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Revisiting Open Source Software Development Models for Community-Based Digital Humanities Research Generation

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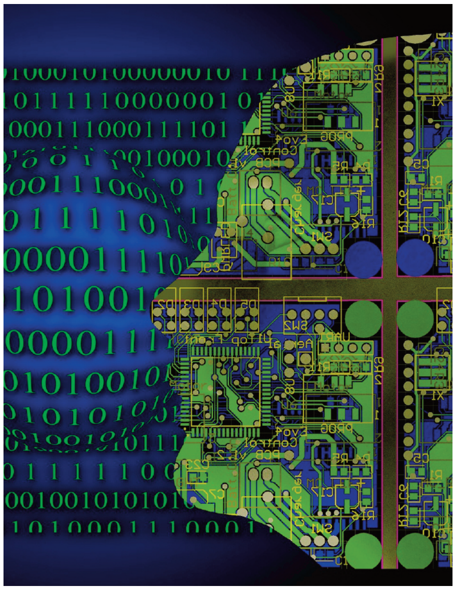

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Abstract

Abstract Enmeshed modes of digital communication are based on public disclosure and the exposed space of the digital, that is to say, where an idea shared is always already an idea utilized by someone else.

Background: Community-based practices of open source software development offer a model for enmeshed private-public digital humanities (DH) research that can balance the demands of macro or global digital disruptive forces with the needs of everyday learning communities.

Analysis: In the space of enmeshed modes of digital communication, knowledge is not owned, since it is essentially discovery-based.

Conclusion and implications: Digital literacy is key for contemporary DH knowledge production, yet also needs to be active (not a passive information technology awareness or ability) about building, making, and improving, as well as functioning within an open environment.

Keywords: Digital humanities; Open source; Free software; Knowledge production; Digital literacy; Community; Collaboration

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The fork

In writing an introductory overview on the differences between open source and free software in *The Big Humanities: Digital Humanities/Digital Laboratories* (Lane, 2016), it became clear that it was necessary to not only explain to a non-specialist audience the fork that led to two competing terms ("open source" versus "free software") but that it was also important to explain the concept of the "fork." Benjamin Mako Hill (2005) provides a thoughtful and highly relevant definition in his essay, "To Fork or Not to Fork: Lessons From Ubuntu and Debian."

> The act of taking the code for a free software project and bifurcating it to create a new project is called "forking." There have been a number of famous forks in free software history. One of the most famous was the schism that led to the parallel development of two versions of the Emacs text editor: GNU Emacs and XEmacs. This schism persists to this day. (para 13)

A number of issues are illuminated by, and in relation to, this quote, such as the fact that at the source of open source versus free software is a *decision* to call the movement "open source" *or* "free software"; that in the preceding sentence I am replicating the slightly loaded language used by free software proponents by calling both of these "movements"; that the language of the Reformation and theology also echoes in this definition (with the word "schism"); and that at the source of open source was a powerful and revolutionary text editor for programmers called Emacs. Emacs was written in UNIX, an operating system (OS) that for much of its existence occupied a liminal space between closed and open in terms of its development. What does "loaded" language mean in this context? This phrase alludes to the four "essential freedoms" articulated by the Free Software Foundation in its statement of philosophy, in other words, the ideological substrate of the movement that involves:

> The freedom to run the program as you wish, for any purpose.
>
> The freedom to study how the program works, and change it so it does your computing as you wish
>
> … Access to the source code is a precondition for this.
>
> The freedom to redistribute copies so you can help your neighbour.
>
> The freedom to distribute copies of your modified versions to others … By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this (GNU Operating System, 1996; modifications and ellipses added).

The discourse used here illuminates the fact that this is a more overtly "political and ethical" definition (Free Software Foundation, 2004–2016) than that of the corresponding definition of the Open Source Initiative. In this instance the freedom to modify and distribute software speaks to a deeper or more foundational freedom or right; the use of the words "neighbour" and "community" also suggest a *social vision*. I am not arguing for one of two forks in this article, since in both the open source and free software forks, there is concern for community. The language may be stronger in the Free Software Foundation's statement of philosophy, but community is at the heart of what I will call for the remainder of this article *open source*, switching to this term because essentially the disagreements between free software/open source critical positions involve questions of productivity and a concomitant suspicion of *economic productivity* on the part of some free software proponents. In this article I argue that open source software provides a model for collaborative knowledge generation, and for a productivity that extends to diverse communities.

"Enmeshed" digital modes of communication

Digital modes of communication are increasingly becoming "enmeshed," that is to say, the same vehicle is used to express personal, private, and public statements that once belonged to separate domains, e.g., a personal print journal or diary would usually remain private; developed film photographs were once pasted into physical binders that usually remained in the possession of an individual or family; judgmental comments about an individual or institution were passed on through private and ephemeral one-on-one discussions, not published to publicly accessible and archived or cached websites, et cetera. A model for developing innovative digital humanities (DH) research that can function productively in such an "enmeshed" situation is that of open source software as sketched above, but this also necessitates a return to our narratives of the open source movement, i.e., *after the movement has significantly matured*. For example Georg von Krogh and Sebastian Spaeth (2007), refer to Bent Flyvbjerg's (2001) earlier notion that social science research needs "to have more impact on society," although one of the barriers is the notion that in this domain "there is an inherent detachment from reality" (von Krogh & Spaeth, 2007, p. 241). One of Flyvbjerg's solutions to "detachment" is to ground "research in the context studied" (von Krogh & Spaeth, 2007, p. 241). Essentially, this context is always a particular community, and the main task of the researcher is to develop and/or observe a self-reflexivity within that community, what von Krogh and Spaeth (2007) call "communal reflexivity" (p. 246), exemplified by the open source software community. As Michael Gibbons, Camille Limoges, Helga Nowotny, Simon Schwartzman, Peter Scott, and Martin Trow observe (2012), "knowledge is now generated in the context of application" (p. 54), that is to say, it is "generated" in the flow of digital communication; another way to put this is that, "Rather than achieving its benefits *ex post* (after the first innovation has been created), open source expands diffusion *ex ante* by drawing in as many as possible in the initial development of an idea" (Niman, 2011, p. 915). Neil B. Niman (2011) calls such a development "community-based innovation" (p. 915). These community-based practices of open source software development offer a model for enmeshed private-public DH research that can balance the demands of macro or global digital disruptive forces (see Dobbs, Manyika, and Woetzel, 2015, and below), with the needs of everyday learning communities.

The exposed space of the digital

Enmeshed modes of digital communication are based on public disclosure and what could be called *the exposed space of the digital*, that is to say, where an idea shared is always already an idea utilized by someone else (it may be claimed as their own; it may be generously acknowledged; it may just go into the process of accessing or contributing to dispersed knowledge generation, and so on). In the exposed space of the digital, knowledge is not owned, since it is essentially discovery-based. Of course, many types of ethical and legal restriction exist in terms of actually utilizing such knowledge, and these restrictions can help us understand why the open source model is preferable for DH, in the sense of allowing the benefits of DH to flow across specialist and then more general communities (i.e., the benefits of a particular DH tool or application, a free digital database, library, or archive). The patent is perhaps the most binding of legally entrenched restrictions, and as Henry George argues, "… prohibits anyone from doing a similar thing" and/or "what has already been attempted" (quoted in Niman, 2011, p. 912). What George means by this is that the claim to originality is problematic (seen, for example, where competing research teams come to the same conclusion, or solution, independently of one another). As he argues:

> Everyone has a moral right to think what I think, or to perceive what I perceive, or to do what I do—no matter whether he gets the hint from me or independently of me. Discovery can give no right of ownership, for whatever is discovered must have been already here to be discovered. (quoted in Niman, 2011, p. 912)

Prior to the enmeshed mode, "open source" in DH meant *partially* open, e.g., the Perseus Digital Library being open in the sense of what was allowed the reader at the level of the interface, yet still holding back from the reader the XML/TEI code.

As Gregory Crane writes in a Perseus blog entry in 2015:

> More than a decade ago, pioneering philologists badgered me to release the textual data that we had accumulated at Perseus. Licenses for private use were not enough. They argued tirelessly that they needed, as part of their fundamental research, the right to analyze, modify, and then redistribute some or all of those texts in altered form. (para 9)

Since 2006, this open data has been made available, leading Crane (2015) to argue that, "The question before us is how to free ourselves from our dependence upon closed data and to establish a comprehensive, open, extensible textual space for the study of Greek and Latin" (para 2). The latter phrase could be rewritten as "for the study of the arts and humanities" since this issue extends across the entire spectrum of humanistic research. With enmeshed modes of digital communication, this question may already have been answered in the sense that the "comprehensive, open, extensible textual space" is the architectonics of Web 2.0, i.e., the highly interactive space where "closed data" is shunned or simply ignored. This interactive architecture shares characteristics with the spaces of community-based innovation that Niman (2011) argues emerges most clearly "with the open source movement in the development of software" (p. 915), where "open source seeks to draw on the greatest possible division of labor in order to maximize the potential value of a new idea," (p. 915) and the benefits are shared in the present, i.e., concurrently with the software's developments, precisely because this process draws "in as many as possible in the initial development of an idea" (p. 915). As Niman continues:

> Changes to an open source product originate not from a small group of programmers under the leadership of a management team that thinks it understands the needs of the market, but rather from those who are actually using the product in real world situations. Thus, the open source process promotes a greater division of labor by drawing upon the "idiosyncratic knowledge" (Hayek, 1945) of its users. Changes are driven from a bottom up approach where end-users both initiate and implement modifications based on real needs … Because of this process, the product eventually moves in a direction that is more in tune with the needs of its users than its developers. (p. 915)

To simplify further, the community of users equates with the community of developers, and this collapsing of roles has myriad benefits. The challenges for DH have long been articulated, where the equation of users/developers is sometime regarded as a negative, for example, as indicated by Charlie Edwards: "the uptake for many DH tools has remained small, the users almost coextensive with the makers, even where the goal of the development team has been to reach a broad audience" (p. 215). However, a more positive view emerges in relation to "the volunteer developer" (Edwards, 2012, p. 218), who becomes "key" in ensuring the success of a project; Edwards quotes Tom Scheinfeldt's blog, "Lessons from One Week | One Tool," where such volunteer developers are shown to "find and fix bugs. They provide end user support. They write documentation. They add new features and functionality. They provide vision and critical assessment" (p. 219). The lesson here is that the equation of users/developers is not simply about a particular technical skill, rather, it concerns the entire spectrum of skills that can be drawn upon, thus, "At least in theory … open source development offers a paradigm for DH as a whole that can incorporate the full range of its users, regardless of technical skill set" (Edwards, 2012, p. 219). Of course this "gift economy" (Eric Raymond quoted in Lerner & Tirole, 2001, p. 821) is not without a whole host of other rewards, not least being that this is a process that has long existed in science, and idealistically framed, perhaps, is the important and relative observation that, "Science has the objective of creating a public good" (Paul David quoted in von Krogh & Spaeth, 2007, p. 248).

Macro and micro: Digital innovation

How is any of the above different from standard applications of open source philosophies to the digital humanities? I am conceiving of enmeshed digital modes of communication as being part of the technological "neural system" (W. Brian Arthur quoted in Dobbs, Manyika, & Woetzel, 2015, p. 33) at a time when computers are "beginning to replace knowledge and skilled workers" (Dobbs, Manyika, & Woetzel, 2015, p.10), that is to say, it is no longer enough to simply theoretically model a DH/Web 2.0 system (Humanities 2.0) on open source software as if this is in itself adequate as a solution to next generation knowledge production in DH: the model has to be put into practice. As I argue in "Creating Narrative Space: New Modes of Navigation for Online Scholarly Publications" (Lane, 2015), digital literacy (defined as the ability not just to use computers, but to be able to hack/code and build/create) is a key to knowledge production in the sense that the very building blocks of the technological "neural system" are code, in this instance any number of computer languages, including extensible mark up languages. It is no coincidence that Richard Dobbs, James Manyika, and Jonathan Woetzel (2015) argue that even though "By 2025 … computers could do the work of 140 million knowledge workers, and robots could do the work of another 75 million people … there will still be high demand for skilled positions in engineering, software development, and health care" (p. 10). These three areas of employment not only share a demand for high levels of education, they also involve constant self-reflexive redevelopment and improvement of complex systems, including software and technology systems, where "self-reflexive" also means incorporating constant cross-community-sourced feedback data from expert users. Digital literacy, then, needs to be active (not a passive information technology awareness or ability) about building, making, and improving, but it also needs to function within an open environment.

While the U.K. embarks on a re-launch of its digital literacy curriculum based on these processes, it also is attempting to replicate the past success story of a joint educational television series and microcomputer product called the BBC Micro, which has been credited with a revolution in computing within the U.K. that led to massive economic success (for example, the mobile computing chip technologies and lucrative patents developed by the U.K. company ARM). Tilly Blyth (2012), in a report for Nesta called *The Legacy Of The BBC Micro: Effecting Change In The UK's Culture Of Computing*, examines more closely whether the BBC Micro computer project really did deliver an intellectual and economic paradigm shift. Again, the concept of community is key, something that becomes apparent in the detailed account of how a company called Acorn (which became ARM) created the BBC Micro. Blyth suggests that the Cambridge-based Acorn was very much a company of "open networks" that facilitated "a unique culture that allowed the transfer of ideas into and out of the company" (p. 19); further, she notes that, "[A]s the company grew, an 'open house' culture for sharing ideas developed" (p. 19). Replicating the success of this project then, depends upon open source, and this is precisely what is happening with the Raspberry Pi computer and more recently the BBC micro:bit, the current hardware technologies being disseminated throughout the U.K.'s schools and homes (one million micro:bits were recently given to all Year Seven U.K. school children [BBC micro:bit, 2016]).

The Raspberry Pi is a low-cost ($35) but powerful computer on a single board, initially launched with a basic model that had a Broadcom processor, onboard 256 MB SDRAM, and a USB connector, but no Ethernet; all models of the Pi run on Linux. While a more powerful Pi was soon launched – with more SDRAM, an Ethernet jack, and a dual USB connector instead of the single USB connector on the Pi model A – both models remained in use due to the fact that these computers form the core of more complex projects, from home-built sensor networks to advanced robotics. Second and third-generation Raspberry Pi versions followed, with the current Pi 3 offering a 1.2GHz 64 quad-core ARMv8 CPU, as well as wireless and Bluetooth capabilities, 1GB RAM, four USB ports, Ethernet and HDMI ports, as well as a camera and display interface among other practical project specifications. Finally, the Raspberry Pi Zero is a newer model that is very low-cost ($5) yet still relatively powerful. What this introduction to the specifications elides, however, is the fact that the Raspberry Pi was always meant to be about re-engaging young people in computer science and coding, not necessarily being about the hardware itself. As founder Eben Upton notes when recounting the story of the Raspberry Pi, "I looked at our founding documents and nowhere does it say 'We'll make a small computer.' What it says is 'We want to get kids programming'…" (quoted in Heath, 2013). The "catalyst" for such a desire was the "drop in the number of applications for Cambridge University's Computer Science undergraduate degree in the early 2000's" (Raspberry Pi Foundation, n.d., p. 4), which in turn indicated a more widespread societal abandoning of, and pedagogic decline in, computer science (see Royal Society, 2012). The core components of this decline stemmed from a shift into passive computing (people trained how to use but not build or code computers), and a consumer culture that no longer appeared to encourage experimenting, hacking, and making (Raspberry Pi Foundation, n.d.). As the Raspberry Pi Foundation (n.d.) strategy document suggests, "This has profound economic and social consequences. Skills shortages in key industries, missed opportunities to solve social problems and innovate, widening inequality gaps, and too many people who are ill-equipped to take full advantage of, much less shape, the world in which they live" (p. 4). A constellation of intersecting initiatives, activities, and products make up what I have simplistically been calling the Raspberry Pi, including low-cost hardware, free software, educational outreach, training programs and resources, a philosophy and associated practice of "minimal computing" (see Gil & Ortega, 2016) and what the Raspberry Pi Foundation (n.d.) calls sustainable "communities that share learning and support" (p. 9).

While the Raspberry Pi constellation has been successful, an even more hands-on device that, as noted, is completely free for Year Seven U.K. schoolchildren is the BBC micro:bit, a device aimed at the world of ubiquitous or pervasive computing. The infrastructure for pervasive computing is now largely in place, that is to say, "the creation of environments saturated with computing and communication capability, yet gracefully integrated with human users" (Satyanarayanan, 2001, p. 1). Mahadev Satyanarayanan opens his paper – which discusses the challenges of pervasive computing as they existed nearly two decades ago – with Mark Weiser's notion that, "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" (Weiser quoted in Satyanarayanan, 2001, p. 1). Ironically, this disappearance leads to an analogous problem that the Raspberry Pi and BBC micro:bit address: that invisible technologies that are seamlessly integrated into our built environments do not lend themselves to hacking, creative tinkering, and re-engineering. From a different socioeconomic perspective, however, there is another underlying problem with these powerful and often quite expensive "invisible technologies," that is to say, there are economic barriers to accessing them or utilizing them in creative ways. Jacqueline Wernimont and Elizabeth Losh (2016), for example, ask

> do digital humanities scholars tend to assume that the typical user is affluent enough to own a desktop or laptop computer and is therefore not dependent on public computing in schools or libraries with strict rules about limiting time at terminals on which censoring software is pre-installed? Does the rhetoric of making and breaking suppose that home computing is an individual, rather than familial experience, such that tinkering and taking apart carries little risk of damaging family member access? (p. 36)

The minimal computing of the Raspberry Pi and BBC micro:bit have been developed with precisely such questions in mind, offering two models of access: a low-cost computing platform that the user builds up, so to speak, with other components that can safely be borrowed with no concerns about damage (keyboard, monitor, mouse, etc.), and a free controller platform that can stand alone or be connected to other extremely low-cost electronic devices. Minimal computing is not just a low-cost or free way to interact with pervasive computing environments, but also a highly creative and critical "conceptual provocation" that offers access, "ease of use, [and] ease of creation" (Gil & Ortega, 2016, p. 28), and even sustainability, with a small carbon footprint generated by low-powered devices. Alex Gil and Élika Ortega (2016) give some interesting examples of minimal computing from "INKE's Birds-of-a-Feather gathering in Havana. As a result of the then extant embargo, some peculiar academic and popular minimal computing practices had developed in Cuba: USB parties to share document libraries, email chains as forms of publication, SMS hacks, and much more" (p. 28). Minimal computing, then, is a powerful pedagogic and social process whereby barriers to access are creatively removed by each individual user or community.

Another aspect of minimal computing that needs to be considered as a counter to arguments concerning the steep learning curve of some open source platforms and processes, is simply the fundamental "appeal" of a particular technology. As Albrecht Schmidt argues, "As digital technologies become embedded in our everyday world, and as ubiquitous computing becomes commonplace, we need to consider how to better educate people about computer science concepts, regardless of their (professional) goals in life" (p. 5). Schmidt regards the BBC micro:bit as a "computing platform, making it easy for students to create ubiquitous computing applications" (p. 6). In other words, this is a hands-on device that can almost immediately be put into action, using a range of computer languages that appeal to different age or ability groups. Thomas Ball, Jonathan Protzenko, Judith Bishop, Michal Moskal, Jonathan de Halleux, and Michael Braun (2016) note that, "There is evidence that students and children are enticed by activities where they can see, touch and change 'the computer', in addition to seeing code on a screen … The growth of interest in Arduino, Raspberry Pi and other small computers has been considerable in the developer world" (p. 1). In many respects, the BBC micro:bit is a cross between a Raspberry Pi and an Arduino microcontroller: it can be literally "handled," e.g., utilizing its two programmable buttons to make some or all of the 25 LEDs light up; its input/output rings can be connected to using crocodile clips or banana plugs (Ball, Protzenko, Bishop, Moskal, de Halleux, & Braun, 2016), and yet the tiny device also has the power of a 32-bit ARM Cortex MO CPU, with accompanying Bluetooth, Micro USB, an accelerometer, and a compass. The device can be coded via a Web page (also accessing the simulator to test out code before downloading to the device), using CK JavaScript, Microsoft Block Editor, Microsoft Touch Develop, or Python; a downloadable version of MicroPython is also available (Tollervey, 2015). Essentially, all of this software is free to use, for example, the Microsoft Touch Develop software is available at GitHub through an open source MIT License.

In *The Big Humanities: Digital Humanities/Digital Laboratories* (Lane, 2016), I undertake a genealogy of open source by imagining a scenario whereby a person wants to access, as a fairly random example, the *Internetarchive* application from GitHub. This useful application is available under the rOpenSci Open Source Initiative MIT License, and I further imagine in this scenario that the person is using a Raspberry Pi computer running the entirely free Raspbian operating systemwhich in turn is based on the free operating system Debian. Significantly, the Debian OS has a "Debian Social Contract" that was formally ratified in 1997 (version 1.0) and then again with version 1.1 in 2004. The social contract "with the Free Software Community" asserts that:

1. Debian will remain 100 percent free.
2. We will give back to the free software community.
3. We will not hide our problems.
4. Our priorities are our users and free software.
5. Works that do not meet our free software standards [an acknowledgment that "some of our users require the use of works that do not conform to the Debian Free Software Guidelines"] (Debian, 1997–2016; modified).

To complete the circle here, the Debian Free Software Guidelines were modified by Bruce Perens to create the Open Source Definition (Debian, 1997–2016). A major part of the contract is open communication: not just distribution, but also sharing with the community things such as "bug fixes," and this includes the communication of the Debian (1997–2016) "bug report database." So an imaginary computer user has opened a free browser on his or her Raspbian OS, such as Epiphany for Raspberry Pi (Upton, 2015) or even Tor, and then heads over to GitHub to carry on as described above. There are obviously a number of significant communities that have been engaged with, and that have freely given of their time and talents, by the time this imaginary user arrives at GitHub. The impetus, however, in this instance of the Raspberry Pi project is such that the imaginary user is not simply a passive recipient of the open source "gift economy"; instead, he or she begins contributing to that economy almost from the beginning, be it simply sharing ideas, enthusiasm, project results, or code, leading to more advanced creation of blogs, websites, and other media to disseminate and share coding ideas (see, for example, Raspberry Pi Community).

The technical demands of using the above open source hardware and software, and the freedom to hack, break, and rebuild, are partly responsible for such a shift in behaviour to one of making positive and productive contributions to the open source communities from which the digital gifts came in the first place.

Concluding with the social space of digital humanities

Returning, then, to the digital humanities, I am arguing for a synthesis of the open source reciprocal model (the "gift economy") with that of the "extended model" (Athey & Ellison, 2010, p. 296) where a broad spectrum of users also contribute to the generation of knowledge, in the exposed space of the digital (Web 2.0, Humanities 2.0, etc.). But in this synthesis there is also embedded a fundamental pedagogic need: to flip the current DH training model whereby minimal DH training happens at a lower more self-directed and general daily level (as described by Smiljana Antonijević, 2015, in her chapter called Workflows of Digital Scholars), and a small percentage of the humanities community take DH training at a higher level, such as at the Digital Humanities Summer Institute at the University of Victoria, BC; flipping this model would create a large community of digitally literate DH-trained people who could then enter their *advanced* training period with the capacity to creatively hack/build/code already established. Returning to Henry George's work on community, the analogy of the settler who has developed the best piece of land yet remains alone is highly relevant: "It is not until the arrival of neighbors that life begins to improve in a noticeable way" (Niman, 2011, p. 906); in other words, the increased productivity from the division of labour cannot be divorced from the increase in the standard of living across personal and social domains. With a flipped training model, there would be a larger community of DH scholars who would be freely sharing data, publications, training tools, and experiences across a host of private-public enmeshed social networking and other digital platforms. The open source model functions as a social space of knowledge production, one in which the ephemeral nature of the medium used to communicate does not really matter (a standard objection to social media), since the knowledge archive is the code, while the code also embodies the aspirations, needs, and dreams of the knowledge community.

How, then, does this social space manifest itself in practice? In the academy, the digital humanities laboratory has become a site in which innovative small to large-scale projects are initiated and coordinated across various economies of scale, through making available a dedicated space that houses advanced technologies and highly qualified personnel, as well as partaking of and offering access to powerful distributed computing networks. In this space experimental research and the development of prototypes, alongside many other types of humanistic activities, allow for the production of blue skies hybrid research that traditionally would only have taken place in a science laboratory. With the synthesis of open source software and knowledge production/preservation (electronic publications, databases, digital libraries, etc.) and the concomitant transition via experimentation with social networking processes and infrastructure, the DH laboratory also contributes to, and partakes of, the neural network known as the "social machine," that is to say, going beyond the individually enhanced "Web-extended mind" (Paul Smart, quoted in Smart, Simperl, & Shadbolt, 2014, p. 55) through the bringing together of computing processes with collective human input or multiple human participants to create "computational entities governed by both computational and social processes" (Smart, Simperl, & Shadbolt, 2014, p. 9). At the heart of the social machine is creativity, either as the human input as Tim Berners-Lee and Mark Fischetti suggest, that is to say, where "people do the creative work and the machine does the administration" (quoted in Smart, Simperl, & Shadbolt, 2014, p. 53), or where the computer and the individual can both "play the role of participant machinery" (Smart, Simperl, & Shadbolt, 2014, p. 54). Either way, contra Dobbs, Manyika, and Woetzel (2015) (see above), open source enmeshed digital modes of communication can lead to a new "neural" space of production, one in which human employment/participation, creativity, and productivity enhance real world knowledge communities.

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