A CRITIQUE OF OPERATIONAL AUTOMATION

by the

NATIONAL WEATHER ASSOCIATION COMMITTEE
ON OPERATIONAL AUTOMATION

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1. INTRODUCTION

Service is the product of over 60 % of the work force. As consumers we pay for services as a price to industry or as taxes to government. The cost of the flour in a loaf of bread, for example, is less than a dime. Baking, transportation, marketing, advertising, similar services, and taxes account for the rest of the cost and for the largest portion of the increase in bread prices. Consumers faced with inflation demand more value and more productivity for their money, and the pressures on each of us to increase our own productivity are no less.

The fact is, people in operational meteorology are in a particularly sensitive position because they stand between the consumer and all of the supporting computers, satellites, ships, radars, aircraft, forecasters, technicians, and managers. In the eyes of the consumer, the costs for these "support" people and facilities are justified only by the apparent value of the services operational people provide.

The dollars spent on meteorology have increased greatly in the last 15 or so years, but the demands for better pollution, recreational, agricultural, aviation, marine, and public weather services have grown even more rapidly. People want more localized, more timely, and more accurate forecasts and services. However, advances in the local forecast and delivery system have not kept pace with either technology or inflation. In fact, given the relatively outmoded facilities and procedures used at field stations, operational epople have very nearly reached the limit of their ability to provide new services. The increased productivity needed to satisfy new demands can only come from the changes at the field level. Automation is a key factor to shape that change, large and small.

Although changes will not occur overnight, they will occur over a small portion of a person's working lifetime. New opportunities will accompany some of these changes and many people will be faced with important decisions concerning their careers. These decisions should be based on as many of the facts as possible.

The facts need an overall framework to be meaningful. Significant parts of that framework consist of information on automation as well as plans and programs for implementation at field sites. There have been several articles written on the impact of automation on people and their jobs. Yet, a considerable confusion exists over the issues and, in some instances, serious apprehension about how automation will affect operational meteorology.

The National Weather Association formed the Committee on Operational Automation to examine the issues, sort them, and prepare a summary for NWA members. The committee members decided to present the summary in three articles. The first, presented here is background material and an analysis of the larger issues involved. The second will narrow the issues and focus on the kinds of impact expected at the operational level. The last article will include suggestions for further NWA action.

2. OPERATIONAL AUTOMATION PART I – BACKGROUND ISSUES

Quick Quiz on Automation - (Answer true or False)

Automation:

1. Increases work output _____
2. Sells electronic components _____
3. It is great because we get air conditioning _____

4. Is a plot to put programmers to work _____

5. Eliminates jobs _____

6. Creates jobs _____

7. Is the wave of the future _____

8. Never works when you need it _____

9. Is all of the above _____

10. Is none of the above _____

3. AUTOMATION – FRIEND OR FOE

Those statements on the quiz underscore two basic concerns -- how will automation effect me, and how will it affect my ability to do my job? The goal of this first article is to identify and discuss the larger issues. The two vital issues facing NWA members are job satisfaction and work effectiveness. Will I have a job? Will I be able to do it? What changes will be made? Will my work have value to the public? Does the job have a future? As long as these questions are unanswered, people will worry about any change due to automation.

The NWA Committee on Operational Automation can't give answers to these questions. What we intend to do is put some ideas into a framework to help evaluate what automation means to you. We found that some fundamental concepts had to be understood first or the framework would be useless. So, the initial task was to develop a working definition of automation and to adopt the term "computerization." In fact, the impact of computers is so great that this series will focus on computerization. Our second task was to separate out details of engineering, implementation schedules and the like from the impact of automation and computerization on people. We will discuss only the impact on people and what people can do about it.

At the end of this article, questions are posed to help you evaluate what you read or hear about operational automation. There are no exact answers, but in the subsequent article we will examine some possible ones. Whether they are applied, or even accepted, depends on the initiative and motivation of people involved with making automation work in operational meteorology.

4. THE TERRIBLE TRIO – MECHANIZATION, AUTOMATION, COMPUTERIZATION

a. MECHANIZATION: Simplistically, mechanization is using a blender instead of an egg beater, or a teletypewriter instead of smoke signals, or an automobile instead of a horse. or a wind vane instead of a wet finger. A human operator is still needed, but mechanization greatly increases productivity. Machines were adapted to meteorology long before any of us were born. In the 18th and 19th centuries, for example, such things as recording tide gauges and elaborate multiple registers were in use. A major 20th century improvement was to drive mechanical devices by electricity rather than by weights and springs.

b. AUTOMATION: Automation strives to do mechanization one better by eliminating or reducing substantially the need for a human operator. Elevators, microwave ovens, central heating and air conditioners, and seat belt buzzers, are examples of automation. Most of us know automation in meteorology in such forms as centralized map plotters, transmissometers, ceilometers and rawinsondes. Few people can claim to have been "there" before all of these devices. Most os us, however, have lived through one or more transitions to these innovations.

c. COMPUTERIZATION: The addition of a programmable decision device-a computer-gives rise to the concept of computerization. Mechanical "calculating machines" predate the industrial revolution, but they were a form of mechanization and not computerization. By computers, we mean the modern, electronic and programmable variety. Computerization builds on both automation and mechanization. As with any offspring, it shares some features in common with both parents. Computerized switching of telecommunications, for example, takes a task which was first mechanized, later automated, and does it 10 to 20 times more efficiently. This control of telecommunications is representative of the mechanical tasks computers can perform. In this context, computerization differs little from automation, except computers do their work more efficiently.

Computers also help people think. This is the fundamental separation between computerization and automation. Computers can process information, correlate facts, dip into a data bank for historical relationships, alter their work schedule based upon what they "learn" and present results for our amazement. If automation makes machines efficient, computerization makes machines "smart."

With these concepts in mind, what can we expect in terms of change from automation and computerization? What are the principal "people" issues? What questions should you be asking about automation and computerization?

5. PEOPLE ISSUES

In broad terms, the people issues are: What is the impact on 1. my job security and 2. my ability to do my work?

Political speeches, taxes and change are inevitable. Include a computer in automation, and the tempo of change is greatly accelerated. Because they can amplify both physical efficiency and "brain" power, computers have a double impact. They do physical things that people once did; the result being a change in how people work. Second, computers organize and process information; the result being a change in how people solve problems. Job security and ability, then, are affected by changes brought about in both the jobs to be done, and the training and skills needed to do them.

a. CHANGES IN JOBS. There is no escaping the fact that automation and computerization mean certain tasks are no longer done by people. When the bulk of a person's job is done by a machine, the impact is predictable: to be employable the person must be retrained. In the subsequent article we intend to look at some of the opportunities for retraining in new jobs resulting from computerization.

A more complicated circumstance is when automation does only part of a person's job and computeriztion forces him to change his though patterns. Now, is automation an advantage or a disadvantage? Is the cup half full or half empty?

The cup may be half empty because he may not have enough to do in one job and he ends up trying to parts of several. The situation is particularly difficult if the jobs are not naturally related. In the latter instance, the person has to maintain proficiency in two or more skill areas. Even an assignment to do the same or similar tasks in another unit can be hazardous, because, like pregnancy, there is no such thing as being a little bit computerized. Tasks similar to those initially computerized are fair game for Phase II: Computerization.

For operational meteorology, however, the cup is more likely to be half full. Service programs in particular suffer from too much to do at critical times. "Free" time, if available when needed, can be used to increase significantly the quality of operational programs or to expand services. As important, the individual can spend more time making decisions rather than working faster to keep up with the machines. This leads directly to the second kind of impact computers have: changes in the training and skills required, and amplified "brain power."

b. CHANGES IN TRAINING, SKILLS, AND "BRAIN POWER." While automation and computerization build on the base of mechanization, there is a significant change in the role of the human. With mechanization, for example, the person still breaks the egg before he beats it, whether he uses a blender or a hand beater. With automation, he might put a whole egg (shell and all), milk, and flavoring in a "black box" and get back a soufflé. Automation changes the tasks performed, their sequence, and their complexity. The skills, training and mental demands of the people are different before and after automation, and so is their overall productivity.

Three techniques frequently used to ensure people remain employable are: retraining, crosstraining and crossutilization.

c. RETRAINING INTO NEW JOBS. Automation particularly computerization, can assume all or just part of the tasks comprising a particular job. If all the tasks, or the preponderance of them are done by the machine, the people have to be retrained if they are to be employable. The cost could be considerable, because the new jobs are normally little related to the earlier ones.

d. CROSSTRAINING. Crosstraining into similar jobs, often in another unit, is another option. The training required is minimal, but these jobs are also susceptible to "Phase II" automation. So, careful planning is needed to prevent a "bow wave" of unemployables from developing.

e. CROSSUTILIZATION INTO RESTRUCTURED JOBS If only a part of the tasks are assumed, there are more options. However, a correct solution may be more difficult to find just because there are choices. Combining parts of several jobs into a new one can be effective if the tasks from each job are naturally related. One attribute of computerization, is that it tends to take over the middle range of tasks. Those tasks requiring considerable judgement and skill remain as do those which are mechanical or support functions. Separately, the lower range of tasks consistute a job at a much lower skill level than previously, and the upper range of tasks requires special abilities and new training. Consequently, it's difficult to join these "ends" into a reasonable job. One common option taken is to create a series of "new" jobs, often leading to significant reorganization. The situation is far from hopeless, but solutions are not easy. One key is careful planning and implementation. Another is an understanding on the part of the people affected, of what they can do to help themselves.

f. CHANGES IN THINKING AND "BRAIN POWER". If the person is given more time to think by a computer, the computer also can become a tool to help him think. It can present data to him in new ways which are more easily digested. New data, such as digitized radar information, can be generated. Relationships among data sets can be highlighted. Conclusions and alternatives can be suggested. In short, computers can give people help as to what decision to make. Further, they can even help him assess the consequences of that decision on the quality of the product he generates.

g. INTERACTIVE SUPPORT SYSTEMS. The primary people-issues of job security and job satisfaction turn on how well the "man-machine" mix is designed and used. How the data are presented and what the computer does to increase available "brain power" are fundamental to the design of that mix. A properly designed interactive support system not only lets the "man" multiply his "brain power" by that of the machine, but also lets him keep pace with the machine---thus retaining his sanity.

In the mix, a machine that tries to do everything for the person, either eliminates his job altogether or reduces it to a rubber stamp. The only interaction the person has with the machine is to wait until it fails and then step in. At this point, it may be too late, or his skills too rusty for his "brain power" to be of any value.

Given an interactive support system, the person must be trained to use it and have a willingness to adapt his work habits to new techniques. If human judgement is excluded or minimized, either by system design or through user apathy, service to the public will be reduced to what the machine can do.

6. A SURVIVAL CHECKLIST

Job security, job satisfaction, automation and computerization are emotional issues. When the juices flow, objectivity is difficult to maintain and answers seem to be nonexistent. We still have no absolute answers, but we can help you organize your thoughts.

Consider the following checklist as your first aid or survival kit.

1. What tasks will be automated/computerized?
2. What tasks will remain?
3. What new combinations of tasks can be made to "create" new jobs with basically the same skills ?
4. What new skills are needed ?
5. What training is necessary to obtain these skills ?
6. What new opportunities are offered to do jobs not now done because of time or data limitation ?
7. What must the computer do to help me do these new jobs ?
8. When automation/computerization is done, will the support system back me up so that the public is better served ?
9. What new training is required to use the support system ?
10. Will machines and computers work for people or instead of them ?

Survival will ultimately depend on the adaptability of operational meteorologists and the willingness of management to increase or improve services through automation.

7. NEXT TIME

In the next article we will elaborate on the broad themes raised here. The emphasis will be on specifics. The National Weather Service's Automation of Field Operations and Services (AFOS) and the FAA's Aviation Weather and NOTAM System (AWANS) will be used as examples of operational automation. Specific impacts on job satisfaction and work abilities will be examined. We will also try to accommodate readers comments.

Readers interested in Automation should also read the panel discussion, held at the Annual Meeting of the NWA, on page 26.