

# AUTOMATION

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Broadly considered, automation includes all those things computers and machines can do to perform tasks for people faster, more accurately, and more efficiently (in terms of time, resources, and human labor) than if they were done directly by people.

Having started more or less in the 1940s and gotten a boost from inexpensive computers in the 60s and 70s, automation itself is now in a stage of awkward adolescence. The childhood, full of promise and user tolerance, is over. In fact there has been much disappointment, as much that was promised (e.g., versatile industrial robotics for manufacturing, artificial intelligence for medical diagnosis and language translation) has not materialized. Yet there have been and will be steady gains. Now automation in the factory, process plant, aircraft, hospital, and marketplace are common, while automation in the home and automobile is just making its entry.

Gradually it is being realized that *automation has not replaced people and never will*, and that to regard automation and human intelligence as mutually exclusive (e.g., astronauts vs. robots in space) is silly, that some *combination* of humans and automatic machines working together is better than either by itself. This usually means the human complements the machine, the human acting as supervisor. Supervision breaks down into the functions: (1) planning, (2) programming, (3) monitoring of the automation, (4) diagnosing of problems if and when they occur, (5) intervening if necessary, and (6) learning from experience. Given this functional breakdown, it is still difficult to understand the proper human role in each different context.

It is now clear that *there is no single model or supervisory control of automation*, but a whole host of applicable models which apply to the six supervisory functions listed above, and typically include all of the traditional psychological categories of attention, perception, cognitive modeling, memory, workload, communication, decision, valuation, control, and learning. Modeling the human operator's relation to automation is not unlike modeling "management" – it seems not to make sense to expect a single model at this level of system generality. Yet I do believe human factors professionals will be more and more concerned with developing and using models of the supervision components.

I would call particular attention to three human factors activities which I feel will be more and more in demand, not only with automation, but also with other aspects of technology application in relation to human users, operators, clients, patients, customers (in the home, health care, education, transportation, business and commerce, industry, government, national security). These are:

1. Inferring people's mental models. This has been much talked about, but the art is still very primitive. Some might say it really can't be done. In any case, as perceptual-motor skills become less important and cognitive activities of the supervisory functions become more important, we must find practical ways to do this.
2. Measurement of costs and benefits not only in dollars but also in terms of individual values (relative worth, utility, "satisficing"). Promising new computer-interactive techniques are becoming available to do this. In the past, human factors professionals have been handed performance criteria, or they were obvious. Now they will have to be inferred in situ. Human factors professionals will also have to consider cultural norms to a greater extent than has been the practice.

3. Monitoring what people actually do throughout their whole day (as contrasted to what they say they do, or say they like, in a confined workplace). Human factors will have to look more and more at larger slices of life, as work and living become more intermixed. This monitoring will have to be done in ways that maintain anonymity or otherwise are ethically defensible.

Human supervision of automation is planning the automatic operation, programming the computer, monitoring of the automatic operation, diagnosing problems if and when they occur – intervening if necessary – and learning from experience.

Three new activities for HF professionals are inferring people's mental models, measuring costs and benefits not only in dollars but also in terms of individual values (relative worth or utility, "satisficing", cultural norms), and monitoring what people actually do throughout their whole day (as contrasted to what they say they do, or say they like, in a confined workplace)[identical wording above—OK?].

Alienation is physical and temporal separation from a task, threatened or actual unemployment, erratic mental workload, centralization of management control and loss of worker control, desocialization, deskilling, intimidation of the computer's power, user's technological illiteracy, user mystification and misplaced trust, user sense of not being productive, diffusion and abandonment of responsibility, and user's sense of enslavement.

To have trust in the machine is to have reliability, robustness, familiarity, understandability, explication of intention, usefulness, and user dependence

Automation must be limited based on user education, user expectations, user creativity, and user responsibility.