The Journal of Modern Craft

Volume 3—Issue 2
July 2010
pp. 179–190

DOI:
10.2752/174967810X12774789403564

Reprints available directly from the publishers

Photocopying permitted by licence only

Virtual Guilds: Collective Intelligence and the Future of Craft

Leonardo Bonanni and Amanda Parkes

Leonardo Bonanni is a PhD candidate at the Media Lab, where he founded Sourcemap.org, a social network for sustainable design and supply chain transparency. Prior to his PhD he was an inventor at the MIT Kitchen of the Future, an architect and a product and interaction designer.

Amanda Parkes is an interaction designer and professor focusing on computational materiality and new fabrication techniques as an area of innovation for future products. She holds a PhD in Tangible Media from the MIT Media Lab.

Together, Amanda Parkes and Leonardo Bonanni developed the MIT course Future Craft, which looks at emerging trends in social and environmental sustainability afforded by digital media.

Abstract

The apprentice model is making a resurgence through online craft communities or *virtual guilds*. These groups are growing through the mainstreaming of computer-controlled manufacturing and the democratic sales channels of the internet. Similar to open-source software communities, virtual guilds have a pioneering role in championing new technologies, often with only niche applications. The future success of these virtual guilds will depend on a careful balance of access to commercial media and focus on socially relevant issues.

Keywords: future craft, digital communities, collective intelligence, invention, long tail

Introduction

In his recent book *The Craftsman*, Richard Sennett presents the nature of craftsmanship as a basic and enduring human impulse—the desire to do a job well for its own sake.[1] Craft, he argues, encompasses a much broader context than skilled labor and promotes an objective standard of excellence in which craftspeople are shapers of culture, policy, and technology. The nature of craft is transdisciplinary; it is rooted in emerging materials, technological processes and cultural phenomena, and it is uniquely positioned to reflect new social values. Craft is not just the way we make objects. It is integral to rethinking the kinds of objects we make.

A future craft is being defined by digital media, which affords new tools and materials as well as the communication channels to join new communities. Over a decade ago now, Malcolm McCullough explored the computer as a tool affording all the interpretation and subtlety of physical craft: digital media can combine the skills of machines and humans (mental and physical) to provide a structured system of transformations capable of resulting in crafted objects.[2] And the fluid nature of digital communities allows craft to evolve into a form which is decentralized and distributed, supporting quality through the heterogeneous approach of collective intelligence.

Craft is a social activity, shaped by communal resources and motivations. The collective approach of craft communities—or guilds—is characterized by the master-apprentice model, where practitioners devote significant time passing on their skills to the next generation. The open source software movement embodies the communal and highly skilled practices of craft guilds, but without the traditional economic function of those organizations (which were closed societies charged with safeguarding competitive advantage). Until recently, skilled handicraft relied on hands-on teaching and access to local resources. The very meanings of the terms "craft" and "guild" have shifted with the growing popularity of multiplayer computer games, where they refer to a collective task-oriented approach coordinated through the internet.[3] But mass media and the internet also make it possible to transmit real, physical skills and resources to distributed individuals, enabling entirely new kinds of digital craft communities. Unlike their locally instantiated counterparts, these *virtual guilds* rely on open access to specialized knowledge and technology, where they can contribute to knowledge that tends to lie outside the boundaries of established domains.

The success of open-source software projects suggests a model by which dispersed, collective innovation might become possible in other domains. Shared resources maintained by a socially motivated community form the backbone of these largely non-commercial efforts. Digital channels of communication can extend this free exchange of information to the domain of craft, so that specialized designs and processes can be shared among a wide audience. Online distribution provides access to otherwise unavailable materials and tools and offers a market for craft products.

Several successful virtual guilds exist today, and they are contributing important inventions, often to neglected markets. These communities of skilled practitioners are characterized by their marginal nature, where the free and open exchange of ideas is carried forward for collective benefit. At the same time, the very popularity of virtual guilds, and the commercial success of their innovations, endanger the free exchange of information on which they are built. The development and survival of collective craft communities is important to under-served groups and for technological advancement, so it is essential that more practitioners engage in collective action. The new generation of digital design and fabrication tools lays the groundwork for larger numbers of skilled craftspeople to collectively expand on their respective practices.

Collective Invention

Digital media is fostering a rise in software applications able to leverage *collective intelligence*: the aggregate knowledge of a diverse community of experts. Communities of software developers are able to share programming expertise and produce new software, operating systems, and programming languages. Writers and journalists can form ad-hoc encyclopedias and news outlets. The convergence of experts enables them to collaborate outside their professions, where they are free to push technical and commercial boundaries. Open and distributed innovation can help to define nascent domains—especially those where commercial benefit is unclear—and plot the paths of technological development.

In a number of well-known instances, a collective approach has fostered inventions that have been influential to the progress of technology. These "collective inventions" were enabled by the open transfer of technical knowledge.[4] One example is the building of the first steel furnaces in the US before there was a clear understanding of the science behind the process. Each furnace was an experiment in itself—a prototype—and proud hearth owners showed off their unique designs to visitors. Scholars were gradually able to deduce which designs worked best and publish their findings in books and journals. Improved furnace plans were made available to all of the hearth owners, and the nascent field rapidly expanded.[5]

Conversely, a protectionist approach risks delaying innovation and keeping potential communities of contributors from forming. When James Watt introduced his version of the steam engine, he made it so expensive to license that many small businesses could not afford it. Independent mine owners in the South of England needed pumps to draw water out of their mines, so they built illegal copies of Watt's relatively inefficient design. Only decades later when the patent expired were the copycats able to share their designs with each other through a widely circulated publication, *Lean's Engine Reporter*. The combined efforts of these lone tinkerers resulted in a vast improvement in the overall efficiency of steam engines, paving the way for modern engine designs.[6]

In both cases, a dispersed group of practitioners made some effort to share their craft to elevate the state of the art of an entire industry, despite the fact that the community of innovators was small (numbering in the dozens or hundreds) and restricted to a geographic region. The technical diagrams that were shared within these communities only served a knowledge transfer role, but the practitioners were already quite skilled—probably trained through traditional means. The transfer of technical knowledge—especially practical know-how—is notoriously difficult and expensive, requiring hands-on training over years.[7] Digital channels of communication, on the other hand, make it possible for vastly more diverse and distributed communities to work together and advance knowledge collectively.

In the most successful recent episode of collective invention, tens of thousands of computer programmers around the world collaborated through the internet to develop the *Linux* operating system—a software backbone of nearly every commercial computer server and millions of PCs. Open source software design is facilitated by the fact that the tools with which software is used are the same tools used to make it; every computer user is a potential programmer. The internet provides a communication channel whereby many thousands of developers can directly collaborate on a project, and in addition maintain a shared set of resources essential to the health of the community itself. Teaching websites, discussion forums, and copious comments written into the code, while not essential to the production of the software, serve to transfer knowledge between programmers. These resources—and the open-source development process—have proven invaluable to the software industry, which relies on the software, documentation, and collaborative processes of the open-source movement for development, innovation and as a marketing tool. In exchange, major software companies regularly donate time to various open-source efforts.

As Sennett points out, the development process of open-source software is more akin to a medieval workshop than a high-technology enterprise. Participants engage in a type of "technological craftsmanship" where the quality of the work can be its own reward. The collaborative process of developing open-source software structures communities with their own social order and benefits. Far from the closed nature of traditional craft guilds, these communities are inclusive of nearly anyone wanting to contribute—not only programmers, but also artists, writers, lawyers, etc. Aside from a small group of experts that direct long-term progress, open source software development gathers an ad-hoc community of contributors who are independently motivated to work on one of the many possible applications relevant to them.

Computers have traditionally lent themselves to text-based work (like programming and writing), but only recently did it become possible to share physical designs and expertise online. Digital media is generating virtual guilds of craftspeople through the proliferation of design-centered social networks, the growing ubiquity of digital design tools, and the "long tail" of internet-based distribution. Social networks act as channels for sharing design and fabrication knowledge in a movement known as "Open Design." Digital design and fabrication support the sharing and manufacture of increasingly complex designs. Even on-line retailers provide access to specialized tools and materials while fostering a market for craft goods. These enabling technologies are giving way to structured communities of experts who—like the open source community—are invested in the craft and in the sustainability of the guilds themselves.

Open Design

Open Design has grown around the sharing of design documentation amongst social networks of designers and manufacturers. Similar to communities of open source software developers, the Open Design community relies on shared resources that offer instructions, foster discussions and provide access to shared physical resources. Social networks such as the Instructables website[8] provide a rich social forum for sharing physical know-how through step-by-step instructions. Anyone can contribute a sequence of drawings, photographs, and videos to make an "instructable" to be shared with the entire on-line community. The community's active members (who number in the hundreds of thousands) promote and refine contributions, or simply leave encouraging comments. While the site is directed at amateurs, it represents a significant leap in the tools available to teach hands-on processes, and demonstrates the importance of an altruistic user base to motivate continued use.

Online social networks favor an intermediate approach to technology in order to attract participation from outside expert domains. A number of the most popular inventions posted to the Instructables website have been manufactured in small quantities as "toolkits," or assembly-required circuits that can be completed with limited knowledge. This intermediate approach makes it possible for people to join the community from other professions and contribute to collective invention.

Open Design also occurs within the traditional designer-centered model of production, where the inventor retains authorship while making design documents available to the public. Varying degrees of transparency and openness are defined by the Creative Commons licensing system.[9] This alternative to traditional copyright allows authors to specify whether their designs can be copied, modified, or used for commercial purposes. Designer Ronen Kadushin, for example, makes available a series of planar furniture designs through plans that are free to download and manufacture with widely available rapid prototyping machines.[10] This open sharing of design information is not completely altruistic, as many designers gain professional notoriety through their exposure on-line.

Computer-Aided Design (CAD) has long been a standard tool of professional practice, but only recently has it become possible to share three-dimensional designs through powerful computer networks and freely available tools. A number of centralized efforts, including the free *Sketchup* modeling software and the accompanying online library of digital models, make it possible for anyone to contribute and make use of three-dimensional models. The standards of two- and three-dimensional design are converging, so that it is becoming far easier to make sense of design documents. Digital fabrication machines are becoming ubiquitous and standardized, and a shared CAD drawing can be translated into physical form almost as easily as printing a text document. These technical improvements do not yet allow distributed communities of designers and manufacturers to collaborate as seamlessly as computer programmers, but given the growing adoption of Computer-Aided Design and Manufacturing (CAD/CAM), it is only a matter of time before they can.

Long Tail

Open-source software development, like the distributed design of the steam engine, relies on the widespread availability of tools and materials. A phenomenon called the "long tail" of digital distribution is broadening access to hard-to-find items, creating both a supply and demand for specialized crafts. Physical markets benefit most by selling a few blockbuster products in very large quantities, an ideal way to limit inventory and maximize distribution. Digital marketplaces, on the other hand, can sell any number of individual items from multiple, widely distributed warehouses. As a result, on-line shopping gateways can make a profit from selling obscure items that would never make it to a store shelf. This works both to supply craftspeople with hard-to-find materials and tools, and to create a market for their unique products. Specialized websites offer industrial materials to individual consumers, and auction sites provide access to historical or discontinued equipment. These same sites, in tandem with niche online shopping portals, make it possible for anyone to sell their own products with minimal overhead. The well-known site *Etsy*, for example, caters to craftspeople by making it very easy to create an online store and allowing shoppers to browse products by color and location (Figure 1).

Craftspeople that engage in online communities are able to market their ideas and designs at almost no cost. Successful online identities are akin to the roles developers play in an open-source software project. Individuals can become (relatively) famous by contributing to shared resources, by making their work available for use by others, and by providing helpful comments in open design communities. The creation of a Virtual Guild relies on a combination of these individual skills and a collective effort toward a common goal.

Despite the wide range of tools available to support collective intelligence in a variety of domains, successful communities are very rare, their success relying on the motivations of participants and the status of the craft. In the following case studies, we identify two successful communities of collective craftspeople working on a common goal that falls outside the traditional boundaries of commerce. The Open Prosthetics Project seeks an alternative to the medical industry for providing effective and accessible prosthetics. The Wearables community is an academic pursuit of alternatives to the traditional conception of hardware. Both are successful efforts at defining a craft community outside traditional boundaries; exploring how they work reveals some of the conditions for virtual guilds to flourish.

Fig 1 The *Etsy* online store.

Open Prosthetics Project

Prosthetics are expensive to research and develop, resulting in a very limited number of available designs. The Open Prosthetics Project (OPP) uses an on-line social network to share design ideas and solutions for more reliable, more tailored prosthetics than those being produced by the medical industry. The project hosts a "wiki" or collaboratively edited document which contains ideas for new prosthetics and improvements to existing ones. Designers can post ideas and problems, as well as uploading CAD files produced using the free software program *Alibre*. The project succeeds in providing ideas for altogether new prosthetics as well as improving on classic designs.

Building on the shortcomings of the prosthetics industry gave the OPP is initial legitimacy. The Trautman Hook, a simple and robust design for a body-powered hand prosthetic, was in continuous use from the 1920s until the recent closure of the company (Figure 2).

Faced with no other supplier and a number of lingering design problems, OPP engineers collaborated to produce an

Fig 2 The original Trautman hook.

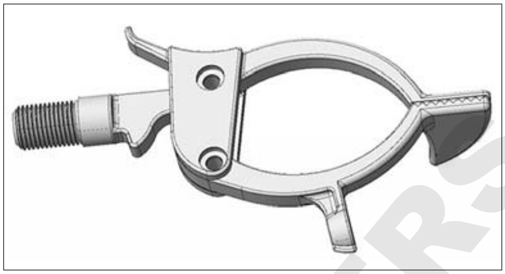

Fig 3 The OPP version of the Trautman hook; note the reinforced cable stay for strength and the recessed screw holes to prevent binding.

improved hand prosthetic which would not bind or break as frequently as its predecessor. The revised Trautman Hook is freely available as a three-dimensional model; it can be downloaded and fed to a computer-controlled mill or other rapid prototyping machine (Figure 3).

The virtual guild devoted to open prosthetics includes engineers that traditionally work outside the medical industry—designers who can bring a fresh point of view to the process. They include personally motivated contributors who are generating ideas that they can use for themselves or their loved ones. One endearing example is a fishing pole arm developed by a father for his son, who has one arm amputated below the elbow (Figure 4).

Engineer Robert Haag fitted a toy fishing rod to an existing lower arm prosthetic so that his son could cast a line, using the same prosthetic attachment he would use to open and close a hand hook. While most prosthetics are designed with purely functional considerations, this hybrid prosthetic/toy makes it clear that there is

Fig 4 The prosthetic fishing pole on openprosthetics.org.

ample room to develop medical devices with expressive and entertaining applications.

The persistence of the Open Prosthetics Project can be explained by their motto: "Prosthetics Shouldn't Cost an Arm and a Leg." The project is motivated by a desire to make medical devices widely available, at a lower cost, and with fewer intellectual property restrictions than competing products. This goal is analogous to that of many open source developers, who believe that information must be freely available (Williams 2002). Similarly to open source software, many of the contributors to the OPP are only working part-time on the project, being employed as professional engineers the rest of the time. The social motivation that underpins the project gives it its legitimacy and enduring importance.

The Wearables Community

A virtual guild is an alliance of craftspeople operating at the margins of industry and craft. This is the case with the Wearables community, a group of fashion, art, and engineering professionals working to develop technologically integrated textiles and clothing. A widespread group of academics, entrepreneurs and professionals, the community is only able to come together through the internet and in person at occasional art exhibits or runway shows. Projects range from wearable devices for generating electricity to clothing that displays information and a bevy of functional, expressive, and artistic designs. Wearables are at the cutting edge of research in the scientific and material science domains, where the restrictions of intellectual property are traditionally very strong. Yet many of the most active participants in the community have emerged from the fashion and art worlds, areas steeped in open and collective traditions. A principal motivation of the Wearables community is to merge traditional crafts with scientific processes while bridging these communities, which are extremely disparate in terms of gender, age and socio-economic circumstances.

Wearables is an intersection of experts with advanced sewing and electronics skills and the desire to pioneer a novel domain. They are able to do so because of a distributed set of resources for sharing complex technical information, hands-on skills, specialized tools, and new materials. Unlike open source software or the OPP, the artists, engineers, and academics of the Wearables community generally retain authorship of their contributions. At the same time, the domain is so marginal that it could not exist without its members sharing their individual contributions. Several different models for sharing information are emerging. Blogs written by a small number of authors (who often double as curators and historians) serve to maintain a current list of research projects, exhibitions, publications, and events. Personal websites that act as design portfolios are useful to spread the techniques and products of individual contributors. Despite their one-way nature, these websites are the primary channel for initiating personal communication between members and precipitating introductions for events and conferences in the real world.

While the Wearables community is small, it draws considerable publicity due to its unique combination of glamorous fashion and cutting-edge technology. It is poised to enter the public consciousness as more high-end "couture," sportswear and military gear incorporates sophisticated technology. Because of the growing public interest and the highly specialized nature of the craft, Wearables has evolved a secondary approach to information sharing and outside engagement. Several leaders within the space have developed specialized "toolkits" to lower the barrier of entry and engage potential contributors as hobbyists. These kits of parts offer an intermediary approach between the open source information of online tutorials and the commercial nature of a product. They also make it possible to attract underrepresented groups to the technological domain through craft, especially young women and practitioners of traditional handicraft.

Toolkits are derived from an approach popularized by Instructables communities as a way to attract members from outside technical specialties. In the Wearables community, these toolkits are often designed for people who are familiar with either the craft of sewing or electronics fabrication, but not both. They include a number of design features aimed at combining the two, both formally and functionally. The Modules by Studio 5050 (the name stands for 50 percent art and 50 percent technology) are circuit boards complete with holes for stitching them into fabric, and snaps that allow delicate electronics to be removed for washing (Figure 5).

Applications include clothing that plays music or shows the temperature on a tiny numeric display. The Lilypad Arduino, a toolkit developed by MIT Professor Leah Buechley, is a circuit board with a floral pattern and button-shaped components (Figure 6).

Its design is intentionally gendered, meant to attract young women to the engineering

Fig 5 "Modules" by Studio 5050.

Fig 6 Arduino Lilypad Deluxe kit.

professions. It can be downloaded under the Creative Commons license. The Electropuff by International Fashion Machines is a light switch in the form of a fabric puff (Figure 7). It is available as a kit that allows the builder to customize its color and pattern.

Fig 7 ElectroPUFF Craft Kit by International Fashion Machines.

All three of these toolkits are the product of academic spin-offs, highlighting the dual academic/commercial nature of this virtual guild. A considerable amount of funding has become available for this type of research, in part because of the US government's interest in developing wearable technologies for soldiers. While this military research is entirely closed to the public, many companies are following the trend and supporting Wearables projects in private research laboratories like the MIT Media Lab and Concordia's Hexagram. The growing popularity of wearable technology and its absorption into mainstream engineering and design practice endangers the Virtual Guild that brought it about. Member of the Wearables community are obtaining faculty positions and starting small companies, and the research is approaching the mainstream in electrical engineering and materials science. The field risks losing its fringe contributors, however. If barriers to entry were to be erected that exclude those outside large companies and major institutions, the social role of Wearables could be sidelined.

Conclusion

The collective pursuit of a distributed group of skilled fabricators is a powerful way to forge new domains and make important discoveries. But the open dialogue on which these communities are based is threatened by their very success in the commercial and academic domains. The motivations that underlie virtual guilds can be at odds with industrial pursuits, and their greatest strength—the effort dedicated to maintaining the community—is altogether lost in the commercial world.

In purely commercial pursuits, the practice of craft becomes endangered—even when its preservation has commercial benefit. During the Apollo project, skilled craftspeople built a one-of-a-kind spacecraft able to reach the moon. At the end of the project, NASA abandoned the single-use rockets of Apollo in favor of reusable spacecraft. The engineers and machinists that built the Apollo spacecraft retired, and most of their specialized knowledge was lost. In 2006, engineers working on a new rocket to Mars realized that their designs would build directly on Apollo. They had to track down surviving Apollo engineers and interview them to salvage what knowledge they could (Patton 2006). To prevent such contingencies, procedural interviews, documentation, and a series of sophisticated software packages have been implemented in the last decade as part of the growing field of Knowledge Management—the effort to preserve specialized knowledge despite constant turnover. This kind of knowledge transfer is assured by the guild structure, founded on the apprentice model.

The motivations that fund industrial efforts are insufficient when it comes to engendering the pride and social cohesion that preserves specialized craft practices. At the same time, a delicate compromise with the business sector is needed to maintain much of the infrastructure that feeds virtual guilds. Instructables and other how-to websites are for-profit businesses benefitting from access to a large audience and tie-ins with products. The Wearables community is both dependent on and threatened by commercial applications for its techniques. And unlike traditional guilds, these phenomena may be short-lived: new technologies and standards are continually evolving that will supersede the media used to share specialized knowledge today. Photographs, videos, three-dimensional designs, circuits, and even sophisticated technical devices can be created and shared using free software housed online. Academic institutions and publications are making their content available online, with researchers and students starting to contribute their own research to the public domain. New interfaces for transmitting high-fidelity content can expand the number of domains open to collective and cross-disciplinary contributions. In the face of all this change, one thing is certain: more virtual guilds will emerge, and with them the potential to transform the technological and social landscape.

Notes

1 Richard Sennett, *The Craftsman* (New Haven: Yale University Press, 2008).

2 Malcolm McCullough, *Abstracting Craft: The Practiced Digital Hand* (Cambridge, MA: MIT Press, 1996).

3 The Massively Multi-Player On-Line Role-playing Game (MMPORG) *World of Warcraft* refers to small groups of players coordinating to achieve a collective task as "guilds;" neither "craft" nor "guild" is used here in its traditional sense, however.

4 R.C. Allen, "Collective Invention," *Journal of Economic Behavior and Organization* 4/1 (1983): 1–24

5 David Hounshell, *From the American System to Mass Production 1800–1932* (Baltimore: the Johns Hopkins University Press, 1984).

6 Peter B. Meyer, "Episodes of Collective Invention." US Bureau of Labor Statistics Working Paper No. 368, August 4, 2003. Available at SSRN: http://ssrn.com/abstract=466880

7 Stephan R. Epstein, "Transferring Technical Knowledge and Innovating in Europe, c. 1200–c.1800." Paper presented at the Economic History Seminar, Department of Economics, Tokyo, December 18, 2006. Available online at http://www.e.u-tokyo.ac.jp/cirje/research/workshops/history/utlse_paper2006/Epstein.pdf

8 http://www.instructables.com/

9 http://creativecommons.org/

10 Ronen Kadushin Open Design: http://www.ronen-kadushin.com/Open_Design.asp

References

Allen, R.C. (1983) "Collective Invention." *Journal of Economic Behavior and Organization*, 4 (1): 1–24.

Anderson, Chris. "The Long Tail." *Wired Magazine*, October 2004. Retrieved April 3, 2009 at http://www.wired.com/wired/archive/12.10/tail.html].

Boykin, Sam. "Open-Source Thinking Revolutionizes Prosthetic Limbs." *Scientific American Magazine*, October 2008. Retrieved April 3, 2009 at http://www.sciam.com/article.cfm?id=open-source-thinking

Concordia University Hexagram: http://hexagram.concordia.ca/

Epstein, Stephan R. "Transferring Technical Knowledge and Innovating in Europe, c. 1200–c.1800." Paper presented at the Economic History Seminar, Department of Economics, Tokyo, December 18, 2006. Available online at http://www.e.u-tokyo.ac.jp/cirje/research/workshops/history/utlse_paper2006/Epstein.pdf

Google sketchup: http://sketchup.google.com/

Hounshell, David. *From the American System to Mass Production 1800–1932*. Johns Hopkins University Press, Baltimore, 1984.

Instructables: http://instructables.com/

International Fashion Machines: http://www.ifmachines.com/

Lilypad Arduino: http://www.arduino.cc/en/Main/ArduinoBoardLilyPad

McCullough, Malcolm, *Abstracting Craft: The Practiced Digital Hand*. MIT Press, Cambridge, MA 1996.

Meyer, Peter B. Episodes of Collective Invention (August 4, 2003). US Bureau of Labor Statistics Working Paper No. 368. Available at SSRN: http://ssrn.com/abstract=466880

The MIT Media Lab: http://web.media.mit.edu

http://web.media.mit.edu/~leah/grad_work/links/material_links.html

The Open Prosthetics Project: http://openprosthetics.org/)

Patton, Susannah. "Knowledge Management (KM): Beating the Boomer Brain Drain Blues." *CIO Magazine*, January 15, 2006. Retrieved April 3, 2009 at http://www.cio.com/archive/011506/boomer.html

Ronen Kadushin Open Design: http://www.ronen-kadushin.com/Open_Design.asp

Sennett, Richard. *The Craftsman*. New Haven: Yale University Press, 2008.

Studio 5050: http://www.5050ltd.com

Williams, Sam (2002). *Free as in Freedom: Richard Stallman's Crusade for Free Software*. O'Reilly Media. ISBN 0–596–00287–4.