

ADAPTIVE AUTOMATION

MEN WITHOUT MACHINES

Peter A. Hancock

University of Minnesota

In our technologically-replete world and our technically-oriented discipline, it is easy to be seduced by the novelty and excitement of contemporary innovation. For those in human factors who advocate 'human-centered' automation (of which I am one), it can become seditiously attractive to view the machine system as the 'problem' to be solved. Consequently, our point of focus is narrowed to the immediate present and near future, while our perspective is oriented toward addressing the downside of machines. In this brief note, I want to redress the balance somewhat by considering an historic example of men without machines. I first distinguish tools from machines and machines from self-intentioned machine systems (SIMS) which represent the next stage of development. This distinction is important as the example concerns the explicit removal of machines. From the bleak circumstances described, it is clear that machines render great human benefit and that there is no machine-less 'arcadia' to aspire to. When next pointing to the failure of systems, it is consequently necessary to consider what conditions would pertain in their absence. Few people, if any, are ultimately willing to trade their absence for periodic failure.

INTRODUCTION

In advocating human-centered automation, it is our mandate to seek ways in which advanced systems can be made responsive to and consistent with human capabilities. Frequently, this means pointing out problems and failures with existing designs, prototypes, or actual operational systems. As the champions of the human operator, we are in consequence, often set in the role against the machine, or more realistically, against the design of insensitive systems. Pursuit of this endeavor over time may lead to the persuasion that it is machines themselves that are problems to be 'solved.' We might, under such stimulation, lose sight of the benefits that machines bring. In other work, I myself have suggested that technology is a dangerous enterprise and that our role in human factors is to help steer the course of technology toward safer waters (Hancock, 1996). In this welter of concern and criticism we can easily lose sight of the advantages machines bring and consequently ignore their central and symbiotic role in current and future human development. This short note is a caution that we not lose sight of such benefits.

DISTINGUISHING TOOLS FROM MACHINES

It is impossible to accurately distinguish when human beings, as we now know them, first appeared on Earth. Similarly, it is equally problematic to distinguish when such human beings first began to use tools. Although we are not so familiar with the work now, Oakley's book 'Man the tool maker' was a well-known text of its time which protested that the distinguishing characteristic of human beings was their creation and use of tools (Oakley, 1949). Although there are examples of tool use in the animal kingdom, the degree to which tools extend human abilities

is qualitatively distinct from any animal. Here, I take tools to be extensions of human capabilities but restrict them to *that class of objects that require immediate human intention and human energy to effect their action*. Even in the examples that I describe, the individuals involved did not live without tools and it can be argued that perhaps modern man cannot survive without them.

Tools then, require not only the presence of the individual to guide them, but rely solely upon that individual for their motive power. *Machines* I define as, *that class of objects which are directed by human intention and which use sources of power not derived solely from human energy*. The difference between machines and tools then lies directly in the source of power. If the source is some hybrid form of both human and other agency power, the object is a machine by default. The step from tool to machine was a step from human to other sources of power. This step occurred early in human development as precursors to such machines as the windmill and the watermill were founded in early antiquity.

DISTINGUISHING MACHINES FROM SIMS

Today, we stand close to the inception of the second change. That is, the source of intention is migrating from solely human intention, through hybrid stages, toward solely machine intention. The full achievement of this transition will create a new entity that is not tool and is not machine. I propose that the name of such entities be Self-Intentional Machine Systems (SIMS). In their earliest stage of development, the intention of such systems is directly bound with human intention which is explicit and attributable to a single individual. The next developmental stage blurs intention across many individuals and there is the birth of some elemental form of 'emergent' machine intention. This is the hybrid stage and such entities are Hybrid Self-Intentional Machine Systems (HYSIMS). It is this stage of development that we are now entering. The occurrence of fully autonomous SIMS will be a state as significant as would a discovery of other life in the Universe. However, since that development will happen in gradual stages before our eyes, we will not recognize a comparable impact. Although human beings will continue to use tools and machines, there is no reason to believe that SIMS will stand in the same symbiotic relationship.

All this is in the future. In this paper, I want to emphasize the value of machines by illustrating specific examples of men without machines. No society, having developed machines goes back. Consequently, it is only under very unusual circumstances that we can see the activities of institutions which have knowledge of machines but do not use it. One clear example are penal colonies.

SARAH ISLAND, MACQUARIE HARBOR, VAN DIEMEN'S LAND

One of the harshest penal institutions ever constructed was the settlement of Sarah Island, Macquarie Harbor in Van Diemen's Land, now Tasmania (Julen, 1976). Although in existence for only eleven years (1822-1833), Sarah Island had one of the blackest reputations of all prisons. It was conceived of as a last resort and housed individuals who had been transported from England and who had subsequently committed offenses in Tasmania following their

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transportation (Brand, 1990). While some of these offenses appear of a trivial nature, convicts assigned to Sarah Island were regarded as incorrigible (Butler, 1975). In providing a mandate for the institution, Governor Arthur insisted upon 'continuous and unremitting physical labor.' The first act of settlement was to clear the island of virtually all vegetation and to build a thirty-foot high fence on the western shore of the island to protect against the more savage ravages of the winds known as the 'roaring forties.' No pack animals were allowed on Sarah Island. The only economically valuable commodity of the area was the Huon Pine, a tree which because of its unique oil resists rotting and is therefore highly valued as a ship building material. In the years of its existence, Sarah Island became one of, if not the major ship building center of Australia, producing some 112 ships in eleven years.

The Huon Pine were floated down the Gordon river (Hepper & Hepper, 1984) and rode to Sarah Island where they were cut into planks. The sawpit was the most feared location on the island. While simply consisting of continuous physical labor for the 'top dog' sawing down through the tree, the conditions for the 'underdog' were horrendous. Permanently dangerous with the potential fall of logs into a hot and confined space, the greatest discomfort was in the continuous shower of sawdust cascading down upon the prisoner. Many went blind in the depths of the sawpit. In this 'place without hope,' certain convicts chose to take their own life rather than sustain an unsustainable existence. I bring this example up not to horrify but as the most startling example I can find of life specifically designed to remove the comforts of machinery and technology, when such technology was available. Purpose-designed to be harsh in the extreme, life on Sarah Island can represent for us the shadow of a potential existence without the support of the machines we have created. One day as an underdog in the sawpits of Sarah Island would suffice to convince the most committed 'arcadian' that a return to life without machines would not be the 'milk and honey' adventure portrayed in some of our more flowery literature. With respect to machines, we have built them, we rely on them, and it is the case that we would not be who we are without them.

One of the more interesting aspects of the evolution of Sarah Island as a penal colony was the gradual change in focus from punishment to economic exploitation of the Macquarie Harbor area. It is difficult to establish whether this was ever a purposive policy, however, Sarah Island was never completely self-supporting and was closed in 1833 because of the financial and logistical concerns of supplying such a remote location. In particular, the entrance to Macquarie Harbor, known as Hell's Gates (Laney, 1989), is so narrow that it prevents the entry of sailing ships except in relatively rare, clement conditions. Given the general nature of an expansionist policy in the whole of the Australian continent at that time, it is not surprising that monetary concerns eventually overtook the concern for punishment and reform. What is clear is that the early years of Sarah Island were an illustration of men without machines and it is critical to recognize that this was viewed as extreme punishment, even in the early part of the nineteenth century.

PORT ARTHUR, TASMAN'S PENINSULA, VAN DIEMEN'S LAND

When the economic feasibility of supplying Sarah Island was found to be a problem, the then administration identified alternate sites for a resident penal colony (Lennox, 1994;

McCulloch & Simmons, 1993). The choice fell on a harbor area on Tasman's peninsula which was named Port Arthur after the then Governor. This settlement was much closer to Hobart Town but was still easy to guard since a number of very thin isthmi, or connecting beaches, linked the parts of the peninsula. In particular Eaglehawk neck was some 200 yards across and was kept permanently guarded with a line of dogs across the neck to warn of anyone trying to cross. The location was permanently manned and was in direct connection with Port Arthur. Port Arthur was a different proposition from Sarah Island. Despite a continued emphasis on hard physical labor, there was much more of what we would recognize today as a modern prison (Brand, 1975; Lennox, 1994). In particular, the nature of punishment for recalcitrant individuals had change dramatically. Rather than prolonged physical activity in a dangerous and uncomfortable environment like the saw pit, repeated offenders were now isolated in the separate or model prison (Brand, 1979). This system was modeled on the Pentonville experiment in England where prisoners were kept in complete silence and complete isolation. Punishment cells in this system consisted of complete black out, and the now cliched 'bread and water' diet. There is some evidence that the prison was stressful for the warders. They had to walk on rush matting and communicate with hand signals. Inspection occurred once every fifteen minutes and the warder had to place a wooden peg in a specific hole in the prison clock to indicate inspection had been accomplished. Pegs could not be placed either before or after the specific time, hence, the supervisor had a direct record is the warder missed the appointed time. A most cruel vigilance task, the punishment for warders missing their assigned times was also rather unpleasant.

If life without machines is arduous, life without stimulation is no life at all. The length of sentence to the model prison had a maximum limit but this was often violated for unfavored offenders. It is not surprising that some convicts went insane under such a regimen (McCulloch & Simmons, 1992). Even with the magic of film and the representation given in 'Papillon' we can have no real empathic understanding of what such a living death is like. Consequently, while life without machines seriously changes the nature of what humans are able to achieve, life without stimulation makes us less than human. In summary, technology evolves and it is only in very rare and exceptional cases that a society having once developed a technology then voluntarily chooses not to use it for whatever reason. In fact we see this as deprivation and punishment. Men cannot survive without tools, men can survive without machines, but it is little more than an extension of the observation that life is 'nasty, brutish, and short' under such conditions.

DIRECTING TECHNOLOGY

The choice is then is not machines versus no machines, or in more general terms, technology versus no technology. We can no more retreat from technology than we can relive our own existence. Rather, the choice is what technology and in what direction that technology progresses (Hancock, 1996). In advocating 'human-centered' approaches to this problem, we have a small voice to proclaim an important message. For we do merely reflect one facet of an overall system. Rather, we are the champions of the individuals who are expected to operate with flawless efficiency in systems replete with opportunities for disaster. In advocating for the human operator, we must also embrace a wider responsibility in seeking to contribute our conceptions of *what* technology should be developed, not merely commenting upon how and why existing

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creations are deficient. If we can be involved in this level of *meta-design*, we can have a full voice in directing technology, which is the most powerful force in creating our future selves.

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