

The airplane as an open source invention

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For decades before there were functional airplanes, there was an international discussion about wings and flying machines. The Wright brothers learned from and participated in these public networks of information. This paper argues that their 1903 invention of the airplane was based primarily on open-source information and networks which were like those in open source software development, and unlike formal research and development in which technical advances are kept secret or declared to be intellectual property.

By the 1890s several journals and societies in France, Britain, Germany, and the United States were devoted to the topic of winged flying machines. Important experiments by Otto Lilienthal, Samuel Pierpont Langley, and Lawrence Hargrave advanced the field. Lilienthal and Langley each wrote books carefully describing their experimental tests of the lift and drag of objects in an air flow. Hargrave published the results of all his experiments and patented nothing, on the principle that flight would become possible most quickly if he, and everyone, did this.

Engineer Octave Chanute was inspired by the possibility that by cooperating, aerial experimenters around the world could make winged flying machines a reality. He visited and corresponded with many experimenters, and encouraged a free exchange of ideas. In his optimistically titled 1894 book, *Progress in Flying Machines*, Chanute summarized and commented on hundreds of kites, gliders, experimenters, authors, and theorists of aerial navigation. Newly interested people learned about the subject from this important book. Wilbur and Orville Wright read it and contacted Chanute.

Like the others, the Wrights discussed their experiments openly. Chanute visited them and invited colleagues to participate in their effort. The Wrights published articles, and met other experimenters. In other words, the Wrights took an open source perspective on their technology.

Starting in 1902, the Wrights developed uniquely effective wings and propellers. They began to withdraw from processes of open sharing, believing (correctly) that they were near to a successful powered glider flight. They patented and licensed their technology. This led to permanent conflicts with Chanute, who was devoted to open-source processes of invention.

In the Wrights' published papers and histories of their work, the key predecessors most often referenced are Lilienthal, Chanute, and Langley. Thus by this form of citation count we can infer they built on the work of these three author/experimenters. Chanute's

book refers to Lilienthal, Hargrave, and Langley among the most frequently. By contrast, the writings of Chanute and the Wrights rarely refer to other experimenters who had patents. The patents seem to have been irrelevant to the advance of the technology, whereas Chanute's open 1894 description tells us the platform of technology the Wrights actually built from.

Several aspects of these experimenters are analogous to open source software developers:

- The motivations of the aircraft experimenters mentioned include intrinsic components and altruistic components (e.g., the interest in the problem, the desire to fly, and the hope to make the world a better place).
- Aircraft experimenters were not in a small local club or hierarchy. Rather, they were autonomous, distributed around the world, and drawn to the activity itself.
- They specialized in particular technologies of experimentation then published their findings in order to advance the technology.

A formal economic model shows a set of assumptions which generate open source technology agreements. If there are self-motivated individual tinkerers who are interested in making progress on some technology and see no way to profit from it, they would rather share their technology than work alone. The members of the agreement form an information network. Endogenously they want to standardize on designs and descriptions of the technology so as to reduce costs of information exchange. Network members tend to prefer not to establish intellectual property since there are no profits in the network, and inducing new costs will reduce the size of the network and thus slow the progress that is their payoff. The network's members optimally specialize based on their opportunities in particular aspects of the technology or in expanding or managing the network. A tinkerer with the capability to recruit, evangelize, or publish might make more progress than by tinkering with the technology itself. Thus we can think of Chanute and the other authors as making functional choices toward advancing progress when they write or speak in public.

A tinkerer in the network is modeled as seeing no way to make a profit from the technology. But this veil may lift, and a tinkerer may see an opportunity to produce a profitable product. If so, the tinkerer prefers to exit the network, establish intellectual property, create a startup firm, and conduct focused research and development. The Wright brothers did this, transforming from creative tinkerers into entrepreneurs. Thus, new industries can arise from networks of open-source technologists. The open-source technologists are a necessary element, and their desire to advance the technology is a kind of natural resource.