Comics as Big Data: The transformation of comics into machine-interpretable information

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Like so many generic literary reconstructions, comics are now being transformed into information -- a process that, for postdoctoral scholar Ilan Manouach, is concomitant with the expansion of tools and services in the field of generative AI. Like so many AI emergences (and emergencies), this one poses important challenges to the comics industry and the careers of comics professionals.

Introduction

Comics studies have, over the last twenty years, explored the digital affordances of an increasingly networked and globalized comics industry. The field has proved to be fertile ground for studying digital culture in general: it has established new concepts (e.g. relatable media) and tools (e.g. infinite canvas) and explored new forms of comics mediation in a variety of online (Baudry), educational (Troutman), medical (Saji et al.), and scholarly contexts (Helms). The digitization of comics has allowed scholars to rethink the productive agency of the reader in mediated environments (Crucifix and Dozo; Ossa et al.) and opened the door to new models of hypertextual or augmented storytelling (Liestøl; Wilde) to analyze works that make creative use of audio streams (Hague), animation software (Smith) and GIS coordinates (Moore).

This article examines the ongoing digitization of the comics infrastructure. Since the beginning of our century, this transformation has continuously impacted how we produce and consume comics media. The article will specifically delve into a global phenomenon of participatory comics fan culture by examining the activities of a dedicated community of fans known as "scanlators." Their importance as "a significant but fragile part of our digital history" (Wershler et al. 3) has been acknowledged early in various fan studies and comics research works. The article departs from the extensive discussions on scanlators in one significant way: it proposes to recapture the scanlating phenomenon through today's perspective on the increasingly aggregate nature of knowledge production in the computational age. It aims to demonstrate how, behind the massive, distributed and decentralized digitization of millions of unlicensed comic book pages, a globalized fan culture's relatively niche cultural economy

has gradually laid the ground for the informatization of the comics industry. The transformation of comics into information is concomitant with the expansion of tools and services in generative AI, which allows users to produce stunning algorithmic illustrations with a single prompt, posing significant challenges to the comics industry and comics professionals.

The digitization of the comics industry

Speculations about the growing role of automation in artistic production have been a consistent trope in modern and contemporary art debates, mainly throughout the mid-twentieth century and on. However, as far as comics are concerned, industrial manufacturing, automation and scalability are hard-coded features of the medium's operational intensity. Since their early beginnings, comics, as a form of artistic expression, have expanded symbiotically alongside the development of printing, distribution, and communication technologies. The standardization of best practices for transforming craft into mass production has consistently driven the production of mainstream comics. Both formally, conceptually and from a technical and economic point of view, comics have foregrounded important notions of efficiency, marginal utility and computability. The industrial scale of these operations, from the early stages of ideation down to the last-minute editorial revisions, relies on the carefully orchestrated work of different professionals whose formal subjectivities and conflicting personal interests and ambitions are manifested throughout the chain of signification and production. Mainstream comics are, by default, a multimodal construction, the product of a collective endeavor that only sometimes fits the narrow auteurist vision of humanities and literary scholarship (Brienza, "Comics and Cultural Work"). The plurivocal nature of mainstream comics makes the valorization and attribution of labor highly problematic (Gray and Wilkins), increasingly so as mainstream comics are often conceptualized, produced, marketed and distributed in diverse geographical and socioeconomic settings. Comics are therefore, the products of an operative architecture, where the division of labor aims to generate efficiencies and to streamline manufacturing operations that unfold sequentially and are built from discrete instructions, like the stages of a recipe: comics are scripted, written, penciled, inked, colored, lettered, edited, lithographed, printed, marketed, distributed, sold, collected, archived, digitized, shredded and recycled into pulp.

Often situated at the vanguard of capitalism, the comics industry's publishing infrastructures have operated as a disruptive force in the knowledge economy, the copyright establishment and the application and enforcement of patent laws, with tangible effects on its very own professional constituency. In today's online globalized labor markets, information computer technologies (ICT) gradually override mainstream comics' traditional assembly line production model. This expansion and generalization of ICT have long-lasting and unevenly distributed effects across all sectors of the comics industry. This turn is generally understood as post-fordism but has also been codified under different and partially overlapping terms

such as "cognitive capitalism" (Moulier Boutang), "supply-chain capitalism" (Toscano), digital capitalism (Schiller) or semiocapitalism- a concept initially put forward by French philosopher Jean Baudrillard. One needs only to examine, for instance, the consolidation of US retail distribution services of comics in the 1980s (Duncan and Smith) and the massively digitized operations of logistics and global supply chains in the twenty-first century to get a sense of the comics industry's very own vibrant "phydigital" topologies.

A determinant element in understanding the ongoing transformation originates in the globalization of labor and the networked exposure of an impressive constellation of semi-professional and amateur activity related to the dissemination of comics media. The visibility of an international workforce from a diverse range of ethnic and socioeconomic backgrounds has contributed to provincializing the global epicenters of comic book production. Globalization, as opposed to uniformization, is the result of the increasingly interconnected affordances of the comics industry, and it is manifested as a complexification of consumer habits. As Jean-Paul Gabilliet examines in his study of the relative commercial failure of canonical works of Franco-Belgian comics in the US market, the globalized dimensions of the comics industry contribute to an intensified striation of comics cultures and economies where "commodities travel more easily… than the consumption practices in which they are embedded back home" (Gabilliet 266). A similar case can be argued through Casey Brienza's sociological research on the complexities of importing and marketing bestseller Japanese manga for the US market (Brienza, "Books, Not Comics: Publishing Fields, Globalization, and Japanese Manga in the United States").

As convincingly argued by writer Benjamin Woo, the comics industry was never a single entity limited to producing print commodities; it is a diverse ecosystem consisting of multiple sub-industries, legal, printing, retail, distribution, and others. The spreading digitization has contributed to the emergence and the ramification of new sub-industries of professional engagement that largely depend on the introduction of digital tools that have a continuous, profound impact on how information is aggregated, stored and retrieved in the comics industry. The cumulative effects of these technologies have resulted in expanding the scope of knowledge, unsettling the professional capacities and the traditional models of production in the industry. Digital comics are embedded in a media-rich online economy. They have become a highly transactional medium begging for new forms of user engagement and expertise, often adding shades of ambivalence to the already complexified technologically driven labor setup. In the comics industry, these forces are manifest in the gradual collapsing of labor arrangements that have traditionally defined the publishing landscape, only to be superseded by new, expanded agencies that can respond to the precepts of a globalized and highly competitive knowledge economy. The precarization of craft traditions in comics – a by-now familiar theme in studies of creative labor (Hesmondhalgh and Baker; Woo)– converges with the rise of entrepreneurial fan culture with its novel forms of amateur and potentially lucrative activities. The developments in the informatization of the comics industry are essential in expanding the broader dynamics inherent in the comics industry. However, when

they are combined with a growing abundance of available media, they challenge and significantly impact the productive capacities of established professionals while driving a massive increase in the disruptive agency of fans and readers.

Scanlating

As a case in point, "scanlating" is a professional activity at the pulsating center of a globalized comics industry and a catalyst for the advent of generative comics. Scanlating is a portmanteau describing the unsolicited work of a global class of largely anonymous comics fans who buy, scan, translate (usually to English), editorialize and distribute their favorite Japanese manga series online and for free. The term "scanlator" refers to an individual or member of a group involved in the process of scanlation and typically refer to the fans of original series who undertake the translation and editing process as a hobby, driven by a desire to share material that is not officially available in their language or region. Scanlators operate in a legally gray area, as their work involves the reproduction and distribution of copyrighted material without the permission of the copyright holders. Despite this, scanlation has become a widespread practice within fan communities, and the resulting scanlated works are often distributed online through various websites and forums.

Described as filling the gaps existing "between what the industry currently offers and what the fans demand" (Lee 15), scanlating work is "indispensable for the international growth of Japanese manga" (Kataoka 25), as the total amount of translated manga in western markets reflects only a tiny fragment of the Japanese market. The efficiency of scanlating communities is often celebrated, as the digitization, translation and dissemination of the latest chapters from the famous manga series *Naruto* and *One Piece* usually precede the concerted efforts of the rights holders for adaptations in English by many months. This situation is not different for US comics, where "leaks" of digital comics will often hit p2p torrent sites such as The Pirate Bay before their official release date (Alverson), further evidencing the symbiotic development of licensed and illegal dissemination. The scanlators' unsolicited activity, framed as "audience building" (Koulikov) and described in terms of a "gentleman's agreement" (Pink), is often strategically allowed by smaller publishers as a safe breakthrough in foreign markets (Deppey; Leonard) and in some cases, it is even embraced by industry leaders such as Tokyopop's vice president who described scanlating as a "flattering, and not threatening" activity (Yang). Alternatively, scanlating is more generally tolerated as an indirect form of advertising, contributing to a network effect or a word-to-mouth marketing, when not consciously integrated into more extensive strategies for grassroots marketing for publishers based in Japan and for series that are not yet widespread in Western markets (Sinervo).

A recent report regarding the unlicensed distribution of Japanese manga comics demonstrates that revenue from authorized publications is commensurate with the value of distributed pirated manga, equaling $6,92 billion for January-October 2021 alone (Hazra). One should be wary of these comparisons, especially when companies with apparent

commercial interests against distributing unlicensed content, such as the Japanese association CODA (Content Overseas Distribution Association), are commissioning these reports. The economic impact of scanlations on legitimate sales is not linear but heterogeneous and correlated to multiple factors that simple economic calculations cannot capture. It has also been convincingly argued that unlicensed distribution of manga often ends up having the opposite effect in stimulating sales for works that are no longer in high demand (Tanaka), or in the case of other media, the effects of unlicensed distribution are moderate at worst, a conclusion that has been corroborated by different researchers (Martikainen; Smith and Telang). It is safe to argue that most comics nowadays circulate online and through unlicensed and non-accredited channels such as decentralized p2p sharing trackers, cyberlockers, private mesh networks, and third-party cloud storage such as Mega or Rapidgator, rather than through the traditional distribution networks of newsstands, brick and mortar bookstores, community libraries and readings clubs.

Nevertheless, it would be simplistic if we were to calculate the economic effects of the rampant digitization of the comics infrastructure only in negative terms, i.e. expressed through revenue and job losses regarding the entertainment industry and the content providers- a perspective that is, unfortunately, the most prevalent when discussing the scanlating sub-industry. The digitization of the comics infrastructure coupled with new forms of entrepreneurial activity has multiple collateral economic benefits that are hard to co-calculate; new network tools allow considerably democratized access to media content and collectordom, by consolidating distributed communities and significantly lowering the entry bar for the maintenance and monetization of open media collections. The general economic impact of third-party and unlicensed digitization could potentially have contributed to the demotion of labor arrangements that have traditionally defined comics labor, an assumption that regulatory bodies and anti-piracy lobbies will often make when refering to authors facing "the unfair competition of unauthorized sources" (Hardy 1). It is possible that the massive accumulation and dissemination of unlicensed comics media not only has not contributed to the increasing marginalization of established comics artists but that, on the contrary, it is embraced and addressed productively, even by comics artists and publishers themselves, and for that matter, not necessarily only from the small, alternative publishing structures. During WonderCon in 2012, Mark Waid, the writer of the successful series *Daredevil* and *Green Hornet*, argued provocatively that piracy is better than buying comics from Comixology, Amazon's largest comics content provider platform. As a distributor of digital comics on his own site *Thrillbent*, Waid described that equating piracy with lost sales is "baloney" and that his work has benefited from unlicensed distribution, which should be treated as "a vehicle for exposure" (Johnston).

Some scanlating groups will abstain from any market and economic considerations and will devotedly work on a nonprofit basis, sometimes going to the extent of calling out and refusing to collaborate even with crews whose business model will entirely depend on small donations. However, not all groups share the same ideals about the charitable nature of their

work. For instance, scanlating communities do not uniformly share the ethical code prescribing the principle of non-interference with established book publishers who have licensed or are in the process of licensing the translations of manga comics. Some groups will refuse to strictly limit themselves to scanlating discontinued or out-of-print manga and may or may not remove from circulation a scanlation that becomes commercially available by accredited channels, even when they are requested to do so by rights holders.

Disrupting the industry's transactional channels

Nevertheless, describing the business opportunities of scanlating entirely in terms of donations, paid memberships, and advertisements would be very reductive. Some of the larger scanlating groups, boasting a workforce of fifty or so effective members based in various geographies, have the entrepreneurial ambition to redesign the entire customer experience and experiment with new business models. Their motivation to eventually disrupt the industry's transactional channels would even counter legal but equally business-disrupting efforts such as Toshiba's "Manganovel" marketplace, a counter-example to the prevailing corporate lag to catch up with online tendencies. Manganovel was scheduled to launch as early as 2007 and would have offered access to digital manga, allowing users to list and directly sell their scanlations on the website. Manganovel did not go far, with some researchers suggesting that it might have entered the "digital manga frontier too early" (Nowlin, *The Digital Frontier of Manga Part I* 66) before the legal understanding of scanlating was firmly in place. Interestingly enough, Manganovel's ambition to provide digital versions of untranslated manga, otherwise known as RAW files, to anyone who would like to use them for their own fun-dubbed scanlated versions is still common among scanlators and RAW providers. To this day, p2p trackers such as nyaa.si, list hundreds of different scanned but not translated manga series to facilitate the work of manga translators.

Scanlators can centralize different operations such as translation, digitization, archiving, deployment, communication, distribution, monetization and customer sales services under a single workflow process. Consequently, the daily supply of comics catering to subscribed readers is predicated on mediated access through a digital infrastructure with increasing interoperability of services, systems, devices and customized apps. Tachiyomi (a term that refers to the act of reading manga comics in a store without having to buy them), for instance, is a one-stop-shop software solution for comics readers that combines an open-source configurable manga reader for Android devices with a browser plugin that supports offline reading. The software can be programmed to index hundreds of different media repositories and manga aggregators for new entries, offering a comprehensive RSS feed to thousands of available scanlated series. As a bonus, it sports a media library, ensuring portability and permanent ownership. This last feature is essential for readers and collectors who have subscribed to legal content providers such as the Comixology platform and have expressed concern over losing access to their digital files if the company suddenly declares bankruptcy (Kozlowski). To give a sense of the scale of the scanlating phenomenon: in July

2022 alone, Mangakakalot.com, one of the largest online comics repositories providing links to thousands of scanlated manga series, boasted an astonishing web traffic of 743m visits, superseding by a large magnitude the official and legally accredited corporate efforts for community engagement.

A robust literature addresses scanlating from a variety of perspectives: formally (Leavitt; Valero-Porras and Cassany; Fabbretti; Sinervo), historically (Wershler et al.), linguistically (Sell), and socially, in terms of fan labor (Scott; Deppey), and fair use (Nowlin). This literature is informative in itself as it contributes to expanding the understanding of fan labor by bringing into light different forms of unsolicited and largely invisibilized affective labor in online setups. Unfortunately, these new layers of mediation cannot be understood solely as "affirmational" fandom activity (Scott) or as expanded forms of community engagement. What has received little scholarly attention is that comics repositories such as Mangakakalot are more than popular channels to experience comics today. They are large database centers of information extraction that expand the knowledge about comics and thrust the medium from the digital realm into the computational.

Fan labor as data processing

According to the pioneer of modern computer science, Alan Turing, the central logic of calculation conventionally involves any operation following a step-by-step instruction that can be carried out mechanically by any formal machine. The discrete, decentralized and relatively asynchronous operations that are involved in the scanlating production pipeline should be captured in terms of what computer scientist Rudy Rucker describes as computation: any "process that obeys finitely describable rules" involving operations of calculating, processing and transforming information with the help of any possible form of substrate, whether digital or not (Rucker). While computation is not a unique property of computer networks involving sophisticated algorithmic architectures, the ubiquity of digital computers contributed to an efficient, economical and scalable development of computational processes at the heart of scanlating operations. Scholars have described computation as an epistemic tool for bringing to general awareness the understanding of the world as a "complex of information processes" (Denning and Tedre 196) and for revealing its role as always "emergent in- and with the world" (Zylinska 65). Nevertheless, we have yet to acknowledge how readers and fans have harnessed the digital and computational affordances of the comics infrastructure and have contributed to the informatization of the comics industry.

The operational pipeline of scanlating consists of a complex series of activities, which, from a computational perspective, could be understood as a full stack of operations in data processing. Data processing is a critical step in machine learning projects. It helps prepare the data for efficient model training, improves model performance, and minimizes the risk of biased or inaccurate results. It requires careful consideration of the specific characteristics of the data and the requirements of the particular deep learning model used. First, the raw data

is gathered from different sources, such as databases, APIs, or through data scraping. It is then processed to remove any noise or inconsistencies and explored to ensure that it is accurate and reliable and that potential issues or biases will be identified and addressed in time. These operations may involve handling missing values, correcting errors, and standardizing data formats. The data is then transformed into a specific format involving normalization operations, scaling, converting categorical variables, and encoding into numerical representations. This operation customarily involves techniques such as one-hot encoding and label encoding. Finally, the data is validated and error-checked, involving cross-checking data statistics, verifying data integrity, and ensuring it is correctly formatted for building the deep learning model.

The entire scanlating infrastructure can be construed as a vast data processing operation. The scanlating pipeline ranges from acquiring printed comics to finally uploading the translated digital files. As a start, after purchasing the physical releases of manga, scanlating crews will carefully disassemble the pages of the book in order to scan them individually. They will apply a consistent naming typology reflecting page numbering for each one of the resulting digital files. They will then apply with the use of photo editing software, a set of digital operations, such as cropping, rotating, collating splash pages in single files, or even redrawing image fragments when necessary, such as when directly replacing onomatopoeia in Japanese with the less expansive English counterparts. They then optimize files for screen viewing through various tested methods that are well-documented in different specialized wikis. It is not rare that they take care to upgrade the visual experience of the low-quality newsprint by removing moire, erasing ghost images coming from the other side of the page (Aoki) or applying a series of saturating and color-correction filters to enhance the readability for mobile screen settings. This process could also be captured in terms of a media preservation practice when, for instance, scanlators go to lengths to convert the cheaply printed comics documents into "bright white, with crisp, clear treys and solid blacks on top" or heavily edit the documents in order to "fix minor flaws, color correction, and sequencing errors" (Delwiche). Simultaneously with the data processing, the translator, possibly located miles from the scanning operation basis, would deliver the text in the intended target language. The translation, known as "the script," would be then proof-read, eventually editorialized to fit the limited space of speech balloons, and typeset in non-intrusive ways following different consistency and readability rules about fonts, character and paragraph styles that are specific to each crew, before it hits the final quality-check. More often than not, digital files will end up as lossy, highly compressed JPEG files that satisfy the requirements of mobile and tablet screens. Scanlating crews will then store the different files in industry-specific file extensions (CBR or CBZ, less frequently in CBT and CB7) known as comic book archives. These file formats are executable by special manga-reader mobile apps programmed for storing and displaying comic books. Each archive will correspond to a particular chapter of the manga series in order to accommodate users with low bandwidth or address those who have subscribed to a specific comics series and only need to download the latest addition to their existing collection (it is still possible to download entire series once

these have been completed). Here, it is essential to mention that the digital releases come with a variety of added digital material: credits for scanlators, recruiting ads for translators and typesetters, announcements for upcoming uploads, fan art, updates, open letters addressed to the scanlating community, "random rants" to rival crews, birthday wishes, "thank you" letters, call to actions, memes and all sorts of different marginalia. These documents are essential as they reveal a hidden side of the manga industry and document the lives and motivations of the different scanlating communities. The chapters and series will finally be encoded and published on different platforms along with metadata about the author, the genre, chapter-level summaries, user ratings, number of views, and links to previous chapters and suggestions for similar comics series. Finally, the files will be stored in hosting servers, indexed on specialized media repositories such as Mangareader, and advertised through Discord channels, subreddits and any other social media platform.

Manga repositories, comics media aggregators, pirate comics libraries and scanlating groups have not only bypassed and disrupted the industry's transactional channels by addressing the widest readership the industry ever imagined. They have transformed comics, a medium that has depended on well-documented materiality signatures for the more significant part of its history, into information that software systems can understand. Comics became machine-interpretable data that can be analyzed, classified, sorted, structured, processed and integrated into data-intensive applications and machine learning models that are particularly "hungry" for non-photographic imagery and multimodal content. One could therefore examine the history of scanlating from a machine learning project's perspective as one chapter in the larger narrative of integrating AI processes in producing synthetic comics.

Reader participation

Raw data, or any information extracted without being processed, is produced daily in tremendous quantities and comprises the most available data online. For raw data to become "information," it requires procedures of selective extraction and processes of deliberate encoding of features that are rich in domain-specific information and consist of a form of knowledge that "encompasses how much someone knows about a particular field" (Rowe). This process is called "data annotation," and in machine learning, it is a central part of model training in unsupervised learning. While robust models can quickly adapt to new, previously unseen data from the same distribution- i.e. a spam filter can flag new and unseen instances of unsolicited messages sent in bulk- models might have limited transferability in new application areas. For instance, algorithmic models based on photographic representations of everyday objects have little or no applicability in other visual domains, such as 3D art, diagrams, or comics (Zhang and Davison). Therefore, models in many application areas have yet to be developed, not necessarily for want of available data but due to insufficient annotation. Annotated datasets that could test the transferability of existing

computer vision techniques to non-photographic visual domains would have to be based on multiple tags, allowing the neural network to learn and infer much richer, domain-specific information about the images.

At that point, the networked affordances of the scanlating infrastructure play an essential role in revealing online comics' highly dynamic and transactional nature. Scanlators are a digital-savvy class of highly networked users who leverage the Internet's information-dense economy in terms of what writer Tim Jordan names "recursion," the process by which information capital feeds into itself (Jordan). Comics businesses that have centralized their interoperative services, allowing users to connect and discuss comics media, have a significant competitive edge: the deliberate encoding of domain-specific information such as user metadata, which in other contexts would have been a costly and time-consuming operation delegated to click-farms, is instead entrusted to platform users incentivized to annotate, comment and discuss comics media. These new layers of user data provided by fan labor at marginal cost enable manga repositories and scanlators to respond quickly to varying customer preferences, providing personalized customer experiences and delivering targeted marketing campaigns. User data transform each transaction into an opportunity to commodify the attention of a vast readership with the use of tools that are tightly integrated into the whole digital infrastructure: RSS feeds, alerts and notifications, optimized microtargeting ads, digital behavioral signatures attributed to unique readers, heat maps, A/B tests, conversion rates, leads, analytics of user behavior, and tracking cookies for embedded services. User participation is therefore converted into a dynamic, highly monetizable productive activity, enmeshed in a networked infrastructure that allows the deployment of novel forms of feedback mechanisms. Comics readers have an active role in the construction of meaning, not just by navigating a proliferation of interpretations in the Barthean tradition of "writerly" text, but through their digital entanglement in a vast paratextual economy where reader reviews, comments, ratings and reading behavior patterns are translated into dynamic layers of rich metadata that are analyzed and integrated into statistical models and recommendation algorithms.

Conclusion

Digital comics have an operational intensity shaped by the comics industry's techno-economic infrastructure and the crossings and multiplications of information flows. The operational impact of a global, distributed class of devoted comics readers demonstrates that new forms of entrepreneurial fan labor, such as the scanlating infrastructure, foregrounded the emergence of a logic that has now thoroughly pervaded the production of synthetic media. This logic is dictated by operations in digitizing, analyzing, classifying, clustering, annotating and normalizing data distributions, contributing to the informatization of the media industry. Currently, online comics are reaching a tipping point that can only be described in terms of Big Data due to their sheer volume, variety in type and quality, velocity of encoding, veracity and precision of entries, and the value resulting from correlation with parallel data

flows and metrics, known as the five Vs—volume, velocity, variety, veracity, and value (Assunção et al.). The abundance of digitized comics transformed the medium into a large-scale ontology of non-photographic, metadata-rich imagery whose online expansion has significant economic and cultural considerations for the comics industry and the medium's cultural heritage.

As a result, the expansion of computational knowledge around comics, driven by the scale of available media correlated to dynamic layers of user metadata, has significant cultural and financial considerations for the comics industry. One should consider the accumulation of comics media against the background of the increasing accessibility of programming language frameworks and machine learning libraries, the sophistication of web crawlers and scrapers, the availability of open-source pre-trained models based on web-scale datasets, the democratization of knowledge through e-learning and the plummeting prices of specialized hardware and deployable computation. While the comics industry is still relatively reluctant to embrace an industry-wide integration of computational tools, the rampant informatization of comics objects and the accelerated digitization of large annotated comics corpora resulting from the labor of distributed communities of scanlators might play a pivotal role in the prevalent AI models in image generation that everybody is now using.

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