Applied Digital Humanities and the Creative Industries in the United Kingdom

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Abstract

The government of the United Kingdom is offering significant amounts of funding to increase engagement between researchers and technology companies involved in the "creative economy", a sector worth £100b per annum. The sector has naturally evolved into clusters involving actors as diverse as the BBC, the Victoria and Albert Museum, and freelance game designers. It collaborates and competes with multinational powerhouses including Google, Microsoft, and Pixar. The imbrication of academic researchers in the sector makes it a good example of the extension of academia to industry, raising ethical but also methodological and practical questions. This article describes a project that embedded a research software engineer (RSE) from a digital humanities (DH) laboratory into a small technology start-up engaged in high risk R&D of an immersive narrative story-telling platform. The platform is enabled by artificial intelligence and has the capacity to remember user input and modify narrative options and character mood accordingly. The team included a researcher specialising in narrative theory and digital production. The project demonstrated the utility of the critical application of DH methods and the need to develop career pipelines to produce people capable of working at the intersection of higher education and industry.

Introduction

New entertainment technologies are creating technical, intellectual, and HR challenges. The problems extend from issues of technology integration to enabling and critiquing hybrid forms of expression that defy categorisation, and finding employees with the skills needed to thrive in the industry. Products powered by artificial intelligence, natural language processing, and immersive technologies (AR, VR, chatbots, games, interactive story dramas, and affective systems) are technically complex to design and build, and require diverse teams including writers, designers, developers, artists, and project managers [McDuff and Czerwinski 2018]. New multimedia and transmedia design and engineering paradigms need to be found to foster innovation, and new career paths and skillsets are needed to enable creative production. Without solutions to these problems the United Kingdom's £100bn investment in creative industries will stand little chance of success. To compete, small to medium enterprises (SME) are engaging in high-risk R&D to find new ways to build talent and manage production. They need the support of research software engineering (RSE) and academic partners to ensure technical, creative, and intellectual quality. Digital humanities teams have an important part to play in this process.

These issues have become a focus of the UK government's research and funding policy, coupled to a wider industrial strategy designed to retain the country's global competitiveness. The problem domain provides a classic example of Henry Etzkowitz and Loet Leydesdorff's "triple helix" of industry-government-university collaboration ([Etzkowitz and Leydesdorff 1995]; [Etzkowitz et al. 1998]) and an opportunity to explore the potential of applied methods in Digital Humanities (DH). This article describes one such experiment, demonstrating theories and methods that can facilitate

the application of DH perspectives to the creative industries and (by extension) the skills and career pathways needed to produce people capable of delivering such work.

Section I describes the project at the heart of the paper, "Applying AI to Storytelling — bringing computational research into the creative industries" (Applying AI), a collaboration between a London technology start-up specialising in immersive narrative storytelling (Charisma Entertainment), and researchers and engineers at King's College London. Applying AI offers important insights into the challenges of producing non-linear and affective technological systems and narrative content that aspire to world-building and intensive human-computer interaction (HCI). Section II explains why this project is best understood theoretically in terms of applied or "interested methods" [Asdal 2018], and its relationship to global trends in academic research. Section III provides socio-technical, economic, and theoretical context for the experiment, to position it within the United Kingdom's funding and policy environment and frame it with relevant scholarly literature. Section IV outlines potential new production pipelines capable of enabling the production of immersive products, and the need to develop people with blended creative and technical skills, and Section V describes the challenges of knowledge transfer and pedagogy in emergent convergent zones such as the UK's creative economy. In taking this ambitiously holistic approach, bringing a broad conceptual apparatus to bear on the problem of immersive engineering in DH, we hope to open multiple avenues simultaneously and prompt conversations about future directions in research, engineering, pedagogy, and career development.

Section I: Applying AI to Storytelling — bringing computational research into the creative industries

The project "Applying AI to Storytelling — bringing computational research into the creative industries" (Applying AI) brought together two streams of inquiry. The first was centred around embedding a DH RSE from King's Digital Lab (KDL) within a creative industry SME (Charisma Entertainment), to function as a connection point between industry and academia. The aim was to facilitate traffic in ideas and methods between the creative industries, RSEs, and academics, and to overcome cultural and institutional barriers that inhibit collaboration. It also sought to develop career pathways and skills for RSEs to help them work effectively with industry through embedded co-creation, understanding the culture and working practices of a start-up and how they align with RSE practice. This work was led by James Smithies of KDL, with Elliott Hall as the KDL RSE who would embed with the SME. A workshop on RSE/Industry collaboration was held midway through the project, bringing together representatives from higher education, the creative industries, and related fields to disseminate the project's work on collaboration and to generate feedback on how it could be taken forward in the future.

The second stream of research was led by Sarah Atkinson and centred around evolving new working principles, practices, and workflows in the creation of interactive and immersive narratives and the development of the charisma.AI interactive media platform. This work package was the primary reason Charisma Entertainment approached King's College London for assistance. The optimisation and refinement of the machine learning algorithms that powered their charisma.AI platform was essential in creating compelling and rounded human characters and convincing character interactions between the AI and the audience, and (crucially) AI-character memory. This raised complex issues relating to the creative writing process. The work package involved an initial workshop for new media authors, writers, and narrative designers to adapt and adopt their established working practices for an AI environment where character memory was of profound importance. Charisma Entertainment needed the narratives generated for charisma.AI to be subjected to critical examination in both literary and social science terms, identifying how conscious and unconscious bias informs the author's conception of the character and the player's responses to it.

A second workshop involved audience and user testing, enabling feedback and responses to be provided to the creative team. The initial shape of the collaboration was designed for Hall to take on a facilitation role during production of the project's showcase demo. He was to use his skills as a published novelist and RSE to enhance a collaboration between Charisma Entertainment and Parabolic Theatre, a performance theatre company known in London for their immersive show *For King and Country*. The aim was to adapt the show into a Unity-based game that would use charisma.AI for all character interactions. *For King and Country* was chosen as a demo because it would stretch the capabilities of the charisma.AI platform. An example of a relatively new genre of theatre, associated with a broader trend towards

immersive experiences [Atkinson and Kennedy 2018], the show has proven to be a popular experience in London. Its narrative is compelling: Germany is winning World War Two and about to invade the UK. The audience meets in a rump parliament, then splits off to work in the various ministries before coming back to parliament to hear the results of their work: has the UK been defeated, or has their work repulsed the invasion? The aim was to create a game demo that would replace the actors and facilitators with AI characters, and for audiences to interact as avatars in the game. The characters would interact with the audiences through text-based conversation and (of fundamental importance) remember and sometimes misremember what they had said. The AI characters had been programmed so that they could also lie and remember when they were lied to.

Figure 1. Immersive theatre set transformed into Unity board. *For King and Country*. Copyright, Charisma Entertainment.

Figure 2. Bunker "parliament" where players interact with AI characters. *For King and Country*. Copyright, Charisma Entertainment.

In many ways, charisma.AI is the latest iteration of a long-standing tradition in electronic and interactive literature, which spanned chatbots such as Eliza (1964 - 1966), early iconic text-based games known as Multi-User Dungeons (MUDS), and hypertext fiction that once held great promise for the development of new modes of narrative experience. Such products were related to the well-known *Twistaplot* and *Choose Your Own Adventure* children's books of the 1980s, and culturally related to the popular *Dungeons & Dragons* board game. Works like Michael Joyce's *Afternoon, a story* (1987), built using Eastgate Systems' Storyspace tool, were claimed by some critics to augur a new era of "ergodic" literature. In 1997 Espen Aarseth claimed such "hypertext literature" produced

> a short circuit between signifier and signified, a suspension of *differance* [accent on the e] that
> projects an objective level beyond the text, a primary metaphysical structure that generates both
> textual sign and our understanding of it, rather than the other way around. [Aarseth 1997]

The belief was that new technologies were radically transforming the experience of reading from a passive to an (inter)active experience. 1990s critics noted similarities between ergodic literature and elements of postmodern fiction such as Barthes labyrinth, itself reaching back to Greek myth [Aarseth 1997].

As Dave Ciccoricco has pointed out, these kinds of narrative in fact implement a range of different "networked" narratives, from simple branching to more complex tree-like structures [Ciccoricco 2007]. The genre has never quite broken through into widespread mainstream acceptance, but there has been a steady stream of innovation over the years and recent technological developments have prompted creative renewal. In 2005 the video game Façade illustrated the potential of generative AI narratives. In 2018 Netflix produced the interactive branching narrative show *Bandersnatch* (to mixed reviews) and the same year the live streamed show *Artificial* was released by Twitch, winning an Emmy for Innovation in Interactive Media. *Artificial* enabled direct interaction with the audience, including votes to fundamentally alter the plot and even remove characters, suggesting something of the potential of the new generation of technology. Charisma Entertainment are contributing to this same history of creative and technological development with charisma.AI, hoping for simultaneous breakthroughs in technological and creative development.

High quality academic critique is essential to this process. Interest in ludology (the study of games not only as cultural artefacts but as expressions of human identity and phenomenological experience) based on Johan Huizinga's 1938 book *Homo Ludens* [Huizinga 1938] ground criticism of early multimedia products in a philosophically serious tradition and suggested that multimedia and transmedia products resist "narrowly instrumental analysis" and are properly conceived as both a foundational human experience and art [Rodriguez 2006], but criticism of electronic literature waned when narrative quality failed to attain the expected heights. The ideas that had been generated were enough to feed new modes of critical interpretation that remain relevant, however, including Donna Haraway's articulation of a "cyborg manifesto" [Haraway 1991] and Katherine Hayles' notion of "intermediation" that suggests an electronic text "performs actions that bind together author and program, player and computer, into a complex system characterized by intermediating dynamics" [Hayles 2008]. The wider tradition can be usefully read through these critical lenses, and beyond to articulations of "imagineering" and immersion [Demetriou 2018], and transhumanist [Chu 2014] philosophies that emphasise the blending of human and machine. There is widespread acceptance that adding aesthetic experience to human-computer interaction heightens phenomenological entanglement.

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The team at Charisma Entertainment were aware of the creative and critical tradition their charisma.AI platform was part of but they were primarily responding to the narrative potential inherent in emerging technologies. In the case of charisma.AI that related to character memory, and the ability of AI characters to "remember" and "misremember" information (such as a player's name, but also narrative decisions and other aspects of gameplay) relayed to them by players. The charisma.AI system has been developed to connect with external services such as weather reports, via Application Programming Interfaces (API), and alter the gameplay accordingly (for example, mirroring the weather outside the player's physical house in the virtual environment).

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The *For King and Country* demo included additional challenging requirements, requiring the team to create several different kinds of character-to-audience conversations: one-on-one between players, ministers, and other heads of state (for example the American President); a version of a parliamentary debate where the player was part of conversations with several AI characters, and would need to influence them to vote in their favour; and multi-character, free-flowing conversational exchanges which would be very different to the one-on-one conversations from other charisma.AI projects. In one key speech, the player, acting as Prime Minister, tries to sway the AI characters to their point of view, creating a range of technical and creative challenges: in one scenario, for example, AI characters do not respond to the player's speech if they have not interacted with them or have had negative interactions with them during the preceding narrative. It is worth noting that before the project started, charisma.AI's natural language processing (NLP) could only parse short, declarative sentences, not the multiple sequential sentences that would be required for a convincing and compelling speech.

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The creative implications of this narrative complexity were commented upon by writers attending the writer's workshop at the start of the project. The group had a wide range of experience writing for the television and gaming industries (working on high profile productions including the BBC's *Sherlock* series) but were struck by the cascading complexity that accrues from the ability of AI-enabled characters to remember and – more problematically – to strategically misremember information. To simplify the problem, the workshop participants thought through the implications of a character in a basic whodunnit narrative being able to remember or misremember player information. When should the writer save a piece of information, and when should they release it (at a dinner party with everyone present, in a private exchange between two characters)? How would they write a narrative that included one thread where a character faithfully remembered a piece of information, but in other contexts duplicitously misremembered it? How could writers control the exponential layers of complexity generated by such scenarios, and how could a writing interface be designed to ensure writers could keep track of the various narrative permutations? The narrative complexity that could be facilitated by charisma.AI is significantly increased by the ability of the writers to define and assign moods to characters, which can act as additional narrative gateways to new scenarios: say the wrong thing or ignore an important character, and they could choose to misremember rather than remember information conveyed at an earlier stage in the narrative.

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Revealingly, given the analysis about skills requirements that we will detail below, Hall's role changed significantly as the project progressed. The lead writer for Parabolic Theatre was unable to contribute to the project as intended due to scheduling conflicts. Hall took over primary writing duties for the *For King and Country* demo, as well as designing new

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logical structures inside charisma.AI to adapt its workflow for use as a plugin inside Unity, while working with the Charisma Entertainment team on the demo's game flow. He continued in these roles when the project's focus moved to a new demo, an adaptation of John Wyndham's *The Kraken Wakes*. This evolving collaboration led to several meaningful outcomes: two functional showcase demos - *For King and Country*, and *The Kraken Wakes* - were written by Hall. The deeper collaboration on the two demos created a test case for how a DH research software engineer (RSE) could be embedded within a commercial development team, providing both technical and creative input. The changing priorities and roles during the project provided an important test of institutional flexibility and a model for effective collaboration between higher education and the creative industries.

Section II: Pure versus Applied Research

Applying AI therefore raises interesting questions about the nature of applied DH research. The project was initiated in conversations between Charisma Entertainment and King's College London but was oriented towards answering problems for the industry partner, rather than research questions developed independently in the university. This is, of course, the essence of "applied" research in the formal Science and Technology Studies (STS) sense of the term: industry partners (whether in the creative industries or other industrial sectors) seek out research teams who can help them navigate an impasse in their R&D or product development process, and research questions are designed with the sole purpose of resolving that impasse. Research is "applied" to "real world" problems, to develop new products or services for the marketplace. The fact Charisma Entertainment operates in the creative marketplace is incidental to this more reductive point. In this telling, applied research is opposed to "pure" research, which originates in the laboratories and offices of researchers free from outside influence. Pure (or "basic" or "fundamental") research aims to build theories or produce knowledge but often has no practical or clinical application: it represents research in the sense implied by the Oxford English Dictionary's quotation of E. Grimeston tr. J. de Acosta in 1604:

> Whether these two great gulphes do ioyne in any other part of the world, which was the enterprize
> of Fernando Magellan a Portugall gentleman, whose great courage and constancie in the research
> of this subject, and happy successe in the finding thereof, gave the name of etenall memory to this
> straight (O.E.D. Online).

Pure research is designed to fill in empty space on the map of knowledge, not to resolve practical problems. In this definition of the term, digital humanists do not engage in nearly as much "applied" research as they might think. Technical effort generally aims to fill gaps in the map of knowledge, not to build new products and services or solve problems encountered in the corporate or government worlds.

And yet, as many readers will have surmised, the distinction established in STS between pure and applied research is anything but straight-forward. Indeed, as Zoe Nyssa [Nyssa 2019b] has pointed out, STS scholars have built a discipline out of exploring and ultimately collapsing the distinction, variously noting the rather fine semantic distinction between knowledge sought to "fill in blank spaces on the map" and knowledge sought to increase our ability to manipulate or intervene in the known world: the cultural and politically mediated [Knorr-Cetina 1981] aspects of both modes of research, the inherently messy "mangle" [Pickering 1995] of researchers, tools and methods, or the way in which objects and humans involved in the research process can be conceived (famously, by Bruno Latour) as mere actants [Latour and Woolgar 1979] in a continuous process. Simplistic binary conceptions of applied versus pure research collapse under even limited scrutiny: in theoretical terms, and as a way of understanding the research endeavour in all its complexity, it provides the flimsiest of foundations. The fact the OED entry does not make a distinction between the two modes is telling.

And yet the distinction retains utility in the context of the DH work described in this article. While it is undoubtedly necessary to collapse the pure versus applied distinction when exploring the epistemological and methodological depths of laboratory science and DH projects designed to advance knowledge, it remains conceptually useful in the context of projects designed to enable commercial sector partners. Perhaps controversially, the distinction also sheds light on the relationship between DH, neo-liberalism, and the corporate university, highlighting a nascent area of DH practice that is presumably even more controversial than the production of historical databases or use of machine learning algorithms

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[Allington et al. 2016]: if the use of digital tools by humanists in the service of general humanities scholarship is controversial, their use in the service of commercial profit must surely be doubly so.

It is important to note in this context that, rather than being merely arguably connected to the corporate university, applied DH (in the strict sense of applied research intended by STS scholars) reflects hard commercial relationships between universities and the commercial sector initiated by the United States Bayh-Dole Act (1980). Bayh-Dole has been identified as a watershed moment by historians of higher education, changing the social and economic contract between universities and funding agencies and allowing them to pursue intellectual ownership of an invention themselves instead of needing to assign it to the federal government. This opened the research environment to market conditions, incentivising universities to define and protect their intellectual property (IP) and monetise it through the development of commercial ventures. Other governments (notably the United Kingdom, Australia, and New Zealand) watched with interest and, over time, increasingly oriented their policies to commercial concerns too. In simple terms, the Act was the legal instrument in America (and the model in many other countries) by which "highly contentious" [Murray 2010] forms of neoliberalism were unleashed on the university sector. As Allington et al notoriously implied in 2016 DH, whether the community is comfortable with it or not, it is imbricated in this wider context [Allington et al. 2016].

Section III: The Creative Economy

The Applying AI to Storytelling project occupied the intersection of these currents, as much as being a straight-forward DH project. Significant amounts of funding have been directed towards Etzkowitz and Leydesdorff's "triple helix" in the United Kingdom, characteristic of a "new social contract between the university and larger society" [Etzkowitz and Leydesdorff 1995] and based on intensive knowledge transfer and co-production across the full spectrum of research, development, and production. Noting progressive changes in the orientation of universities to the private sector since the 1980s, Etzkowitz and Leydesdorff's 1995 paper claimed that university-industry relations had "become a laboratory for the conscious reshaping of…knowledge infrastructure" [Etzkowitz and Leydesdorff 1995] in a manner that was transforming "the role of the state in academia, the role of corporations in innovation and of the university in the economy…" [Etzkowitz and Leydesdorff 1995]. In the United Kingdom, research activities (often conceived as "applied" research) that encourage collaboration between academia, industry, and government reflect this larger international reorientation of knowledge production towards instrumentalist concerns.

And yet, the Applying AI project demonstrates why this activity is justifiable in academic and creative as well as purely commercial terms. As is shown below, the success of the project hinged on the proper functioning of an interdisciplinary team involving technical developers, businesspeople, academics, and creative writers. The contribution of the RSE developer and creative writer were particularly essential; their lack of progress or unavailability was enough to halt the entire production process. It is not so much that Etzkowitz and Leydesdorff's triple helix pulls otherwise purely creative writers and academics into the commercial world, in other words, as it creates a new set of creative challenges that require inter-disciplinary approaches to resolve. Projects such as Applying AI allow those new approaches to be trialled, for the benefit of commercial and research partners alike, creating significant creative and intellectual insights as well as new career paths. It is unreasonable to assume that cross-sector co-creation unwittingly acts as a Trojan horse for capture and the warping of HE priorities.

This has unfortunately become a natural assumption in some areas of humanities and DH scholarship. It is difficult to be sure of the precise intellectual genealogy, but it appears to be built on methodological positions established in STS by scholars such as Knorr-Cetina, who view "knowledge as practices - within structures, processes, and environments that make up specific epistemic settings" [Knorr-Cetina 1999]. This created an excellent framework for holistic analysis of scientific and technological initiatives but negative perceptions of applied research built on such work too, culminating in the work of Sheila Slaughter who coined the term *academic capitalism* and suggested it exposes the "neoliberal tendenc[y] to treat higher education policy as a subset of economic policy" [Slaughter and Leslie 2001]. Another strain of literature built directly on Etzkowitz and Leydesdorff's 1995 paper, criticising its emphasis on linear modes of knowledge transfer that assumes the progressive evolution of concepts from R&D to production without an allowance for iterative cycles, co-production, and failure. Many humanists find it difficult to see the possibility of creativity or intellectual freedom in such models.

The conversation is becoming increasingly nuanced, however. Carayannis and Campbell's Mode 3 Innovation Ecosystem emphasizes more fluid interaction between participants, and what the authors refer to as "a multi-layered, multi-modal, multi-nodal and multi-lateral system, encompassing mutually complementary and reinforcing innovation networks and knowledge clusters consisting of human and intellectual capital, shaped by social capital and underpinned by financial capital" [Carayannis and Campbell 2009]. Revealingly, Carayannis and Campbell's analysis adds a fourth aspect to the triple helix in the form of feedback from the public and media culture, in a complex "fractal" innovation system that is self-correcting and constantly evolving [Carayannis and Campbell 2009]. Sarah Atkinson and Helen Kennedy use the term *ecosystem* in a similar way, noting the early adopter role of London theatre companies in the production of Virtual Reality (VR) experiences [Atkinson and Kennedy 2018]. However conceived, STS research has made it abundantly clear that policy changes at national level and economic pressures at a global level since World War Two have resulted in fundamental changes to the operational context of academic research, creating opportunities for new modes of creative production and collaboration.

In the United Kingdom this crystalized in 1997 in the policies of the New Labour government led by Prime Minister Tony Blair, which established a Creative Industries Task Force (CITF) within its newly established Department of Culture, Media, and Sport (DCMS). This taskforce, and the resulting Creative Industries Mapping Document (CIMD), has been widely credited with establishing the modern notion of the "creative industries" in the UK and positioning it at the forefront of national and international efforts to extract economic value from cultural activity. As Terry Flew notes, the CIMD defined the creative industries as "those activities which have their origin in individual creativity, skill and talent and which have the potential for wealth and job creation through the generation and exploitation of intellectual property" [Flew 2012]. New Labour subsequently positioned the creative industries at the heart of national identity, using the "then-new concept of convergence to argue that the future of arts and media in Britain lay in a transformation of dominant policy discourses towards a productive engagement with digital technologies, to develop new possibilities for the alignment of British creativity and intellectual capital with these new engines of economic growth" [Flew 2012].

Applying AI to Storytelling provides an excellent example of this new model of government/creative industry interaction, contributing to policy changes designed to enable economic and cultural "clusters" the government identified as key drivers of Carayannis and Campbell's fractal innovation ecosystem. In a 2009 article the authors identified three different kinds of clusters of "fractally connected" organizations dependent upon rich cross-sector interactions and complex transfer and production of R&D activity: geographic, sectoral, and knowledge clusters [Carayannis and Campbell 2009]. These clusters - often overlapping and almost always interacting in complex cross-functional configurations - include a "pluralism of a diversity of agents, actors and organisations: universities, small and medium-sized enterprises and major corporations, arranged along the matrix of fluid and heterogeneous innovation networks" [Carayannis and Campbell 2009]. They function as what military analysts might term force multipliers, aggregating diverse economic and methodological capabilities in either real-world or virtual configurations and creating the conditions for exponential levels of creative and technical innovation and economic growth.

The concept of clusters clearly resonated with UK policy makers, who are eager to ensure the continued competitive advantage of the country's creative economy they feel has been "changed beyond recognition" [Mateos-Garcia et al. 2013] by internet-based technologies: a £100bn sector worth more than the automotive, aerospace, life sciences, oil and gas industries combined [Choudhury 2019]. The sector has grown at more than twice the rate of the wider economy since 2010 [HM Government 2018a]. Significant funding streams were directed at creative clusters[1] in 2018, with £80m allocated to fund nine creative industries clusters across the country [HM Government 2018b]. In a clear signal that the country acknowledges the synergistic relationship between scholarly analysis and economic production, an associated Policy and Evidence Centre was funded to work out how to best measure and enable future initiatives. A further £33m was allocated to an Audiences of the Future programme designed to enable cross-sector R&D resulting in virtual and augmented reality (XR) products [UKRI 2018].

The Applying AI project was funded by a related Innovate UK scheme, similarly aimed at enhancing knowledge and skills transfer between elements of the triple helix [Innovate UK 2018]. The Creative Clusters and Innovate UK programmes amount to an overt attempt to extend the United Kingdom's competitive advantage in the creative industries, in support of a plethora of flagship institutions such as the BBC, the Victoria and Albert Museum, the British

Museum, the Tate Modern, the Royal Opera House and in the context of emerging technologies that at once threaten and promise to transform their potential and scope. Revealingly, Carayannis and Campbell's Mode 3 model extends the innovation environment from these traditional organisations to myriad small, medium, and large technology start-ups alongside established vendors, freelance designers, and gaming studios. The complexity is overwhelming but forecast disruption caused by emerging technologies and a related skills shortage has prompted remarkably directed action [Innovate UK 2018].

Section IV: Production Models for Immersive Engineering

Any robust analysis of Applying AI needs to take this policy context into account. The primary aim of the project was to enable the commercial goals of Charisma Entertainment, who were grappling with issues endemic to the creative industries, beset by increasingly complex design and engineering problems at the intersection of art and technology. Hall's work with the charisma.AI platform reflects this challenge: his work took on recursive characteristics as he moved between the role of writer, developer, and product consultant. Working with an evolving technical product, he realised its support for branching narratives would not be able to support the complex plot and character developments required for *For King and Country*. Using computational logic and working closely with the core development and creative teams at Charisma Entertainment, he surmised that the interface could be stretched to accommodate a more complex hub and spokes plot configuration. This made management of the various story nodes difficult, so he hacked together a basic external technical solution (something that could later be integrated into the main product) to keep track of the narrative.

High quality production models for immersive engineering need to account for this symbiotic relationship between creative artists and technologies, enabling creative collaborations between artists and machines [Sandry 2017]. A 2018 UK report into production pipelines for immersive engineering noted companies were experiencing difficulties across the entire spectrum, from budgeting to managing small teams, consumer expectations, design, dynamic workflows, inadequate and fast evolving toolsets, and a lack of people with appropriate skills and experience [Opposable Group and TechSpark 2018]. Stuart Whyte, Director of VR product development at Sony's SIE London Studio, framed the issue in stark terms, noting that

> [i]t's so new. I think in traditional games we've taken many generations and iterations of designs, around control schemes, and so on. The challenge and excitement around VR is that it is a very new space and some of those designs and languages from other games just don't work so well in this medium and yet there are alternate ways you can do it that are even better (Whyte cited in [Opposable Group and TechSpark 2018]).

Charisma Entertainment experienced much the same pressures as other start-ups building products for the creative industries during the Applying AI project (tight budget, small team, competing demands) and their production pipeline was similarly challenged. Hard choices had to be made between additional R&D or creative effort and technical investment, and the ultimate decision to transition from production of the *For King and Country* demo to *The Kraken Wakes* required resolution of complex business, technical, and creative issues.

At a more granular level, tension between creative and technical expression in Applying AI was generated from the characters in the charisma.AI system being "audience aware". This means that they could: react to the language, mood and conversations of the players; "remember" previous interactions with a player; access a knowledge base of that character's interactions with other players; and use this data to provide responses tailored to the user (implicitly in the way a chatbot learns from interactions, and explicitly, in directly challenging users with their shared history e.g., "yesterday you said this."). While it might seem premature to read phenomenological significance into such interactions, even with the critical apparatus provided by critics such as Aarseth [Aarseth 1997] and those that followed him, it is worth noting the deep ramifications of memory for our understanding of not only human experience, but the nature of intelligence and artificial intelligence (AI). As Gisela Bahr et al note, "[h]uman long-term memory is [merely] an example of naturally occurring big data" [Bahr et al. 2017]. As rudimentary as contemporary chatbot and AI technology currently may be, and as minuscule as contemporary computing storage is next to the exabyte capacity of the human brain, the underlying mechanisms at work - especially in use cases as fundamental to experience and identity as narrative -

provide valuable insights into the boundaries between human and machine intelligence. The study of memory and forgetting, and its implications for next-generation computing systems that struggle to manage the vast quantities of data being funnelled into them, is just one example of the strangely synergistic tensions emerging between the creative industries and industry proper. Production models for immersive engineering are likely to offer practical applications in a range of industrial settings.

Section V: Knowledge Transfer and Talent Pipelines

Production pipeline issues were not satisfactorily resolved by the Applying AI project, although that was a key focus of the grant application. Progress was made identifying issues, and acknowledging the complexity of issues in play, but the problem is a generational one. Hall's hybrid role as technical consultant and writer greatly increased the technical and creative capacity of the charisma.AI platform but was unsatisfactory as a long-term solution. Demand for hybrid talent is strong enough that Hall became unavailable for future phases of the project, and the Applying AI project made no provision for passing his skills on to another RSE. That issue was, of course, intractable in the short time available for the project. Hall's skills have been developed over the course of more than a decade working as an RSE in digital humanities and creative writing. [29]

Developing workers with Hall's blend of technical and creative skill is something that would ideally begin at primary and secondary school and be laced throughout university experience as well. It may be that practical masters, doctoral and post-doctoral fellowships will help in the interim, perhaps augmented by more vocationally focused apprenticeships and on the job mentoring, but they will need to be extremely flexible in their capacity to foster people with diverse talents expressed with different emphasises on different areas. Hall's balance between technical and creative knowledge was useful but in many cases an inflection towards one or the other would be optimal. It is unusual to find someone with equal parts creative and technical talent, and more feasible to provide people with the skills they need to contribute to multi-disciplinary teams. Similarly, it will often be useful to involve people with theoretical academic knowledge as well: perhaps possessing barely enough technical knowledge to work closely with engineering teams but deep understanding of the creative and theoretical aspects to a problem. [30]

An emphasis on teamwork skills, and confidence working across disciplinary boundaries will resolve many issues — accepting the need for hybrid teams as well as people with rare hybrid skills — but this will not resolve the deeper issues of narrative and aesthetic quality demanded by next-generation creative products. At some point the education system will need to adapt to the challenging requirements imposed by the creative industries and develop graduates with myriad indefinable mixtures of talent, fusing computational and creative skills along tailored learning pathways. The transfer of knowledge between university research teams and the creative industries is in this sense merely the first act in a wider process of a humanistic re-tooling of (a growing part of) the engineering profession. The development of robust talent pipelines from the education system into the creative industries should be the medium-term goal. [31]

Applying AI to Storytelling was an ambitious and complicated interdisciplinary project undertaken in the context of a complex intellectual, creative, technical, and policy development landscape. The United Kingdom's cognizance of the difficulties (and potential economic benefit) in the development of next-generation immersive products, and their proactive funding of applied research activity between academic and commercial partners, made it possible to engage in the relatively high-risk R&D necessary to make progress but significantly more work is needed. A full-spectrum approach is needed to understand the implications of immersive product development in applied and theoretical terms. The goal must be to enable development of more sophisticated products (dare we hope, on a par with the centuries of tradition inherited by the creative industries), enabled by interdisciplinary academic enquiry, improved design and engineering processes, more effective pedagogical approaches, and enhanced career pipelines. The humanities, and DH in particular, are well positioned to contribute to this process but experimentation will need to occur across many concurrent areas of activity, and we will — in order to work at the cutting edge of creative endeavour and have a voice in the development of next-generation creative products — need to reconcile ourselves to contributing to commercially driven endeavours. [32]

Notes

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