Polaroid SX-70 camera system: an optical-mechanical-chemical tightly-coupled design

Martin H. Krieger a,*

aUniversity of Southern California, Los Angeles, California, United States

Abstract. We survey the design of the Polaroid SX-70 camera system, to exhibit what it means to design a tightly-coupled system (rather than a loosely coupled or modular one). The optics, the mechanics of the camera, and the chemistry of the film-picture unit are described as being adapted to each other so that we have a system, and the system as a whole is optimized with superfluous refinements avoided. We then discuss the picture-making experience inherent in such a system. © 2022 Society of Photo-Optical Instrumentation Engineers (SPIE) [DOI: 10.1117/1.OE.61.12.120701]

Keywords: design; SX-70; polaroid; tightly-coupled.

Paper 20220919PV received Aug. 17, 2022; accepted for publication Oct. 6, 2022; published online Nov. 30, 2022.

1 Introduction

The technology of the Polaroid SX-70, a camera and a film specifically for it, is comparatively well documented in the open and the patent literature. The level of detail, the revelation of less-productive directions, and the motivations are readily observed. I want to describe the SX-70 as what might be called a tightly-coupled technology (rather than loosely coupled and modular technology) and indicate features that likely are more generally present in such designs. When going through that literature, I felt much as did d’Alembert and Diderot, as they asked workers how they did their work and then diagrammed the processes.1,2

I should note that developing loosely coupled versions of tightly-coupled systems is often taken as modernization. But, there is always the temptation to install some tight coupling in the name of customization or to gain greater efficiency in a narrow but crucial direction.

I begin with a description of the SX-70 system, then discuss what I mean by a tightly-coupled technology, and then describe features of the system’s design: tight-coupling, efficient and flexible optimization, compensating features and capabilities, problems as virtues, and design compromises as advantages. I then describe the kind of experience that such a system provides for the picture maker.

2 SX-70 as a Technology

As photography developed in its first 125 to 150 years, it eventually offered interchangeability or flexibility in the choice of film, camera, lens, developing and printing processes, and printing papers. Manufacturers would like to convince consumers to stay within a brand, perhaps to ensure quality and compatibility, surely to achieve greater control of price competition. This is still the case in the realm of digital photography, although the even earlier point-and-shoot automatic camera can be designed to provide little room for contributions by a competing brand. Polaroid’s cameras and film allowed for virtually no room for contributions by competitors. However, the earlier Polaroid technologies, from the 1940s to the 1970s, were awkward and messy; the print accompanied by extra paper some of which was coated with a corrosive gel. It was felt that if their tightly-coupled system was to thrive, it had to produce no garbage and be smoothly operating, elegant, and simple for the user (Buse3 is deliberately not about the technology; Bonanos4 is a bit more technical; and Fierstein5 is about the Kodak patent battle and is an exhaustive history (from the 1940s on) by an outside attorney who represented Polaroid, with

*Address all correspondence to Martin H. Krieger, krieger@usc.edu
details about the various actors whose names appear in patents. McElheny is perhaps the best account, while Refs. 7–31 provide further details).

Edwin Land’s Polaroid SX-70 “instant” camera system (1972–1986) produced prints (about 3+ in.²) that developed outside the camera in about 5 min. Viewfinding and manual focus were through the lens (a single lens reflex), exposure was automatic, and eventually focus was automatic, too. The quality of the Polaroid dye-diffusion process of development was limited by the diffusion process (and so the horizontal spread induced by that process). Since the film/print was combined, and it was integral to the system, the lens could be designed to be of just-sufficient quality, much less than even modern point-and-shoots so that the prints looked at least good-enough (good contrast, but fine detail could not be discerned—6 to 8 line-pairs/mm, not much more than the unaided eye, and lens aberrations matched the film’s insensitivity to them). One kind of picture that is encouraged and facilitated by the lens’s design is detailed close-ups of everyday objects and phenomena, which what was until recently most difficult for almost all amateur and professional cameras. In part, this is because the SX-70 system is in fact of low definition so that its lens might well be adequate for such close-up images. (Similarly, digital point-and-shoot cameras have optics that are usually of medium quality, so the definition of close-ups could also be modest.) The SX-70 image developed in front of the user, in the light, as opposed to conventional cameras where the image develops in the darkroom in the developer tray.

3 Bureaucracy versus Tight-Coupling

The notion of tight-coupling has resonances in ideas about bureaucracy and economy, in Adam Smith, in computer science (Mac versus PC), in notions of a friendly machine, and more generally in design.

In the classic accounts of bureaucracy, the various bureaus have distinct roles, they take in “stuff” from other bureaus, process that stuff according to the exact nature of each bit of stuff and perhaps with some random or environmental influence, and send the processed stuff to other bureaus, the path at each point depending on the state of the stuff. There is a well-defined division of labor (We will get to Adam Smith presently.). Since, in fact, the workers in a bureaucracy are often longstanding, and they may well have family ties (from before or after they joined the organization), idiosyncratic stuff that might be mangled by the bureaucracy is given a legitimate and expeditious path by those workers, informally cutting across the lines, violating the classic account but not the norms of their organization. Still, idiosyncratic path-breaking has in general been viewed as both ingenious and delegitimising.

We might say that getting inside one of the bureaus is a matter of “intimacy,” but the classic bureaucracy is formal and proper.

In computer science, tightly-coupled systems usually have intimate connections between the software and hardware, and particular internal features of each are taken advantage of by the other. Rather than their being black boxes in a well-defined system, each of whose characteristics is specified in terms of inputs and outputs, and whose connections with each other are well specified and rather limited (so that they are loosely coupled)—the various parts depend on their being able to invade other black boxes (intimacy) and take advantage of sweet peculiarities.

In contrast, Adam Smith’s pin factory, described in the first chapter of The Wealth of Nations (1776), allowed for mass production at low cost, the pin having various “parts,” each part associated with a worker. What was once produced through artisanal work, the pin might then have been seen as the product of a “tightly-coupled” technology since the various artisanal steps, likely done by one artisan, were so closely associated with each other, presumably each step compensating for minor defects in the previous step. Now, it is mass-produced by a division of labor.

So, it is perhaps a commonplace to distinguish technologies that are tightly-coupled from those that allow for interchangeable parts. Apple’s Mac computers had, at first, distinctive processing chips, a distinctive operating system and other features, all of which appeared to work together to create a distinctive and unique machine. And Mac computers came to be seen as especially attractive to those who worked in the graphic arts, in part because Apple encouraged suitable software. On the other hand, the PC (whoever manufactured it) allowed for many realizations in terms of processors, operating systems, and attached external devices, allowing for many sorts of applications. The tightly-coupled technology product, the Mac, could demand greater loyalty and a higher
pricepoint, especially with patent protection since there was no direct competition for a configuration, but price competition and quality competition soon were prevalent for PCs.

On the other hand, a tightly-coupled technology may be designed to allow for greater reliability and fewer unanticipated breakdowns. Yet, as modern automobiles have become rather more tightly-coupled with the advent of intrinsic computation and electronics as part of their design, glitches have developed in new models since unanticipated coordination problems showed themselves. And, if there is a breakdown of some aspect of the tightly-coupled technology, there may be no off-the-shelf replacement and hence there is great vulnerability if there are failures.

The marketing problem is one of legitimation: convert limitations and idiosyncratic advantages in tightly-coupled technologies into virtues and unique selling propositions, so to speak, or, intimacy makes for love. Tight-coupling allows for, or perhaps demands, efficient and flexible optimization, compensating features and capabilities, problems or limitations to be taken as virtues, and design compromises to be taken as advantages. Put differently, what was good-enough given these limitations and constraints had to become seen as a sign of excellence. It might be said that this artisanally manufactured pin is sharper and more beautiful than the mass produced one. Moreover, the experience of the user, given the idiosyncratic nature of the design, may be given a portmanteau of intimacy, friendliness, or perhaps of luxury and the high end. We might say, intimacy is better than alienation and economizing.

These notions are generic; they become informative when we see how they are actualized in a particular technology and a design.

There was a time when Leica cameras were more artisanally manufactured, with hand adjustment of the fit of the parts. I suspect that the aura and appeal that surrounded those Leica cameras or modern-day Mac computers may be understood in these terms of tight-coupling.

It should be noted that designers of software in general want to have loosely coupled technologies, and hence, the talk of object-oriented programming and modularization, in part to isolate problems, in part to make the software readable. Yet, some tasks are so demanding of a computer’s power that it is necessary to get down in the ditches, so to speak, and employ tricks and moves taking advantage of the computation mechanism itself, if those tasks are to be possible at all in finite times. Of course, the tricks and schemes of one generation may become incorporated into standard loosely coupled practice in the next generation. (Wilson,33 in discussing his computation method for solving the Ising model, in which he uses a variety of tricks and approximations since they then make the calculation practical, says that the tricks of one generation become the theory and methods of the next.)

4 Design in Use

To recapitulate, the Polaroid SX-70 camera-film system employed a single-lens-reflex camera to produce 3 in.² instant pictures that developed outside the camera in about five minutes with no discarded paper (an “integral” film).34

One could work in the light. (Mark Klett is said to have analogized the Polaroid positive-negative film, P/N Type 55, to wet plates, the washing of the instant negative being the analogous step.35) And, like a daguerreotype, there was a unique image (rather than a negative that might be used to produce multiple prints). (In the case of SX-70, the negative was not useable or accessible; there was no negative at all for the daguerreotype.) It would seem that the camera was designed to encourage formal composition, rather than detailed representations.

It is perhaps worth indicating the level of deliberate design of that system and its connection with picture-making. In addition to the close-ups, the motorized automatic system allowed for rapid sequences of prints (so rapidly using up lots of profitable film!) and portraits. Portraits, which more or less fill the image, become easy—although it requires a readily attached supplementary telephoto lens if their perspective is to be pleasing. The Charles and Ray Eames film made to introduce the camera, “SX-70” (11 min, 1972, readily available on the internet), features just these sorts of pictures—close-ups, details, patterns, and sequences—and the rapid checking of the pictures in their “robust” easily handled little units. (When I use terms such as robust, in quotation marks that is the term of art employed by Polaroid.) This familiar shall be made available and strange. And the artist David Hockney’s joiners or mosaics make use of the close-up,
sequence, and rapid checking of the instant image. Lucas Samaras, another artist, manipulated the developing emulsion to create phantasmagorias.

The Polaroid SX-70 system was not the only way for amateurs to make these kinds of photographs—rather, it makes them easily and straightforwardly compared to conventional systems or to previous instant systems. By hiding most of the technology, and allowing for immediate retakes based on the previous image, Land argued that the amateur can participate in what he designated as the romantic tradition of the photographer—as artist (presumably elevated from the role of snaphooter). (This was Land’s recurrent dream.) (I believe that Land was committed to or at least enchanted by these notions of creativity and humanity; they were not just salesmanship or just an attempt to sell more film.) If the photographer can observe her work immediately, she can learn to make better photographs. The secret is to “work in the light” (if possible, next to the subject), as Richard Benson has argued for photo-offset lithographic printing (Richard Benson, see Refs. 36–38).

By design, the technology facilitated a kind or style of photographing by making technical choices invisible to the user.

5 SX-70 Design

The design of the SX-70 is an example of a tightly-coupled technology, where the advantages and limits of one aspect are complemented by those of other aspects. (I shall use the present tense to describe the design, rather than the historical past, since my sources are contemporary with the SX-70s era. I have not discussed all the problems and weaknesses of the SX-70, except if they were then converted into virtues and advantages. See Ref. 39 for a more objective account, comments from internet viewers being especially interesting.)

5.1 Tight-Coupling

The SX-70 is a system (McElheny also argues this in Ref. 6): the camera, the style of photography, the nature of the user, and the film’s resolution and palette—all are meant to work together. So, e.g., the way the camera is held, the transparency or clarity of the viewfinding system, and the kinds of pictures that are encouraged by the lens’s capacities are meant to enable each other.

The user is assumed to be an amateur with little expertise. All the user need learn is how to focus (which is not so easy). The camera is meant to teach the user how to make better photographs. Land referred to the system as absolute one-step photography since there was no timing, no separation of the picture from the negative, no exposure metering—burdens in earlier Polaroid systems. (It is worth noting that how past problems justify the uniqueness of the novel technology, an argument that might well pay little attention to earlier competitive achievements that had already solved the problem.) As Walker Evans said late in his career about using the SX-70 system, “It reduces everything to your brains and taste.”

It seems that Polaroid had carefully studied what makes a photograph look good to the average user (as had Kodak and Fuji), its image structure and color, and which lens aberrations are tolerated and which need to be reduced. Since Polaroid’s system includes the film and camera and the print, it can ask that question for the system and make improvements in the lens or the camera or the film as need be to achieve a sufficiently high-quality print. So, e.g., the sharpness of an image, the acutance of the edges of objects, depends on lower levels of resolution (a few line-pairs/mm) than do details (30 line-pairs/mm). A lens with good gross resolution may well appear sharper than one that has its strengths in fine resolution. Moreover, it makes little sense to design a lens for very high resolution if the film itself cannot record details at that level. Hence, Polaroid might well optimize the system for subjective perceived sharpness rather than for high resolution as measured objectively.

5.2 Efficient and Flexible Optimization

So, as a tightly-coupled system, constraints can be solved systemically, rather than through just one part or another: The film is exposed through the front surface of the picture unit and viewed
through that same surface. Consequently, there must be a mirror in the image path within the camera to ensure that the image is properly left-right oriented, for viewfinding and for the print itself. Again, the lens need be not much finer in resolution than is the film unit that is the hand-held print. That the film-print unit is a given, which means that the system’s design can optimize more efficiently, not needing to consider a variety of films. So, e.g., in the design of the telephoto attachment, the lens’s designer, James G. Baker, says that one achieves

... a compact afocal lens that is characterized by optimizing other corrections at the expense of a limited degree of pincushion distortion and some sacrifices in longitudinal color correction, particular in the ultraviolet. Experiments have shown that good quality color prints can be obtained, particularly with Polaroid SX-70 Land film, so long as the optical system is well corrected for astigmatism, coma, spherical aberration, flatness of field, and lateral color, reasonably well corrected for distortion, and corrected for longitudinal color except for a fairly considerable latitude in the violet.

Some constraints are by-the-way loosened: SX-70 apparently dry images take about two weeks to dry internally. That internal dampness is not apparent to the viewer or the holder of the print, although one might notice the vents built into the top of the film unit. By allowing for slow drying, one is enabled to have what Polaroid called a self-washing print-stabilizing system, which produces (within the picture unit itself) water as its final product (just what needs to evaporate over time). The picture unit stays flat, unlike earlier Polaroid prints, because it is made with a polyester front and back (Mylar), that polyester, unlike cellulose acetate, not being very permeable to water but being especially good at dimensional stability is just what is needed for flatness. (McElheny, p. 357, on the internally wet final product. Land spoke of the picture unit as being hard, dry, shiny, and flat—all lacking in his previous peel-apart films.)

Polaroid also discovered that the consumer would accept garbage, as they put it, in the sense that the print would still have attached to it the pod that held the gooey developer as well as the trap that held leftover developer—as long as the consumer did not have to deal with them. The print might have strange borders but no one seemed to care. (Previous Polaroid systems produced lots of garbage that had to be discarded, and Kodak’s initial integral instant system deliberately arranged for the pod and trap to be retained in the camera cartridge.)

5.3 Compensating Features and Capabilities

As a system, there can be compensating features in the different elements that make up for each other [see Fig. 1(b)]. The viewfinding elements variously tilt, decenter, and introduce aberrations into the image, but the elements then compensate for each other to give an upright, correct right-left, almost life-sized aerial image with good eye relief (so the image is more readily seen by spectacle-wearers). One is supposed to live in the viewfinder, composing much as does the user of a view camera (under a hood and examining its ground glass). An aspheric corrector plate of 1/10 in. diameter, at the point where the light exits the exposure chamber, is in effect a contact lens on the viewer’s eye making up for some of the distortions and aberrations. The ground glass needs to be rough enough for one to be sure one is focusing on the image, yet not make the image too dark—and by being able to modulate both the roughness of the focusing screen and the tilt of an incorporated Fresnel lens, one can achieve both focusing and brightness goals. The picture unit bends behind a light baffle or shield on the way out of the camera to prevent too early exposure to room light (before the “opacifier” acts) and also prevents light-piping, which would cause fogging of the image—and that bending as well makes for a more even spread of the developing reagent. To the picture taker, what is crucial is that the film unit emerges from the camera from a thin slot, which also holds it in place so it does not fall to the floor. What might have been accidental features, not necessarily fully intended, are now presented as deliberate advantages.

5.4 Problems as Virtues

Design criteria are sometimes derived from limitations of previous embodiments. Given problems with previous Polaroid instant systems, one now wanted photographs that would not curl up and would stay flat, and a process that did not produce litter. The symmetric support system of
the picture unit (polyester on both front and back) and the fact that it was integral solved both problems. That it took a long time for this instant integral system to develop (versus the fabled 60 s or even 10 s for earlier Polaroid processes), was made into a virtue—for one could watch as the image appeared over a several-minute period.

In my reading of the record, again and again Polaroid took its solutions of problems as unique inventions and signs of “brilliance,” and what could not be solved became a virtue of the experience. (Land regularly referred to Polaroid’s brilliance in this regard. Competitors might claim that much of it was obvious or prior art.) Tightly-coupled almost always means limited flexibility, and that may be then presented as a virtue.

Fig. 1 The SX-70 camera had a two-sided movable mirror on a hinge, and a fixed mirror on the diagonal surface, in effect behind the two-sided mirror when it is flipped up. (a) Viewfiding: when the two-sided mirror is flipped down, the image is reflected off the fixed mirror; that mirror is in roughly the same place as will be the flipped-up two-sided one, onto the Fresnel lens-mirror on the back of the now-down two-sided mirror, from there back onto the fixed mirror, and then through a small aperture in the bellows and then through a curved mirror and a lens to the eye. When the two-sided mirror was flipped down, it prevented light from reaching the film unit. (b) Taking photographs: when the two-sided mirror is flipped up, the image is reflected off one side of the mirror onto the film unit. After exposure, a motor pushes the film-picture unit out of the cassette, then through rotating rollers that break a developing-fluid pod inside the film-picture unit, and then spread the developing fluid onto the sensitized film (which will become the picture), and then, curving the film unit a bit, out into the open. The fluid also contains a chemical opacifier (to prevent the developing picture from becoming fogged by the ambient light), and that opacifier will become transparent when the processing is done. (c) An SX-70 image, taken from a Polaroid advertisement of 1979. “A” indicates the location of the developer gel packet. (d) The SX-70 camera.
5.5 Design Compromises as Advantages

Given a conception of the user and the kinds of photographs that might be taken, many design compromises could be made that would improve the picture-taking experience. Since the camera was meant to be mass-marketed, a great deal of effort could be put into the design, the design costs amortized over a larger number of units. Fancy technology made cheap could then provide for superior performance.

1. The viewfinder design, involving aspheric and non-rotationally symmetric elements, thus became affordable. The chemical opacifier that insured that the emerging picture unit would not be fogged by the bright room light, also enabled the image to emerge from behind such a chemical shield (the print itself has emerged from the camera through a mechanical shield), and so provided a distinct sort of several-minute experience for the viewer. A similar experience happens in the darkroom and the developing solution in conventional photographic materials, but now we are working in the light rather than working in almost darkness—again, a point often made by Land and also made by Richard Benson (but in his case, about photomechanical printing, which in part was Fox Talbot’s impetus to develop photography). If you work with printing-out-paper, you can also work in the light, subdued, and sunlight, and check on the progress of your print. In each case, “you’re continually being informed by what you do.” [This is exactly what Richard Benson does in his photomechanical printing. In a book of Irving Penn’s photographs, he used black (shadow detail), black cut with transparent white (longer half-tone scale to add weight to the middle tones down through the shadows), a variety of grays depending on the image color and highlights], and a bump black added to give weight to the shadows, and then spot varnish to hold the various layers together. See also the wonderful essay by Benson on printing Lee Friedlander’s photographs, in Galassi. Both Edwin Land (about Polaroid instant film processes) and Richard Benson (about photo-offset lithographic processes) emphasize the ease of experimentation, comparing the image with the subject (albeit different sorts of subjects); the pleasure of working in the light (rather than the darkroom) with a dry and clear print; and, the apparent accumulation of effort in their respective processes (and, for mechanical printing, tone is an accumulation of impressions). Benson argues that photographs were meant to be printed mechanically, as an adjunct to gravure or letterpress or lithography. It is worth noting that Photoshop with an inkjet printer offers many of these facilities. (See Richard Benson, “An Artist’s Perspective on the Photomechanical Alternative to Silver.” On Land see Ref. 6, p. 164. By the way, there is something quite different in philosophy here than Ansel Adams’ “previsualization”—although surely Adams experimented, and Benson previsualizes. Caponigro provides some of the Benson quotations.)

The lens was designed to be thin so that the camera could fold nicely. But, again, it was also designed to have superior close up capacities (to about 10 in.). Yet it needed to have only a medium aperture (f/8 to f/12) and very moderate resolution (6 to 7 line-pairs/mm)—given the speed of the film and the film’s limited resolution (and the fact that enlargements are likely to be modest). The ground glass eventually was equipped with a built-in split image rangefinder, but its location is at the center of the image. Rather it is at the right-left center but 2/3 of the way down from the top. It is said that the designers wanted to encourage the users to use the ground glass focusing, to “stay” in the viewfinder. (The through-the-lens viewfinder gives a life-sized image at 20 in. and a larger than life-size image for closer distances.) But in the patent, they point out that by forcing people to move off the center of the image the user might find new compositional choices that would be preferable. Moreover, by locating the rangefinder, the image is likely to capitalize on the best focus of the lens for the whole image rather than just for the center. (Unfortunately, people tended to center their image on the split-image rangefinder located in the lower third of the image, and so the top third of their pictures was blank or filled with irrelevant material. In portraits, the bottom half of bodies was chopped off.)

[I am aware that one might be skeptical of claims made in interviews, in patent filings, and in legal venues. Still, I believe that such claims are made ubiquitously indicates what Polaroid (and E. Land) thought about the system.]
The camera’s automatic exposure system must be accurate since there is no chance to make corrections to a poorly exposed negative in the actual printing itself. Each image is unique, the process of development going to completion with little or no discretion on the part of the photographer. Of course, the photographer might just take another picture, then and there, having adjusted the exposure after seeing the image materialize. But, one wants to assure a high degree of success in general so that the photographer does not get discouraged and abandon the camera. (It was said that garage sales, and now eBay, were created to get rid of old Polaroid cameras.)

Hence, one has to have a very good sense of the capacities of the film and the likely subjects and lighting conditions that ordinary users will encounter, and make sure that the built-in program of automatic exposure takes these factors into account. Modern point-and-shoot cameras (film or digital) have quite complex programs, anticipating an even wider range of picture-taking situations.

### 6 Intimate High-End Experience

As a consequence of these systemic design choices, picture-making is said to be more intimate than for most camera systems—the lens, the viewfinding system, and the size and shape of the picture unit encourage such intimacy (Ref. 48, pp. 234–237; Ref. 55) (of course, in making such a claim one is defining what intimacy means in this context, clearly to the advantage of your realization). One is, in effect, creating unique hand-held miniatures. And, again, as for any rapid process, it is easy to experiment, to make a picture, examine it, make corrections, and shoot again; and, crucially, here one is working in the light. (It is worth noting that modern digital point-and-shoot cameras have many of the features of the Polaroid system, but of course with the proviso that the print is still outside the system—although there are some such cameras that do produce prints. But, nowadays it is not clear that most users demand paper prints, especially when they view images on the computer screen or in an electronic frame.)

The look of the print is built into the camera-film-photographer system. In each case, compromises are made, which from the point of view of the envisioned user are perhaps advantages. Of course, the photographer may not sense these advantages or these choices explicitly. The system is just the way things are, how this camera and film work.

For example, the surface structure of an ordinary print derived from a 35-mm point and shoot film camera would seem to be duller than that of the SX-70 print, although the ordinary print has much greater resolution. The translucence of the SX-70 print is in part due to the fact that it has no grain structure since it is a dye image on a white pigment background (Ref. 56 and 57, p. 247). (Still, there is fluctuation in areas of uniform tone and color.) A Polacolor peel-apart print, the earlier non-integral Polaroid instant system, a carbro print, or a photomechanical print (say six-color offset lithography) will have a textured relief due to the multiple layers used in making it up, something not seen at all in the SX-70 or in an ordinary photographic print. The tone and palette of each image is an achievement, and the design choices in the way the image is built up lead to images that are in fact quite different in feel.

In a systemic design, one sees quite poignantly the consequences of that design. The technology has a look. The kinds of pictures it accommodates are idiosyncratic, and so systemic design choices have stylistic consequences. But, it would seem, there is room for choice nonetheless, some of which might be deleterious. Land and Polaroid chose to make a system that they took to be a “new” form of seeing and photography, a system that was a “sweet” state-of-the-art design, one that was meant to set a standard, create new markets, and appeal at first to higher end users. The owner was given a detailed how-to-photograph manual, *The World of SX-70*, ostensibly an instruction manual but actually about how to get good photographs suited to the film and camera’s capabilities and how to make more artistic pictures, as well. In particular, there is advice about how to learn to focus and how to work with the camera’s built in exposure automation. And the Eames film about the camera and film unit (SX-70) began with Alfred Stieglitz’s magazine *Camera Work* (1903–1917) as a model, and went on to speak of “art,” a “step in learning,” and “insight” when referring to taking pictures with the camera.

When Eastman Kodak developed its integral instant film system (PR-10), in response to Polaroid’s, it aimed for more conventional snapshotners who now would get their pictures...
instantly from comparatively inexpensive technologically simple cameras (but with film priced roughly the same as Polaroid’s). Their goal was to gain some market share against a competitor and to expand the market, not to create an entirely new market. (In Polaroid’s patent infringement suit against Kodak, in the damages phase of the trial, Polaroid referred to Kodak’s “trashing” the integral instant-film photography market. Polaroid bragged about the permanence of their images; Kodak’s were discovered to fade much more readily in the sunshine.)58 The advantages of the dye-release system employed by Kodak were a consequence of there being no active diffusing dye molecules, so the image was not redoxed on way to the mordant or by aerial oxidation in the mordant (as would be the case in the dye-developer process employed by Polaroid, in which the diffusing dyes are still attached to developer molecules). Polaroid calls the dye-release process that Kodak adopted, Excedrin with L(and)-Coat (to neutralize the active molecules and stabilize the image in the mordant); the process it adopted was called Aspirin.

Fuji’s Instax technologies, such as Kodak’s PR-10, exposed the film through one side of the unit and the print was viewed through the other (derived legally from Polaroid patents, and initially just for Japan, for which Fuji exchanged their recording-tape technology), allowing for a rather more conventional camera design (again as in Kodak), with no need for a mirror to reverse right and left. Now, the film-print unit is itself a wonderfully complex tightly-coupled multi-layered chemical technology (as was Polaroid’s and Kodak’s). But the tightly-coupled technology of the SX-70 camera would not be needed. The then-current Polaroid cameras of the early 1970s could have been readily adapted through minimal redesign to employ the new integral film. Ironically, the iconic SX-70 cameras and their justification (as I have described them here) might never have been developed. Later, the Polaroid snapshot models that used the integral film still must build in the reversing mirror, although they use a conventional optical viewfinder, and so they have that idiosyncratic shape.

7 Conclusion

Bureaucracies actually work well when they allow for likely legitimate violations of the classic model, namely, some tight-coupling. I have tried to describe in detail one tightly-coupled technology, not only as an object, but as an object in use so that the material aspects have direct implications for the experience and capabilities. Mac computers (hardware and software), as tightly-coupled systems, and Steve Jobs have been analogized to the Polaroid SX-70 (camera and film) and Edwin Land: objects, objects in use, and leadership that creates a myth (see, e.g., McCracken39). Insofar as the historian of technology has access to the actual design process (here again, think of d’Alembert and Diderot), and to the marketing strategy, one may appreciate the peculiarities of a technology not only as a matter of efficiency or cost, let us say. Rather, what we see is how individual or corporate vision finds a way to make something that they may be described in more engineering-economic terms. Of course, this too is a commonplace, but when we see it in actual action, in detail, in leadership, in a transformation of what we take as desirable, we appreciate history as it actually or essentially happens (to paraphrase Leopold von Ranke).

References

42. J. Thompson, The Last Years of Walker Evans, Thames and Hudson, New York (1997).

Martin H. Krieger is emeritus professor at the Sol Price School of Public Policy at the University of Southern California. His doctorate is in experimental particle physics. A website featuring his photographic and aural documentation of urban phenomena is at sites.google.com/view/urban-tomographies, which will also link to his Amazon Author’s Page.