Even if we understand the collaborative effort of the creator and the application, there remains the question whether predictive media can be considered art. Evidently, this age-old question, i.e. what makes art, has eluded a definitive answer and has been a subject of contemplation since Plato. It might be more straightforward to assert that art obtains its definition from the collective agreement within the artistic and aesthetic communities. So, in this section I shall present two examples that prove that predictive media can find its way into the art world.

The first case provides evidence that even without comprehensive information, the artists' community recognised an image produced through predictive technology as an exceptional photograph. A notable example is the winner of the Sony World Photography Awards 2023 (Sony 2023), which was an image generated by Boris Eldagsen, a photographer from Berlin, utilising the DALL-E application. Upon winning, Eldagsen declined both the award and the prize money, declaring the work an experiment, and highlighting the necessity of establishing a distinct category for image generation. Eldagsen termed his activity and the distinct category "promptography" (Eldagsen 2023) emphasising the essential role of prompt engineering in the case of predictive media. In the context of this study, what is important is that the image, "PSEUDOMNESIA | The Electrician," was regarded a photograph of artistic value by the competition's curators and jury members, essentially a distinguished community of photographers. The fact that they were unaware of the image's creation mechanism is less intriguing from this perspective than the product gaining recognition from the artistic community.

In the second case, exemplifying the standpoint of photographic artists towards generated images, I will mention a 2023 contest organised by Hungarian gallery, cafe, and photo shop Főfotó. This competition specifically welcomed generated images that mirror the style of prominent figures in Hungarian photography history (Izing 2023). It is important to note that this does not signify an outright acceptance of generated images as art within the artist communities, but rather represents a potential step in that direction.

CONCLUSIONS

We have explored the discourse and framework conducive to viewing image generation as an art form, avoiding sensationalist and misleading terminology. As a theoretical foundation, I adopted the posthumanist approach, which provides a framework for taking artists and algorithms as equal collaborators. We have examined predictive media from both the process and product perspectives. Based on this we can conclude

that it is more fruitful to understand predictive media not in opposition to photography or painting, or even the hybrid digital art of the past and present, but as a distinct art form separate from traditional modes.

Discussing the impact of image generation on visual culture at this juncture presents challenges, primarily because the transition of image generation into the public domain is a relatively recent development. This complexity is heightened by the necessity to acknowledge that the initial enthusiasm surrounding this innovation may wane if the model of free access proves unsustainable. Furthermore, copyright issues must be overcome as well. In September 2023, OpenAI unveiled DALL-E 3 to the public, allowing visual artists to withdraw their images from the training corpus (Wiggers 2023). To avoid creator related copyright issues, the T2I application Tengr.ai, which launched in November 2023, built image editing into the process of image generation so that the product would be made by the human creator, i.e. user of the application (Tengr.ai 2023). However, it is evident that image generation already exhibits enormous potential across various domains. It stands to impact professions that involve visual content creation and offers fruitful applications within educational contexts. Moreover, it presents a compelling arena for experimentation and exploration in the realms of visual arts.

REFERENCES

Bánkuti, András. 2023. "Borsi, Kincses, Korniss és Szlukovényi a Mesterséges Intelligenciáról." *Digitális Fotó*, 23 (4) Július–Augusztus: 3–4.

Browne, Kieran. 2022. "Who (or What) Is an AI Artist?" *Leonardo* 55 (2): 130–34. https://doi.org/10.1162/leon_a_02092.

Caramiaux, Baptiste, and Sarah Fdili Alaoui. 2022. "'Explorers of Unknown Planets': Practices and Politics of Artificial Intelligence in Visual Arts." *Proceedings of the ACM on Human-Computer Interaction* 6 (CSCW2): 1–24. https://doi.org/10.1145/3555578.

Cetinic, Eva, and James She. 2021. "Understanding and Creating Art with AI: Review and Outlook." https://doi.org/10.48550/ARXIV.2102.09109.

Eldagsen, Boris. 2023. "Sony World Photography Awards 2023." Boris *Eldagsen* (blog). April 14. https://www.eldagsen.com/sony-world-photography-awards-2023/

Ferrando, Francesca. 2020. *Philosophical Posthumanism*. London: Bloomsbury Academic.

Izing, Róbert. 2023. "Tudsz olyat, mint Capa, Kertész vagy Brassai? Akkor eljött a te napod!" *Roadster* (blog). March 5. https://roadster.hu/fotos-ai-palyazat-fofoto/

Manovich, Lev. 2023. "Seven Arguments about AI Images and Generative Media." In *Artificial Aesthetics*, 1–25. http://manovich.net/content/04-projects/168-artificial-aesthetics/lev-manovich-ai-aesthetics-chapter-5.pdf.

Nemes Z., Márió. 2018. "Ember, embertelen és ember utáni: a poszthumanizmus változatai." *Helikon Irodalomtudományi Szemle* 59 (4): 375–94.

Oppenlaender, Jonas. 2022. "The Creativity of Text-to-Image Generation." In *Proceedings of the 25th International Academic Mindtrek Conference*, 192–202. Tampere: ACM. https://doi.org/10.1145/3569219.3569352

P. Szathmáry, István. 2023. "Lopott szépség – Így öli meg a mesterséges intelligencia a művészetet." *Válaszonline*, January 11. https://www.valaszonline.hu/2023/01/11/muveszet-progresszio-mesterseges-intelligencia/

Sony (blog). 2023. "Sony World Photography Awards 2023." https://www.sony.co.uk/alphauniverse/stories/swpa-2023-winners

Szalai, Péter. 2023. "Benne van a varázs… Ecset lett a mesterséges intelligencia egy magyar művész kezében." *Forbes*, October 9. https://forbes.hu/uzlet/szauder-david-mi-ai-muvesz-art/

Szemerey, Eszter. 2021. "„Szeretnék Halhatatlanná Válni a Művészet Által": Interjú Borsi Flórával." *Elle*, November 12. https://elle.hu/kultura/szeretnek-halhatatlanna-valni-a-muveszet-altal-7626

Tengr.ai (website). 2023. https://tengr.ai

Wiggers, Kyle. 2023. "OpenAI unveils DALL-E 3, allows artists to opt out of training." *TechCrunch+*, September 20. https://techcrunch.com/2023/09/20/openai-unveils-dall-e-3-allows-artists-to-opt-out-of-training

A Distant Reader

An Interview with Iván Horváth by Szilvia Maróthy and Márton Szentpéteri

https://doi.org/10.21096/disegno_2023_1szmmszih

Iván Horváth (b. 1948), professor emeritus of ELTE is one of Hungary's leading literary scientists, an internationally pioneering scholar of digital humanities, engaged, as early as the seventies, in computer-aided literary studies—a field he would later call humanities informatics. He is a prominent researcher of Bálint Balassi and of early Hungarian literature and a major figure in the publication and interpretation of Attila József's oeuvre. Active as a public intellectual during the years of Hungary's democratic transition, he was a founding editor of the journal 2000. Professor Horváth is also a noted HiFi enthusiast and expert, and one of the initiators of the Wilhelm Furtwängler Society of Hungary.

Disegno: One stimulus for this conversation is your "digital ascendance," so to speak, your recent election as (first) honorary member of the Digital Academy of Literature (Digitális Irodalmi Akadémia, DIA).[1] The other is the book you and your son, Andor Horváth, are working on, and which, if we are not mistaken, can be read as a kind of design history. How did you initially discover digital humanities, or, how did you, in a sense, invent the field?

Iván Horváth: Me?! it was Franco Moretti, with his relatively recent book on distant reading, who invented digital humanities.[2] Although, in a sense, you could say I invented it too, given that my book The Poem[3] is about looking at poems through different glasses. Putting on a certain pair of glasses, I see poems not as subjects of scientific inquiry but as messages from a world beyond direct experience. Putting on another pair, I see a specific mode of speech, the subject of literary studies. Putting on yet another pair—the book has three chapters—, I see an enormous array of poems which I process right away as a literary historian. World literature is, for the literary historian, a gigantic pile of texts. Without a computer one cannot even touch it. This modern literary science can be beautifully practiced without knowing languages.. I am being ironic here. And so is Moretti—which I like. So yes, I have something to do with digital humanities. The field of humanities came into being in the Middle Ages and

[1] *See: https://dia.hu/hirek/uj-tagokkal-bovul-dia*

[2] *Franco Moretti. 2013.* Distant Reading. *London: Verso.*

[3] *Iván Horváth. 1991.* A vers. *Budapest: Gondolat.*

has worked perfectly well. I think we, humanities people, are dealing with the same kind of issues even today, nothing has changed, basically. There is a journal or yearbook called *Digital Humanities*, originally titled *Computers and the Humanities* in the sixties—I would stick with the old, more modest title. Computers are great, and as humanities students and scholars are expected to know everything, using computers is compulsory. But it is too strong to call this digital humanities. Moretti, who stirred up the whole storm, says he does not know what digital humanities means, either.

D: Even if everyone in the humanities must have some expertise with computers, we can basically say that humanities research that applies computer-based tools and methodologies is different from traditional research. For example, in creating and formalising a database it is necessary to diverge from traditional interpretations…

IH: My first book was on Balassi,[4] and it read as if it was written using computers, even though when I finished the manuscript in the late seventies, the computerised inventory of old Hungarian literature was not yet available. I used the existing, mostly printed, bibliographies, and my handwritten cards. If needed, one can fulfil the role of the computer, only in a way that is mind-bogglingly slow and risky in terms of making scientific hypotheses. The three branches of the literary sciences are publishing texts (critical edition), registering texts (bibliography), and arranging texts into a meaningful narrative (literary history). Plus the fourth one of making such pompous claims (literary science). As is the case with any quantitative research, it is better to set up a database of the forms of versification with computers. This is how I and my students created my opus magnum, the RPHA database of medieval and early modern Hungarian poetry.[5] But the first such database, on the metrics of troubadour poetry, a classic work by István Frank—a Hungarian!—, published in Paris, 1948, was created without using computers. Our inventory is much more multifaceted, suitable for much better queries, but Frank's work is still great to use and our approach is mostly the same.

D: But can we say that, beyond thing like expediting the making of databases and queries, computers also elicit revelations in literary research?

IH: Truly novel things are very, very rare. Once I managed to prove the "izo rule"[6] about old Hungarian poetry in a fully inductive way—this would have been much more difficult to do before computers. But a lot of these things are trivialities. I think the first Hungarian publication in digital humanities was a statistics of phonemes in Endre Ady's oeuvre which helped me learn that Ady used the exact same speech sounds and with roughly the same occurrence as me

[4] *Iván Horváth. 1982.* Balassi költészete történeti poétikai megközelítésben. *Budapest: Akadémiai Kiadó.*

[5] Répertoire de la poésie hongroise ancienne, 1979–2023, *https://f-book.com/rpha/v7*

[6] *A finding on the relative formal homogeneity of verse form and rhyming in sixteenth-century Hungarian poetry.*

(or any Hungarian). A truly edifying read, right? Moreover, it is often the case that what we ask from the machine is not what we are really curious about but what we are technically able to formulate.

D: It is often claimed—by Mario Carpo, among others—that by altering the medium of architecture, computer-aided design (CAD) has also altered the practice of architecture: perhaps a gigantic tower like Burj Khalifa could have been designed before too, but computers not only radically shorten such a process but effect every detail from structure to surface. Can we speak of analogies here?

IH: Literary science has changed, no doubt about that. Humanities research has become much faster and more effective, ever since we have a world library. But I do not think that the research methods of the humanities have changed. Our advantage is comparable to the change the invention of glasses brought in the Middle Ages. I am also happy with our much derided symbiosis with computers and the net; very different from my times in the seventies, characterised by GDR and Soviet mainframes and Bulgarian discs.

D: Getting back to the relation between planning – modelling and design: this is an important element of research in the humanities involving computers; for example, a text edition's structure, the data model of a database and its design are interrelated aspects.

IH: Interrelated they are! You are right, now I am getting your point. Yes, I can tell you about thorough changes underway in the literary sciences, thanks to computers. As I said, we mostly deal with registering works, publishing their critical editions, or organising them into a narrative. Now, the first two are merging. Databases and text editions fuse. The critical edition of the Balassi oeuvre and of the "Old Hungarian Lamentations of Mary"—in preparation—will be integrated into the RPHA, while the upcoming critical edition of the sacramentary that contains the twelfth century "Funeral Speech" has from the beginning been a collaboration with the *Usuarium* project, a monumental, international database of all medieval sacramentaries (lead by Miklós István Földváry). But our approach has not changed. Without the required tools we just couldn't do these things before, but never stopped dreaming. There is an expression used by OULIPO, the Parisian literary circle I am loosely aligned with: anticipatory plagiarism. Take the case of Tibor Papp who was into producing automatic hexameters—he got so angry with me when I told him about a similar enterprise by the seventeenth century English poet, John Peter.[7] So, it seems something was realised even before it was invented. Such a case of anticipatory plagiarism in the computer-aided humanities is the vogue for big data. Big data is a nightmare to work with without computers, nevertheless the Russian formalists, the first structuralist school, loved to work with

[7] *John Peter. 1677.* Artificial Versifying.

a lot of data. One can draw less scientific conclusions from a single utterance of a poet than from a hundred thousand poems, so they fell in love with this approach even before computers. The forefather of the formalists, Alexander Veselovsky was already conducting big data research at the end of the nineteenth century. Vladimir Propp was also thinking as if there were already computers when he created his folk tale morphology, inferring general rules from a certain corpus of tales. One more thing about modelling: our introduction to computer science happened parallel to the emergence of generative linguistics in the sixties. Chomsky's model can be interpreted as a computer before computers. It was a philosophical and mathematical model of man—at the university in the sixties, I was reading it conspicuously, and there were professors who even taught such things in secret. Everyone was a Chomskyite in those days. In his early period, Chomsky regarded language as defined by transformational rules: take S (sentence) and rewrite it as NP (noun phrase) and VP (verb phrase). And really that is how you create a sentence. As if you were commanding your servant, a robot, a computer. There is a sadistic, bossy aspect to it, which has its lure. Eased by a more humanistic and creative aspect: sentences no one ever heard before can be generated and understood. Anyway, for Chomsky, sentences in natural language are formed as if people were computers, and I would count his amazing popularity among the early computational inspirations in the humanities.

D: There is another Chomsky though, the one who is sceptical about the earlier Chomsky in his book on Cartesian linguistics.[8] There he compares cybernetics, machine translation, modern computers, and linguistics to automatons and Descartes. Chomsky writes that language cannot be made perfectly algorithmic, precisely due to the creative aspects of language you implied. How do you see this question in the age of artificial intelligence? Is it possible to formalise and algorithmise even the creative aspects of language usage? What does the computer know now it did not know back then?

IH: I have not had the time yet to delve into artificial intelligence. As far as I can see, we have witnessed the creation of a semantics-based, passable machine translation program (that is, one that translates not directly to another language but to sememes, meanings). If that is indeed the case, that is a very big thing. Machine intelligence is perhaps not here yet. (Natural intelligence is often on leave too, for that matter.)

D: Let us talk about your new book on photo cameras and HiFi systems. Can one find links here to digital humanities?

IH: Yes, the end of the sixties—the time of Chomsky becoming the most cited author, the time of launching Computers and the Hu-

[8] *Noam Chomsky. 1966. Cartesian Linguistics. New York: Harper & Row*

manities, the beginnings of digitisation—are quite interesting when looked at from the other side: *Analóg* is the working title of the book Andor and I are working on. By the late sixties, analogue technology had reached very high peaks in the industry of high fidelity sound reproduction. No doubt that the inventions of the following decades yielded great results as well, everything got cheaper and more accessible—there was a giant leap in quantity but perhaps not so much in terms of peak quality. Something happened in design around 1968, certainly something to do with a major shift in mentality in the background. If you walk into a HiFi store, you will see some vacuum tube amplifiers. People are going back to sixties' technology. Vintage HiFi shops are selling huge, old-fashioned speaker cabinets with; equally staggering price tags. Museal pieces are being restored and kept going. But is there any reason for all this? I once bought a digital amplifier. It soon broke down, the motherboard had to be replaced, one year later it broke down again, the motherboard needed to be replaced again—it is just a faulty construction. I also have an English Quad amplifier, a model designed in 1953 and in production until around 1970. It has vacuum tubes, which—unlike transistors—have to be replaced every five to ten years, but with such care, it will endure for a long time to come. But what will happen to the digital amplifier, even if I am willing to pay for a new motherboard (at the cost of two sets of tubes for the Quad)? One feels there is not only progress but also decline in this field. We have a historical hypothesis about what happened in the sixties. Our book will contain aesthetic analyses on HiFi systems, plus a chapter on the construction of cameras, mostly about lenses. Not about the external but the internal design, the constructional aesthetics.

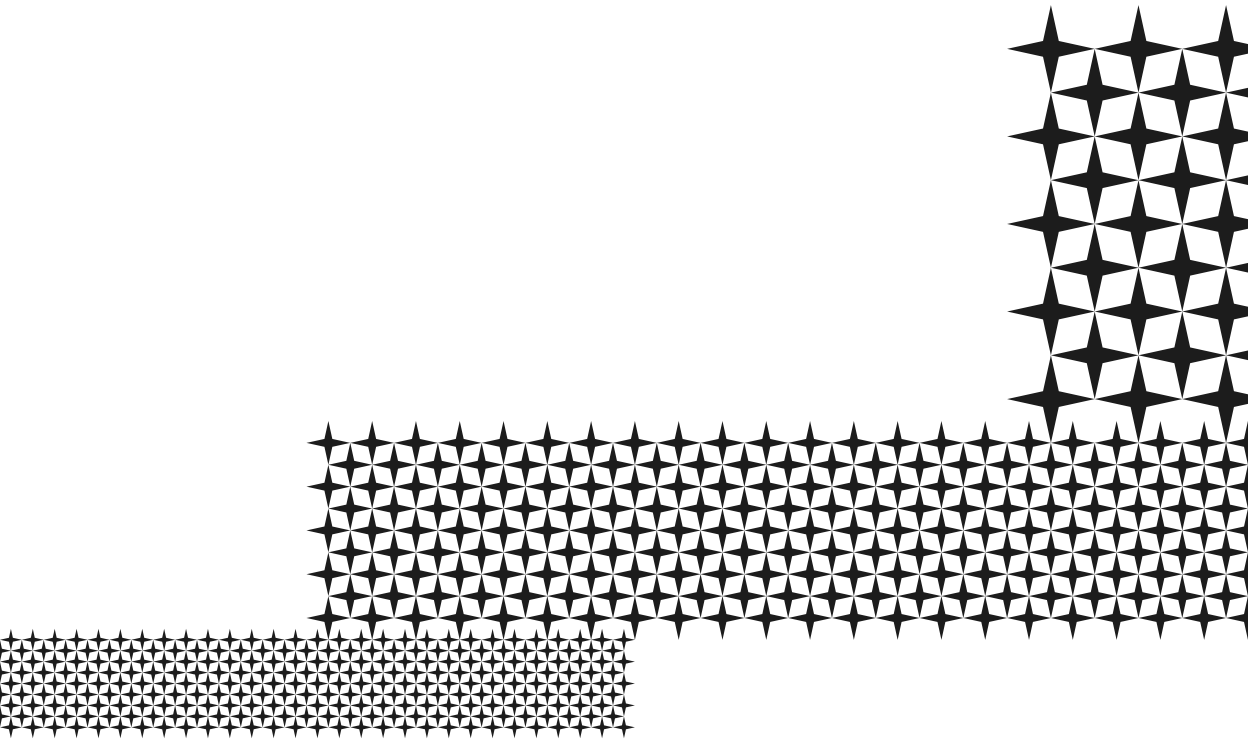
D: You spoke about a historical construction: a turn at the end of the sixties is indeed established in traditional design historiography. It is usually about the end of design in a classical sense—about anti-design, radical design, and postmodernism—, discussed in the light of ideology and the events of '68. But these approaches rarely tackle mediality or the appearance of computers in design at that point in time. What do you think about this?

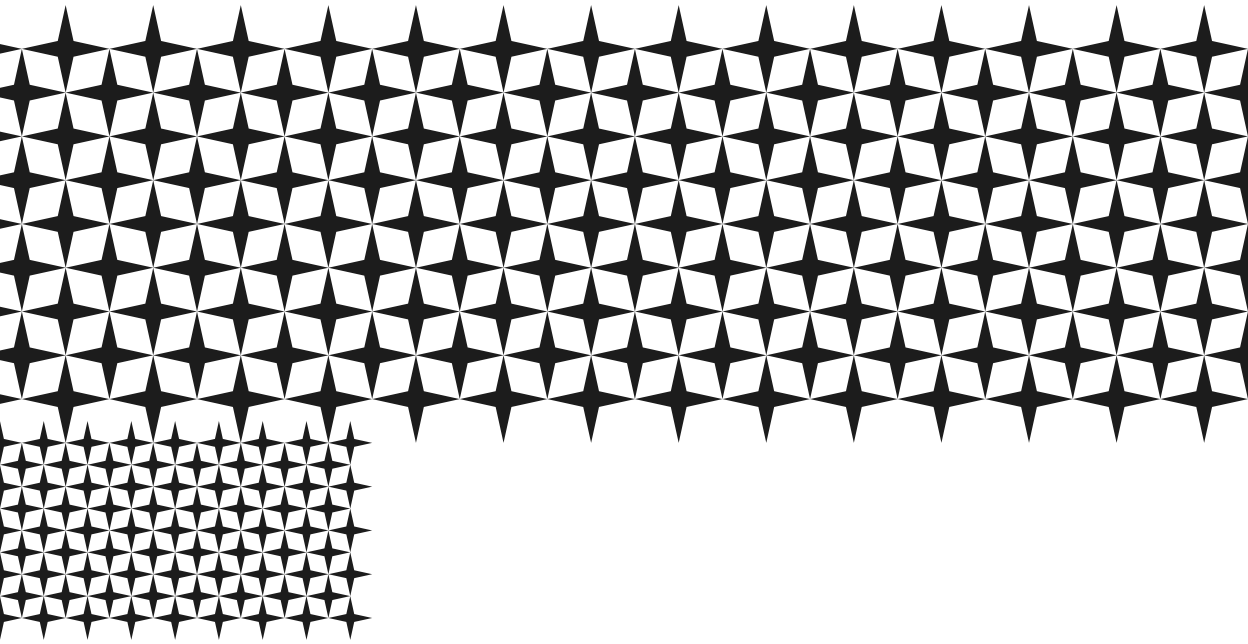
IH: I am not familiar with this field, although I very much like Jony Ive's dI am not familiar with this field, although I very much like Jony Ive's designs, which are in the spirit of the Braun HiFis, or the Leica IIIc, or M3 cameras, or the casing of my Quad amplifier. Which also remind me of the Bauhaus. But the great ambition of our book is to not focus on external design but on constructional design. Where did the designer set the load resistor of the beam power tubes? Is the output transformer's primary resistance attached to the anode, the cathode, or split between them, and if the latter, in what ratio?

Is there global negative feedback or only local? Is there no positive feedback? What is the amplifier's output impedance? What was the general effect of the transition to transistors? What decisions were made in terms of the weight of the membranes, their rigidity; size, width; the materials of speaker enclosures, the depth of reflex tubes? We will investigate these things by analysing famous HiFi csystems. The historical sketch I am supposed to finish alone without Andor's contribution (making it the weak point of our enterprise), starts with Bach—the production of music preceding the reproduction of music. Haydn, Mozart, and Beethoven are also analysed in detail with regard to their relationship to the audience. The idea is to ponder music and its audience without separating one from the other. Bach got to the point of performing concerts in cafés for a paying audience. He always felt it important that he was not a church musician, preferring the title of court composer, bestowed upon him by the Prince of Köthen. He wanted it to be known that he belonged to an institution of music, not to a church institution. Haydn was the composer of an aristocrat but allowed himself some showboating as attested by the Farewell Symphony with the musicians leaving the stage. Mozart freed himself from the Cardinal of Salzburg, and tried to be an entrepreneur in Vienna, making a living from his operas. And Beethoven—he made the human personality his central theme; often, in the odd-numbered symphonies, the self-sacrificing hero. Running through these topics I have brought up some examples of the emergence of the self-conscious man. Before Bach there were only very embryonic cases of independent musical institutions. In an opera, music is not fully independent but stays within the literary institution: theatre. Performing a symphony or a piano concert for a paying audience is a very late development. Compared to painting, sculpture, or literature, music is a belated phenomenon with its roots in wars, pubs, and churches. Only from the eighteenth century can we speak of music as a sovereign domain, with live music reaching its peak of popularity in the 1930s. It was almost unfathomable that Attila József would miss a Bartók concert, despite his poverty. The intelligentsia considered such things important. Contemporary music is now the concern of the few… music, otherwise, has pretty much returned to the cinemas, pubs, and those shows where you're allowed to twist and shout. Beethoven's late string quartets, composed around the time of *The Ninth*, are pieces gone wild. They resemble Bartók, for example. It is very hard to understand and follow them. But on demand Beethoven had to transcribe some of them for piano four hands, as there were many families who could not form string quartets and had to settle for a piano. And they did play these pieces! And even these difficult pieces had audiences, although they really tax the attention and the devotion of the listener. There were some twenty thousand people at Beethoven's funeral! Where is this audi-

ence now? Where are the *citoyens*? In literature, you have Robinson as the first realist novel. In it, the world is taken into account rather literally: how much gunpowder I salvaged from the shipwreck, how many and what kind of weapons, tools, seeds—which I need to stay alive. In his diary, Robinson is occupied with recording what he possesses and what he produces. This is a civic attitude: reality is what I possess. I am socially independent with Providence alone above me. But a romantic aspect belongs to this proud, sovereign self just as much as the factual approach does to the world. I do not only own my wealth, I own my decisions. My free, independent person matters too (the romantic aspect), not only the external facts which I soberly register (the realist aspect). Usually—and perhaps correctly—these merits are associated with the ascendance and eventual political triumph of the bourgeoisie. Now, access to radio, to records was already widespread in the 1930s, then microgroove records appeared in 1948, stereo in 1958. When high fidelity sound reproduction started to get more and more popular, most of its consumers presumably belonged to the traditional bourgeoisie. The best speakers could only fit in properly spacious salons. Amplifiers consisted of two separate boxes already in the mono era. All this was crazily expensive. It is telling of the astonishing musical culture of this audience that some of the reviews in the early issues of *High Fidelity* were written by Glenn Gould himself. But artistic music lost a valuable part of its audience with the contemporaneous emergence of the television, and this whole world was starting to go under around 1968, I think. Vacuum tubes were getting replaced by semiconductors, the large speakers, huge cabinets were getting shrunken to the size of a shoebox. The HiFi industry of the USA and the UK, the camera industry of the two Germanies, the watch industry of Switzerland were in no small part replaced by Japanese products. Everything was becoming mass produced—and perhaps of a bit lower quality—so that everyone could buy them. This was the very substance of this change, I think. By that time all members of the middle class, even employees could buy anything that previously only the bourgeoisie could afford. One could buy colourful coffee table books on art and make imaginary visits to the best museums. Occasionally, one could afford a holiday abroad and make those visits reality. With some years of work, one could build a beautiful record collection; HiFi systems were not prohibitively expensive anymore. One could buy a car, a flat, a modest weekend house. Anything that previously only the bourgeoisie could afford, save for two things (being an employee): freedom and leisure time. György Lukács who never abandoned his enthusiasm for the masterpieces of traditional "Bürger" culture, often emphasized—with the French distinction— that we should keep its citoyen side but throw away the bourgeois side. Does this alluring notion have some truth to it? Or anything to do with computers? Before there were home

computers and personal computers, using computers was a shared activity—time-sharing—where you were only allocated a short time to use computers personally. But IBM has spoken: "Personal Computer. The computer is all yours, working for you exclusively!" This was a bad principle—the UNIX operating system was the good one, for UNIX is based on one's collaboration with one's fellow citizen, "thy neighbour" as it were. The e-mail, the internet, the C programming language are all results and tools of multi-user cooperation. We took the other path. But perhaps in the rosy future, with robots having taken over all the toil of production, with universal basic income, with fully sensual broadcasting and electronic drugs via direct brain stimulation—perhaps then, computers will show their true colours.





About the authors

Ágnes Anna Sebestyén is a Budapest-based art historian and curator at the Hungarian Museum of Architecture and Monument Protection Documentation Center. She obtained her master's degree at Eötvös Loránd University, Budapest in 2013. She is currently a PhD candidate in Design Culture Studies at the Moholy-Nagy University of Art and Design. She has curatorial experience in twentieth-century architectural history and research expertise in the history of modern architecture and architectural photography with a special focus on interwar Hungary. She is one of the curators of the exhibition about modern housing at the recently refurbished Rózsi Walter Villa, the new exhibition space of the Hungarian Museum of Architecture and Monument Protection Documentation Center. Her current research addresses the international transfer of modern architecture in printed media and professional networks. She has published essays in Hungarian and English, and lectured at international conferences on related topics.

Dinara Gagarina is a digital humanities and digital history scholar at the University of Erlangen-Nuremberg, Germany. She is also a visiting researcher at the American University of Central Asia, Kyrgyzstan, and a visiting lecturer at the Faculty of Liberal Arts in Montenegro. With over fifteen years' experience, Gagarina's expertise spans research, education, and infrastructure in digital humanities and digital history. Her interests centre on digital humanities methodology and pedagogy, digital modelling in history, historical information systems, and digital public history. She co-authored the books "Historical Information Systems: Theory and Practice" in 2021 and "Digital Humanities" in 2023, both published in Russian. Gagarina's current projects examine postcolonial digital humanities in Central Asia and the digital documentation and analysis of the Russia –Ukraine war through art. She has experience in developing DH infrastructure, programs, and communities, including launching master's and bachelor's programs and creating MOOCs on digital history and digital humanities.

Dorottya Kun graduated first as a librarian at Eötvös Loránd University, specialising in Book History, and then studied Art and Design Management at Moholy-Nagy University of Art and Design (MOME). Since 2009, she has been working at MOME, where her main activity is managing and developing the library's institutional repository. She participates in the work of the Creation Working Committee of the Hungarian Science Bibliography. Her interests include book art and

different bookbinding techniques, and she has also held bookbinding workshops for children and adults. She is a PhD candidate at the Doctoral School of MOME, where her research is about describing design works through semantic knowledge representation.

Merve Pekdemir Başeğmez holds a bachelor's degree in architecture from Erciyes University Kayseri in 2015, and has been a PhD candidate at Abdullah Gül University School of Architecture since 2017. She was a teaching assistant at Abdullah Gül University from 2017 to 2022. Her primary research interests are in the field of industrial architecture, production spaces, future factories, developments in industry and their spatial reflections on architecture, and industry and city relations. She is also interested in technology, human-technology interaction, and introducing the terms "smart production," "smart factories," and "smart cities." Her academic research field includes architectural history, modernisation, post-modernisation, and design and theory. She is co-author of several publications.

Burak Asiliskender is Professor of Architecture at Abdullah Gül University and the Dean of the School of Architecture. He has been also working as the Advisor to the Rector for Bologna Process and Accreditation. He was former—and founding—chair of the Department of Architecture. His work focuses on architectural theory and design; space, place making, spaces and identities in transition, in particular. He has several publications on architecture and identity, space and place concepts, and transformations of space and cities. He has been involved in the design and implementation projects for the restoration and adaptive repurposing of the former Sümerbank Kayseri Textile Factory as an AGU campus.

Iacopo Neri serves as Computational Lead at the Institute for Advanced Architecture of Catalonia - IAAC, and scientific collaborator for the Center for Digital Visual Studies (Max Planck – University of Zurich) focusing on Urban Digital Visual Studies. With research at the intersection of architecture, computer science, and urban studies, he has been involved in teaching activities since 2015 at the University of Florence, the Polytechnic University of Milan, the Ecole des Ponts – ParisTech, the Harbin Institute of Technology, and at IAAC. Engaged in both theoretical and applied research, he is passionate about the implications of machine learning for architecture and city studies and has been a lecturer at institutions including AA, UCL Bartlett, and Imperial College in London.

Darío Negueruela del Castillo has been scientific and operational coordinator of the Center for Digital Visual Studies (Max Planck – University of Zurich) since January 2020. Between 2017 and 2019, he was Head of Research at ALICE lab, École Polytechnique Fédérale de Lausanne (EPFL), where he completed his PhD entitled "The City of Extended Emotions" in 2017. Previously, he was founder and principal of Ná architectural office in Madrid after receiving an MSc in Architecture from TU Delft and a BA from the University of Westminster. In 2021, he coordinated "Deep City International Symposium" at EPFL, and, previously, the International Symposium "Scaffolds – Open Encounters" in Brussels. His research spans architecture, urbanism, affective science and spatial and visual perception with special emphasis on imagination and spatial agency.

Ludovica Schaerf is a PhD fellow at the Digital Visual Studies Center (DVS) between the Max Planck Society (MPG) and the University of Zurich (UZH). She holds a bachelor's in informatics from Amsterdam University College and she completed a MSc in Digital Humanities at the Swiss Federal Institute of Technology in Lausanne (EPFL). Before joining DVS, she worked as a Data Scientist for insurance and academic publishing and as an AI developer in the art market. She is currently interested in critical computer vision and computational creativity, with a focus on latent space analyses of deep learning models specialised in design and artistic creation.

Valentine Bernasconi is a PhD student in Digital Visual Studies and is working on the computational analysis of the painted hand in early modern times. Strongly interested in the field of art and new technologies, she received an education in Computer Science and Art History from the University of Fribourg before accomplishing her first master's degree in Multimedia Design and 3D technologies at Brunel University London. She then naturally engaged the new field of study of Digital Humanities and pursued a master's (MEng) in the domain at the Ecole Polytechnique Fédérale de Lausanne (EPFL).

Pepe Ballesteros Zapata is a PhD fellow at Digital Visual Studies (University of Zurich). His background is in telecommunications engineering. He received an MSc in "Signal Processing and Machine Learning for Big Data" from ETSIT-UPM. His master's thesis proposal was a winner of the Radiotelevisión Española (RTVE) funded contest "Impulsa Visión Ayudas a la Investigación III." In the resulting work he developed text generation systems for AI-assisted journalism. He is currently interested in computational models for the analysis and study of art. His research focuses on the application of computer vision models that describe light features in early modern painting.

Stefano Corbo is an architect and educator at TU Delft – Chair of Public Building, where he also serves as MSc Coordinator. Corbo holds a PhD and an MArch II in Advanced Architectural Design from UPM ETSAM Madrid. Before joining TU Delft, he taught at several academic institutions in the United States, Europe, the Middle East, and China. Corbo has contributed to several international journals and has published four books, including the recent *Exteriorless: Form, Space, and Urbanities of Neoliberalism* (Routledge, 2023). In 2012 Corbo founded his own office, SCSTUDIO, a multidisciplinary network practicing public architecture. Corbo's research trajectory focuses on the comprehension of spatial and aesthetic conditions that characterise late-capitalist architectural production and that manifest in a diverse constellation of types, typologies, and hyper objects.

Zsolt Almási is an associate professor in the Institute of English and American Studies, Pázmány Péter Catholic University, Hungary. His book, *The Problematics of Custom as Exemplified in Key Texts of the Late English Renaissance* was published in 2004. He is the co-editor of journals *International Journal of Digital Humanities* and *Digitális Bölcsészet* (Digital Humanities) and was co-editor of books with Mike Pincombe, *Writing the Other: Humanism versus Barbarism in Tudor England* (2008, Cambridge Scholars) and *New Perspectives on Tudor Cultures* (2012, Cmbridge Scholars). More recently he co-edited with Kinga Földváry a special issue of *Theatralia* titled *Shakespeare in Central Europe after 1989: Common Heritage and Regional Identity*" (2021). He serves as the head of the Department of English Literatures and Cultures, and is president of the Hungarian Shakespeare Society. His current research projects and publications focus on Shakespeare, Shakespeare in the contemporary Hungarian theatre, digital Shakespeare, and digital and visual culture.