Vectors of Change

Users as Agents of Technological Change

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The automobile industry has often been seen as the hallmark of the American system of manufacture, the prized descendent of "Whitney, Colt, and the rest."[1] Henry Ford achieved mythical status as the developer of mass production and everyone tried to follow in his footsteps. "Certain segments of American society looked at Ford's and the entire automobile industry's ability to produce large quantities of goods at surprisingly low costs… [and] wondered why, for example, housing, furniture, and even agriculture could not be approached in the same manner."[2] However, mass production, with moving assembly lines, was only applicable with varying degrees to other industries. In fact, "'much of the problem of industrializing the building industry has grown out of the mistaken image of the automobile industry as a model.'"[3]

Ronald Kline and Trevor Pinch, in their, *The Social Construction of the Automobile in the Rural United States*, argue that automobile users, particularly rural, male users of this technology, were major agents for technological change, and hence greatly influenced the course of automobile development. Just as production techniques developed for the automobile industry were used in varying levels by other industries, the influence of users in the technological development of the factory system, radio, and household technologies was not the same as in automobile development. Consequently, users were agents of technological change to varying degrees in regard to the factory system, radio, and household technologies.

The idealized linear model of innovation follows a continuous stream, where basic research leads to applied research, which in turn leads to prototyping and testing. Finally, product development occurs, in which users of the technology are given a slight voice. There are no feedback mechanisms, allowing an exchange of ideas between phases. The interactive model of innovation, contrarily, involves continuous interaction among the various stages, including the large influence of users. Different industries and different companies differ in the degree to which aspects of each model

are followed. The model of innovation that is adopted plays a key role in determining the influence that users can exert on the trajectory of technological development, though users can influence development from outside the system as well.

Early amateur users of wireless communications, specifically radio, were instrumental in not only influencing the path that technological development took, but also in creating major technological innovations themselves. While farm men made only modest changes to the automobile, amateur radio users introduced major technological change to the radio. Farm men "converted the car from a passenger vehicle to a produce truck. Showing off further, they returned the car to its original configuration, as defined by the manufacturer."[4] On the other hand, "One of the more famous amateurs, Edwin Armstrong, developed the regenerative or feedback circuit, which amplified the often feeble signals coming in over the receiving antenna."[5] Amateur users also developed "spectrum-economizing, spectrum-developing technology,"[6] and "It was the amateurs… who would pioneer one of the biggest breakthroughs in radio: short-wave broadcasting."[7]

The reasons behind the prevalence of users in the development of the radio can be traced to three major factors. One of these was the great euphoria that accompanied the development of the radio. "*World's Work* asserted: 'The triumph of Marconi remains one of the most remarkable and fruitful that have ever crowned the insight, patience, and courage of mankind.'"[8] "Wireless seemed to promise something different: instant communication, through 'the air' free from both operators and fees,"[9] and everyone wanted to get in on it. Everyone wanted to be a part of the "huge social changes, gigantic social changes,"[10] that seemed inevitable. The second major factor, the crystal detector, allowed any boy or man to build his own radio set. By and large, the users were male, so this characterization is valid. "More than any other component, [the crystal

detector] contributed to the democratization of wireless, the concomitant wireless boom, and the radio boom of the 1920s."[11] "The amateurs' ingenuity in converting a motley assortment of parts into working radio sets was impressive. With performance analogous to that of an expensive detector now available to them in the inexpensive crystal, the amateurs were prepared to improvise the rest of the wireless set."[12] The third of the primary factors was the fact that the enthusiasm of the amateurs "was not matched in either the corporate world or the armed services."[13] Consequently, many of the technical challenges remained unsolved until amateurs, acting on their own interest, were able to solve them. Overall, "The emergence of the amateurs and their often unrestrained fervor influenced both the immediate and long-range regulatory, technical, and social developments in broadcasting."[14]

The user social group, in regard to the factory system, is difficult to define. Strong cases could be made for three distinct social groups being the users of the factory system: the factory workers, the factory owners, or the consumers that consume the products of the factory. In the context of this essay, factory workers will be defined as the users of the factory system. Factory workers, in the history of the United States before World War II, had a moderate influence in the development of the factory system and were, in some instances agents for technological change. In many instances of technological change, the impetus for the technological development of the factory system came from the top, the factory owners and their surrogates, the managers. However, the changes themselves originated from the bottom, that is to say the technical initiatives were of the workers. Therefore, the users of the factory system, the workers, influenced development. Ford Motors' development of interchangeable parts offers a prime example of this phenomenon. "Although he knew little about jig, fixture, and gauge techniques, Ford nevertheless became a champion of interchangeability within

the Ford Motor Company, and he hired mechanics who knew what was required to achieve that goal."[15]

The growth of scientific management was also a major development in the factory system. It was generally opposed by workers, but was instituted anyway. This demonstrates that the influence of the workers had limits. In fact, one of the goals of scientific management was to reduce worker flexibility and initiative. Frederick Taylor, the architect of scientific management said that "'The shop… was really run by the workers, and not by the bosses.' His revulsion at worker control… prompted him to ask…,'to spend some money in a careful, scientific study of the time required to do various kinds of work.'"[16] Taylor felt that his techniques would increase productivity by "doing away with slow working and 'soldiering' in all its forms and so arranging the relations between employer and employé that each workman will work to his very best advantage and at his best speed."[17] The reason that workers could not influence this technological development to a large degree was because they were perceived as the problem. As a general rule, the most technologically knowledgeable and skilled workers were the ones who were in a position to significantly influence the course of the factory system. However, once these workers acquired the requisite knowledge and skills, they passed out of this social group into the group of managers. Hence users lost their most prominent members as soon as they became prominent. Consequently, users were less able to be agents of technological change. Overall, users, as a result of their position as vital cogs in the machinery of production, directed some limited aspects of technological development, but did not have the overarching influence of their radio user brethren.

Users of household technologies had little influence as agents of technological change. The exception lay in the fact that "the transactional relationships between manufacturers, dealers, and buyers both constrained and

enabled the design and usage of this technology."[18] Despite the economic weight that consumers brought to bear on producers, they were largely shut out of the development process. Home economists and home management scientists were thought of as representatives of the users by manufacturers, when testing new designs, in spite of the fact that the two social groups were wholly different. One such home management scientist, Christine Frederick, said that "So many women say, 'I don't want to run my home like an office or a factory. I want it to be a *home*. I hate system and methods, and all this efficiency idea seems to be too mechanical and formal for me to follow.'"[19] It is evident from this statement, that the two groups had different ideas.

The social group of users lacked influence partly because it was predominantly female. In the male-dominated pre-war American society, the male head of household was considered the decision maker, and so the opinions of the females were minimized. Hence, the users had less ability to be agents of technological change. One reason why users did not actively seek to influence the development of new technologies was the fact that despite the introduction of technological innovations that were labor-saving devices, the average number of hours that full-time home workers worked remained fairly constant.[20] The patterns of work for these workers changed; higher standards of cleanliness, more elaborate food preparations, and greater time spent in childcare were incorporated into the routine.[21] Consequently, the promise of an easier life was not present, like the promise of free communications was in radio. In general, household technology users were not significant agents of technology change.

Kline and Pinch say that, "Different social groups associate different meanings with artifacts."[22] Even if "manufacturers may have inscribed a particular meaning to the artifact… Users precisely as users can embed new meanings into the technology."[23] They go on to say "Such meanings can get

embedded in new artifacts, and development paths can be traced which reinforce this meaning."[24] Consequently users' interpretation of an artifact can significantly alter the course of future technological development of that artifact. The radio, the factory system, and household technologies had different meanings inscribed in them by users. This inscription of meaning, in addition to a multitude of other historical and cultural causes explain the reasons why users were agents of technological change to varying degrees, for the three classes of technology in the United States in the pre-World War II era.

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[1] David A. Hounshell, "*Mass Production*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 330.
[2] David A. Hounshell, "*Mass Production*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 335.
[3] David A. Hounshell, "*Mass Production*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 335.
[4] Ronald Kline and Trevor Pinch, "*The Social Construction of the Automobile in the Rural United States*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 342.
[5] Susan J. Douglas, "*Amateur Operators and American Broadcasting: Shaping the Future of Radio*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 370.
[6] Susan J. Douglas, "*Amateur Operators and American Broadcasting: Shaping the Future of Radio*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 370.
[7] Susan J. Douglas, "*Amateur Operators and American Broadcasting: Shaping the Future of Radio*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 370.
[8] Susan J. Douglas, "*Amateur Operators and American Broadcasting: Shaping the Future of Radio*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 365.
[9] Susan J. Douglas, "*Amateur Operators and American Broadcasting: Shaping the Future of Radio*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 367.
[10] Ronald Kline, lecture, November 7, 2001
[11] Susan J. Douglas, "*Amateur Operators and American Broadcasting: Shaping the Future of Radio*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 368.
[12] Susan J. Douglas, "*Amateur Operators and American Broadcasting: Shaping the Future of Radio*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 368.
[13] Susan J. Douglas, "*Amateur Operators and American Broadcasting: Shaping the Future of Radio*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 367.
[14] Susan J. Douglas, "*Amateur Operators and American Broadcasting: Shaping the Future of Radio*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 369.
[15] David A. Hounshell, "*Mass Production*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 333.
[16] Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 267.

[17] Frederick W. Taylor, "*The Principles of Scientific Management, 1911*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 271.
[18] Ronald Kline and Trevor Pinch, "*The Social Construction of the Automobile in the Rural United States*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 344.
[19] Christine Frederick, "*The New Housekeeping, 1913*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 279.
[20] Ronald Kline, lecture, November 7, 2001
[21] Ronald Kline, lecture, November 7, 2001
[22] Ronald Kline and Trevor Pinch, "*The Social Construction of the Automobile in the Rural United States*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 337.
[23] Ronald Kline and Trevor Pinch, "*The Social Construction of the Automobile in the Rural United States*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 340.
[24] Ronald Kline and Trevor Pinch, "*The Social Construction of the Automobile in the Rural United States*," in Merritt Roe Smith and Gregory Clancey, eds., *Major Problems in the History of American Technology*, Boston, p. 337.