Panel Proposal for SHOT 2007

Title: Networks of Knowing – Technology Transfer & Open Source Innovation

Organizer:

Thomas Haigh, University of Wisconsin-Milwaukee, thaigh@computer.org

Chair:

William Aspray, Indiana University, waspray@indiana.edu

Presenters:

Challenging the Engineering Perspective: A New Look at the Development of the World's First Stored Program Computer
David Anderson, University of Portsmouth, cdpa@btinternet.com

From Technological Mimesis to Creativity: Early Online Rail Reservations in Japan
Chigusa I. Kita, Kansai University, ckita@res.kutc.kansai-u.ac.jp

Open Source Software at 50: Its Corporate and Mathematical Origins
Thomas Haigh, University of Wisconsin—Milwaukee, thaigh@computer.org

Beyond Computer Exceptionalism: Open Source Aeronautics Before 1903
Peter B. Meyer, Bureau of Labor Statistics, meyer.peter@bls.gov

Commentator:

Lars Heide, Copenhagen Business School, heide.lpf@cbs.dk

Relationship to Conference Themes:

These papers have a strong historiographical content, in accordance with the conference focus on more reflective panels.

The panel is organized by the SIG on Computers, Information and Society

"The Historian and other Disciplines" & request for "Diversity of Approaches" within a panel: one of the presenters is an economics researcher with the Bureau of Labor Standards, and two combine graduate degrees in the history of science and technology with current appointments in departments of informatics. The commentator has a business school appointment. There is also a diversity of national approaches: the panelists are British, American, Danish and Japanese.

The papers meet the challenge to consider "'IT's' origins and ascendance in relation to other technologies" particularly by including contrasting accounts of open source development in early computing and early aeronautics.

Session Abstract
Networks of Knowing – Technology Transfer & Open Source Innovation

This panel explores the process of knowledge transfer in technological innovation, looking particularly at the role of social institutions. In keeping with the conference theme, this panel revisits the events of the 1950s and returns attention to fundamental issues in the innovation process. The papers integrate the human and institutional aspects of knowledge transfer, documenting personal networks, the use of published materials, tacit knowledge, and the creation of formal and informal mechanisms for information dissemination similar to those associated with today's open source software movement. Three panelists focus on information technology, while, to provide a comparative perspective, the fourth addresses early aeronautics.

Within the history of computing, work on the early hardware and software of the 1940s and 1950s has generally been carried out either from an internalist engineering approach or a business history perspective. Anderson revisits one of the most famous innovations, Manchester University's creation of the first stored program digital computer. Using new archival evidence he argues for the importance of mathematicians and their expertise in the creation of this computer, looking particularly at the process of knowledge transfer from the then-classified Colossus project. Kita picks up the theme of knowledge transfer in early computing in her analysis of the creation of a pioneering electronic seat reservation system by Japan National Railways in 1959. She suggests that expertise transferred from MIT and a foreign supplier was reshaped within the institutional context of this firm to produce a distinctive and successful technological system. Both papers reconnect the history of technology with the history of science by turning attention to the institutional dimensions of knowledge transfer.

The other two papers look at antecedents to today's open source development practices, rooted in the free exchange of technical information and computer code. Open source, as a combination of development methods, a social movement, and a set of licensing arrangements, has not yet received much attention from historians. But the many journalistic and popular works on the topic trace it to work on operating systems software in the 1980s and 1990s. Haigh and Meyer both explore continuities between the modern open source movement and the practices of earlier technological communities. Haigh argues that all of the formal characteristics of open source and many of its cultural practices can be traced back to the mathematical software libraries produced by IBM user organization SHARE in the 1950s onward. Meyer goes even farther back, using a painstaking examination of publications by experimenters and patent lists to argue that open source methods are visible in the community of aeronautical pioneers during the late nineteenth and very early twentieth centuries. Seeing open source development as a technique already used in several historical contexts and eras, rather than an entirely new invention, helps us to better understand its strengths and weaknesses and so understand how and where it is likely to function most effectively.

Challenging the engineering perspective: A new look at the development of the world's first stored program computer

David Anderson, University of Portsmouth, Hampshire, UK

Topic: The story of how the world's first stored-program computer came to be developed at the University of Manchester in the immediate post-war period is conventionally told only from an engineering or technical perspective. The dominant discourse to which this has given rise may be characterized as what Mike Mahoney calls an "insider history", which, almost completely de-contextualized, fails to explain adequately the behavior of historical actors.

Argument: I examine the institutional imperatives which led to the location of computing activity at Manchester and reject the usual portrayal of M.H.A. Newman, I.J. Good and D. Rees of the Department of Mathematics as merely bit-part players whose independent attempts to build a computer failed while a rival effort in the Department of Electrotechnics carried all before it. Newman is re-situated as the initiator, leader, and principal financial supporter of a single unified project. It is demonstrated that Newman was engaged in an active and officially-sanctioned transfer of computing know-how from the classified Colossus computer at Bletchley Park into the civilian world. It is further shown that the contribution made by members of the Mathematics Department was very significant and did not, as the conventional narrative would have it, amount merely to offering encouragement to the engineers, F.C. Williams and T. Kilburn.

Evidence: Previously unpublished material from the UK National Archives is examined together with correspondence and reports written by the principal players. Using material from the Royal Society archives and the Council minutes of the University of Manchester it has been possible to reconstruct, for the first time, the funding of the SSEM project. Finally, contemporaneous notes made by I.J. Good and not previous published are used to illustrate the contribution made to the project by members of the Mathematics Department. The whole is contextualized resulting in the exposure of a number of historical myths underpinning the dominant discourse and, by so doing, the way is opened to a more nuanced account of the development of the stored memory digital computer.

Contribution to Existing Literature: This paper provides a counterbalance to previous accounts such as Simon H. Lavington's "Early British Computers" and "A History of Manchester Computers", Chris Burton's "Replicating the Manchester Baby: Motives, Methods, and Messages from the Past" and Mary Croarken's "The Beginnings of the Manchester Computer Phenomenon: People and Influences".

From Technological Mimesis to Creativity: Early Online Rail Reservations in Japan

Chigusa I. Kita, Kansai University

Topic: This paper is about how technological knowledge diffuses and is digested as a new discipline or framework. In the Japanese history of computing, we should be careful to describe how pioneers in the 1950s or 1960s got information about computers that had been never seen, or how researchers went abroad absorbed information and experienced real technological process of system development to become an informant for the Japanese practitioners. And at the same time social factors for pioneer works in Japan affected to form technological visions, which sometimes shows creativity and original ideas by Japanese researchers and engineers.

Argument: In this paper, I will argue how "technological mimesis" could be a cradle of creativity in the system development on the view of technological visions that sometimes bore the motivation for the system development had been formed. To describe a history of technological system development, Thomas Hughes' approach has been undertaken by history researchers to study social perspectives of the technological systems. At the same time, we could pay attention to how the technological visions, which is formed through absorbing technological new set of knowledge or imitations, and shaped in the social circumstance or needs. Also I will refer to the ideas of Kuhn's "paradigm", Mahoney's "agenda", and Knorr Cetina's "epistemic cultures" to think about international circulation of knowledge and "technological mimesis".

Evidence: Case to deal with this topic is mainly seat reservation system of Japan National Railway that was in operation as early as in 1959. Primary sources are documents on the study group in JNR during the 1950s, and oral histories. There was an informant who spent a year in MIT, and his group decided to import Bindex G-15 and learned its architecture. They gradually formed a notion of on-line real time system to help the need within the company. Fortunately the governmental company owned communications network and the group could implement on-line system through, while others could not use phone lines to send data by law. In this group, foreign knowledge stimulated their creativity and let them form a technological vision for the new system.

Contribution to Existing Literature: In the literature on the Japanese history of computing, JNR's on-line real time system is not described as a mainstream, though many of refer to it briefly. In this paper, I will use documents that were never used in historical researches. And it could serve as a piece for comparative history for literature on SABRE, such as McKenney, Copeland and O. Mason's, *Waves of Change: business evolution through information technology*, Harvard Business School Press, Boston, Massachusetts, 1995.

Open Source Software at 50: Its Corporate and Mathematical Origins

Thomas Haigh, University of Wisconsin—Milwaukee, thaigh@computer.org

Topic: My paper focuses on the role of SHARE in the development of mathematical software routines, for generic tasks such as matrix computation, elementary and special functions, and solution of differential equations. SHARE was formed in 1955 by companies using IBM's most powerful scientific computer, the IBM 704. SHARE soon boasted hundreds of member companies and by the mid-1950s was performing a range of activities including regular conferences, an extensive software library, the production of standards and reference manuals of all kinds, and a number of joint software development projects.

Argument: I argue that by 1956 SHARE had many of the formal and informal characteristics of today's open source software projects, including a software library, distribution of standards for coding and documentation, mechanisms to support discussion between project members, mechanisms to report bugs back to the authors of routines, and mechanisms for users to contribute improvements back into a common code base. Creating these routines was laborious but brought little proprietary advantage, so firms realized they would benefit by pooling their efforts. However, SHARE also demonstrated some weaknesses of this approach. Tacit mathematical knowledge was being embedded into software and rendered invisible. Programs varied greatly in quality, and many possessed subtle mathematical flaws. During the 1960s a SHARE committee attempted to adapt academic peer review methods to test and improve the library. This effort largely failed, and in the early 1970s SHARE was eclipsed by computer vendors, academic research groups and software companies as a source of high quality mathematical routines.

Evidence: Sources for the paper include archival SHARE material at the Charles Babbage Institute and National Museum of American History and oral history interviews with surviving participants.

Contribution to Literature: I sketch connections between the activities of SHARE and Kuhn's concept of the open society, Shapin's discussion of the gentlemanly origins of science, and the power of the ideas of efficiency and elegant design in engineering culture. So far the burgeoning literature on open source is usually uncritical and evangelical, written by participants or impressionable journalists. There have been some useful managerially oriented guides, and a growing number of serious ethnographic and economic investigations. The topic has not yet been investigated by historians, and as a result little attention has been paid to these historical continuities or to the question of what is really new about the modern movement.

Beyond Computer Exceptionalism: Open Source Aeronautics Before 1903

Peter B. Meyer, Bureau of Labor Statistics, meyer.peter@bls.gov

Topic & Argument: The term "open source" is new, and describes a form of software development. I argue that the idea naturally extends to earlier technological experimentation, and doing so helps highlight interesting elements of technological change. One principle seems to be that if it is clear how to advance a technology and its future prospects seem good, its advance will be accomplished principally by hierarchical or profit-seeking organizations. But if the technology's prospects are unpredictable and the path to improvements very uncertain, the field may be left to ad hoc experimenters, who may then explore it and find useful paths forward. There are useful example episodes to refer to. In particular, the devices leading up to the first airplanes were developed largely by experimenters who did not have a direct financial interest in the outcome, and who made much information available to the interested public. The early development of the personal computers also had an open-source feel to them, in the Homebrew Club for example.

Evidence: This paper surveys the experimenters and publications that led up to the first (1903-1909) aircraft, and evaluates the ways in which the developments leading up to the first airplanes were analogous to those in open source software. Hundreds of authors and experimenters in the 1800s can be identified, based on secondary works, patent records, and by tracing back what the known experimenters are known to have read. This population is large enough that statistics on this group are possible and distributional questions can be addressed. We can infer the motivations of the aircraft experimenters, study their publications, and evaluate their use of intellectual property mechanisms. For example: How many experimenters contributed indirectly to publications read by, for example, the Wright brothers? (At least 200 that we can name.) How many experimenters filed for patents? (Lists of U.S. and German patents are known.) How many of the experimenters seem to have kept their inventions secret, and how many clearly did not? How many of the contributors to the information streams leading up to the early airplanes had made discoveries or inventions that were clearly useful to subsequent airplanes, and how many made some kind of discovery or innovation which was apparently not useful? How useful to the early airplane makers were the inventions which had in fact been patented or kept secret?

Contribution to Existing Literature: To the extent that there are clear parallels between open-source episodes, it helps us frame a historiography of open-source technology development that is not tied to technological and institutional details of software. It would help integrate the history of computing with the history of other technologies and industries. This would help frame a theory of the contexts in which self-motivated inventors are relevant and open-source development is likely, and thus support a common language and useful interactions between fields such as the History of Technology, Sociology, and Economics.

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SELECTED ACADEMIC:

University of Wisconsin--Milwaukee, Asst. Professor**,** School of Information Studies, 2004-

Indiana University, Bloomington, Visiting Assistant Professor, Informatics School, Fall 2003

Colby College, Visiting Instructor/Visiting Researcher, STS/Admin. Sci., 2001-3

University of Pennsylvania, History and Sociology of Science Ph.D. May 2003

Manchester University (UK), Department of Computer Science, B.Sc. & M.Eng, 1991-1995

SELECTED PEER REVIEWED PUBLICATIONS:

"Remembering the Office of the Future: Word Processing and Office Automation before the Personal Computer," forthcoming in *IEEE Annals of the History of Computing* 28:4 (October-December 2006).

"Engineering the Progressive Office: Technical Claims to Administrative Authority, 1917-1931" forthcoming in *Enterprise and Society*

"'A Veritable Bucket of Facts:' Origins of the Data Base Management System," ACM SIGMOD Record 35:2 (June 2006).

Thomas Haigh, "Software in the 1960s as Concept, Service, and Product", *IEEE Annals of the History of Computing 24* (January-March 2002): 5-13.

Thomas Haigh, "The Chromium Plated Tabulator: Institutionalizing an Electronic Revolution, 1954-1958", *IEEE Annals of the History of Computing 23* (October-December 2001): 75-104

Thomas Haigh, "Inventing Information Systems: The Systems Men and the Computer, 1950-1968" *Business History Review 75* (Spring 2001): 15-61.

OTHER PUBLICATIONS, HONORS & SERVICE:

Around twenty five other publications, including research articles, book reviews, obituaries, biographies, and a review essay. Around thirty published or forthcoming oral history interviews.

Seventeen competitively reviewed presentations, including four SHOT papers, three Business History Conference papers, and papers at the North American Labor History Conference and Hagley conference on the Technological Fix. Ten invited presentations and departmental seminars including Tokyo University and a public keynote address at the 2005 CHOC workshop in Amsterdam.

Awards, Grants and Fellowships include: Software History Center Research Fellowship (2003), IEEE Life Member Fellowship in Electrical History (2000-01), Tomash Fellowship in the History of Information Processing (Babbage Institute, 1999-00), William Penn Fellowship (1995-99), Fulbright Award for post-graduate study in the US (1995-96)

Biographies editor and board member of *IEEE Annals of the History of Computing*

Chair, SHOT SIG on Computers, Information and Society, 2005-

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Selected Academic:
- University of Portsmouth, Principal Lecturer, School of Computing, 1995-
- Manchester Metropolitan University, Principal Lecturer, Dept. Computer Science School of Computing, 1990-1995
- University of Teesside, Senior Lecturer 1986-90
- University of Canterbury, NZ, Visiting Research Fellow, 1998-
- Queen's University Belfast, Artificial Intelligence, Ph.D. Dec. 1985
- Queen's University Belfast, B.A. Hons. Philosophy 1982

Authored Book
- Artificial Intelligence and Intelligent Systems, Ellis Horwood, Chichester ,1989

Edited Books
- The Pioneers of Computing Vol 1: Europe. The Science Museum Palgrave Macmillan, London, *2008 forthcoming*
- The Pioneers of Computing Vol 2: USA. The Science Museum Palgrave Macmillan, *2008 forthcoming*

Journal Publications
- 2005 'A research note on the discovery of a prototype Hollerith machine in Paris' , The New Zealand Journal for the History and Philosophy of Technology, Co-Author(s) Hans Pufal and Janet Delve
- 2005 'The French History of Computing Scene' , IEEE Annals of the History of Compuitng,
- 2004 'Pioneers of Payroll on computers: LEO, the Army, the Navy Dockyards and De Havilland' , IEEE Annals of the History of Computing, Co-Author(s) Janet Delve
- 2004 'Turing in Manchester: A celebration', IEEE Annals of the History of Computing.
- 2004 'Commemorating the life and death of Alan M. Turing' , IEEE Annals of the History of Computing2003 ACONIT: trying to put the ghost back in the machine. Co-author: Hans Pufal. IEEE Annals of the History of Computing Vol. 24 No.3
- 2003 Max Newman: forgotten father of the computer? Co-authors: Janet Delve / Mary Croarken. IEEE Annals of the History of Computing Vol. 24 No.2, 2003 Artificial Intelligence: recollections of the pioneers. IEEE Annals of the History of Computing Vol. 24 No.1
- 2002 Artificial Life and the Chinese Room argument. Co -author: Jack Copeland Artificial Life Vol. VIII No. 3

Awards, fellowships, etc.:
- Member IFIP WG 9.7 History of Computing Committee
- Founding member of the Executive Committee of the European History of Computing Group
- Executive Committee of the BCS Computer Conservation Society (CSS)
    - for which I am webmaster and
    - meetings co-ordinator
- Member of the Canadian Society for the History and Philosophy of Mathematics Society
- Member of the Institute of Historical Research
- Member of the British Society for the History of Mathematics
- Reviewer for numerous conferences and journals including IEEE Annals of the History of Computing

Conference organisation:
Co-organiser of the UK History of Computing Research In Progress Workshops

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Fields of specialization: Technological change; economic history; labor economics
Education
Ph.D., Economics, Northwestern University, Evanston, Illinois, 2001.
>> Dissertation title: "Technological uncertainty and earnings inequality"
>> Faculty committee: Joel Mokyr, Joseph Ferrie, Christopher Taber
A.B., Applied Mathematics with Computer Science, Harvard College, Cambridge, MA, 1988.

Working papers and publications
"Proposed category system for 1960-2000 Census occupations." (with Anastasiya M. Osborne). Sept 2005. BLS working paper 383. http://www.bls.gov/ore/abstract/ec/ec050090.htm
"Turnbulence, inequality, and cheap steel." Feb 2005. BLS working paper 375.
http://www.bls.gov/ore/abstract/ec/ec050010.htm
"Preliminary estimates of multifactor productivity growth" (with Michael J. Harper) *Monthly Labor Review* 128:6 (June 2005), 32-43. http://www.bls.gov/opub/mlr/2005/06/contents.htm
Book review of *Productivity, Inequality, and the Digital Economy: A Transatlantic* Perspective by Greenan, L'Horty, and Mairesse for *Journal of Economics/Zeitschrift für Nationalökonomie.* Vol 81, No. 3, 2004.
 "Episodes of collective invention." US Bureau of Labor Statistics Working Paper 368. August, 2003. Available at http://www.bls.gov/ore/pdf/ec030050.pdf
Entries for "Henry Cort", "Siemens-Martin process", and "Machine tools industry" in *The Oxford Encyclopedia of Economic History* (2003);
The Weeks Report from the 1880 Census, online. Edited. 2001-3.
http://econterms.net/weeksreport/weeksdoc.htm
Online Glossary of Research Economics. 1997-2004. At http://econterms.com.
"Integrating an Economics Glossary into any Web Site," with Martin Poulter. *Computers in Higher Education Economics Review.* Vol 13, No. 2. 1999. http://econltsn.ilrt.bris.ac.uk/cheer

Presentations
"Technological discussions in U.S. iron and steel, 1871-1885", at Society for the History of Technology conference, Oct, 2006 (joint with Carol Siri Johnson).
"Network of tinkerers: a model of open-source innovation" Midwest Economic Association, Mar 2006; Bureau of Economic Analysis, July, 2006; Naval Postgraduate School, Monterey, CA, Aug 2006
"The airplane as an open-source invention" at Nov 2005, Social Science History Association conference; Asia-Pacific Economic and Business History Conference, Feb 2006, Brisbane, Australia; International Economic History Congress, Helsinki, Aug 2006
"Episodes of collective invention" at Social Science History Association, Oct. 2002; European Social Science History Conference, March 2004.
"Technological uncertainty and earnings dispersion in U.S. iron work 1866-1881" at Berlin Colloquium workshop of economic history, in Dec 2005; Society of Labor Economists conference, April-May 2004; American University, Oct 2003; Economic History Association, Sept 2003; Social Science History Association, Oct. 2002; University of North Carolina, spring 2002.
"Updated unified category system for 1960-2000 Census occupations" at Western Economic Association meetings in San Diego, July, 2006; Social Science History Association conference, Nov, 2006

Other work experience
Senior Software Engineer and other software-related positions. Symantec Corp., Cupertino, CA. 1988-1994.

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Current Position
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Education
>   Ph. D.,   Kyoto University, Graduate School of Letters, March 2002
>   M.A.,   Kyoto University, Graduate School of Letters, March 1999
>   B. A.,   Kyoto University, School of Letters, March 1985

Dissertation
>   Technological visions of Information Processing Techniques Office at Pentagon's Advanced Research Projects Agency in the 1960s and early 1970s

Major Publications
>   J. C. R. Licklider's Vision for the IPTO, IEEE Annals of the History of Computing, vol.25, no.3, July-Septemver 2003, pp.62-77.
>   *J. C. R. Licklider and his age*, Seidosha, Japan, 2003
>   *Prototyping the Internet: Xerox PARC and Alto system*, Seidosha, Japan, 2005

Awards
>   Nikkei BP, BizTech publishing award 2003, (for *J. C. R. Licklider and his age*)

Major Professional Societies
>   IEEE Computer Society, member
>   (IEEE Annals of the History of Computing, Editorial board member)
>   SHOT, member
>   Japan Association for Science, Technology & Society, member
>   The Japan Society of Information and Communication Research, member

Dr. Lars Heide

Associate professor, Copenhagen Business School

Lars Heide has a PhD in History from Odense University, Denmark, and an MA in History and Mathematics from Aarhus University, Denmark.

He is Associate Professor at the Centre for Business History at the Copenhagen Business School since 2000. Before he joined the Copenhagen Business School, he held positions at Odense University, was network manager and curator and deputy director at a museum. He has written and published extensively on the history and application of technologies in various countries and their impact on society.

Lars Heide is a member of the Transition Committee of the "Tensions of Europe" research network. In the first phase of this network he was a deputy chair of the working group on "Information Systems and Technology in Organizations and Society" and he is currently editing a set of paper from the work in this group with Dr. Robbie Wilson, University of Sterling, which will appear in the journal *History and Technology* in 2007.

He has just completed a comparative study of the punched card industry in the United States, Great Britain, Germany, and France from 1880-1945 based upon extensive studies in archives across these countries, which will be published in the United States in 2007.

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William Aspray is Rudy Professor of Informatics at Indiana University – Bloomington. He also holds adjunct appointments in the department of history and philosophy of science, the school of library and information science, and the department of computer science. Until recently, he was also special advisor in the Office of the Vice President for Research.

His research focuses on the history and policy of information technology. He is the author or editor of more that ten books and fifty articles in the policy and history fields. Recent publications include Computer: A History of the Information Machine (2004, 2nd edition, Westview, co-edited with Martin Campbell-Kelly), Using History to Teach Computer Science and Related Disciplines (2004, Computing Research Association, co-edited with Atsushi Akera), Women and Information Technology (2006, MIT Press, co-edited with Joanne Cohoon), and Globalization and the Offshoring of Software (2006, Association for Computing Machinery, co-edited with Frank Mayadas and Moshe Vardi).

Current research includes a book, co-edited with Paul Ceruzzi, on the history of the commercialized Internet and its impact on American business; a corporate history of Symantec, a leading computer security firm; and a social science literature review of the reasons for the under-representation of women as information technology entrepreneurs.

Aspray has taught at Harvard (history of science), Minnesota (history of science and technology), Pennsylvania (history and sociology of science), Virginia Tech (science and technology studies, public policy), and Williams (mathematics and computer science).

He has also served in several administrative positions: associate director of the Charles Babbage Institute, University of Minnesota; director, IEEE Center for the History of Electrical Engineering; and executive director of Computing Research Association.