HOW THE YEAR 2000 COMPUTER CRISIS MIGHT REENERGIZE SYSTEMS SCIENCE

Stuart A. Umpleby

Research Program in Social and Organizational Learning
The George Washington University
Washington, DC
Email: Umpleby@gwu.edu
URL: http://www.gwu.edu/~umpleby

July 9, 1999

Prepared for the Annual Meeting of the International Society for the Systems Sciences
Asilomar, CA, June 27-July 2, 1999

ABSTRACT

The various traditions of systems science were almost all founded during or soon after World War II. That social crisis led to great intellectual innovation. The world is now approaching another global systemic crisis – the year 2000 computer crisis. Perhaps this crisis will reenergize interest in systems science.

Fixing computers so they do not encounter the year 2000 computer problem is now the largest technical project in human history. Not all equipment will be fixed in time. Many corporations and government agencies will cease to operate. A report by the U.S. Senate says that basic services such as water, electricity, and petroleum distribution will be disrupted in some areas. Understanding this crisis, along with its social, economic, and political repercussions is a complicated, interdisciplinary systems problem. The crisis will affect everyone in the world who is in some way dependent on telephones, electricity, or fossil fuels.

Y2k is a challenge to universities given their roles in education, research and public service. Y2k is a particularly suitable topic for cyberneticians and systems scientists, given their interests and unique skills.

FACETS OF THE YEAR 2000 COMPUTER CRISIS

In the early days of computing one megabyte of memory cost hundreds of thousands of dollars. Today it costs less than a dollar. Although shortening four digit dates to two digits, for example 1962 to 62, made sense at one time, software programs written in the 1950s and 1960s are still in use and many have not been repaired. The use of two digit dates became a convention that was widely used until only the last year or two. Consider "Windows 98." If date-sensitive computer equipment had been recognized as an important problem

ten or more years ago, it would have remained a technical and management problem. Since it was not fixed in a timely fashion, it is now a social, economic, and political problem. There are several facets to the year 2000 (y2k) computer crisis.

1. Mainframes and PCs are vulnerable on several levels. Hardware, operating systems, application programs (e.g., a spreadsheet program), and specific applications (e.g., a spreadsheet containing two digit macros) all need to be checked. Those who are managing year 2000 projects are in some cases managing budgets ten times greater than they are accustomed to managing. They are also managing about ten times as many people as they usually manage. Many y2k managers are working with contractors, and some of the contractors have hired programmers in other countries, such as India and Malaysia. Hence, there are opportunities for cross-cultural miscommunication. Furthermore, the managers are in most cases not familiar with the tools being used – tools which create an inventory of the programs on a machine, tools which change dates, and tools used to test repaired code. Many of the tools being used are of recent vintage. So bugs can be expected in the tools. The psychological issues include guilt and blame as well as denial. The people one might be tempted to blame for y2k difficulties are the same people one is counting on to fix the problems. If technical people feel they are being blamed for the problems in one organization, they may leave to go to other organizations where they may very well be offered higher salaries, since salaries are rising. However, when people leave, they take knowledge of the local situation with them.

2. Embedded systems were recognized as a y2k problem only in about 1997. Originally the y2k problem was assigned to the IT (information technology) staff, which is in charge of computers but not production processes or buildings, where most embedded systems are located. Of the chips that are manufactured only 10 to 15 percent go into computers and calculators. The rest go into automatic control equipment. This equipment is used in networks that distribute water, electricity, and natural gas. Consider the case of a utility company. If an electric utility does not repair its computers and software, it will not be able to bill customers or pay employees. But if it does not fix its embedded systems, it will not be able to generate electric power. Embedded systems are also used in chemical plants, refineries, and nuclear reactors. If embedded systems are not repaired, or if the equipment is not shut down at the end of the year, there may be multiple accidents such as Bhopal, Chernobyl, and the Exxon Valdez just at a time when telephones and other services may be disrupted.

3. To understand possible economic disruptions, consider the case of a large manufacturing company, such as General Motors, which has thousands of suppliers. Each of these suppliers also has many suppliers. Suppose that GM is completely year 2000 compliant, and most of its suppliers are as well. What will happen if, for whatever reason, GM cannot obtain five percent of the parts it needs to produce an automobile. What will GM do? It will have to shut down and lay off workers. And the compliant suppliers shipping parts to GM will lose an important customer. The U.S. Department of Commerce (1999) has recently released a report describing the many interconnections and interdependencies in the global economy. I think it is reasonable to expect a high level of unemployment in the spring of 2000.

4. Government services are also threatened. In October 1997 the Canadian Auditor General issued a report saying that unless the pace of repairing code was dramatically increased, the Canadian government would not be able to collect taxes or make payments. In December 1997 the government issued a report saying that their concerns had increased. In the summer of 1998 the Canadian government told the Royal Canadian Mounted Police and the Canadian military to prepare to assist the civilian population in the event of widespread disruptions of utility services. In the fall of 1998 the Canadian military replied that they were dependent on the same sources for water, electricity, gas, and petroleum as the civilian population. They added that if there were widespread civil disorders, they would not have sufficient resources to control them. In the spring of 1999 the U.S. government asked the Canadian government to stop making announcements that might fuel

"public overreaction." Canada is ahead of most other countries in repairing its computer equipment. State and local governments are behind national governments.

5. There may also be cultural effects. At the present time people have faith in technology, progress, and government programs. If technical failures disrupt the current standard of living, if companies go bankrupt, and if governments are unable to respond, people will be disenchanted and frustrated. The basic beliefs of industrial civilization will be challenged.

VARIETIES OF DISASTER

Several types of y2k disasters are possible.

1. Nuclear weapons are a concern. A computer failure will not automatically launch a nuclear missile. However, the failure of the early warning system might lead a nation to believe that it is under attack and hence choose to launch its missiles before they are destroyed. The Pentagon and the Russian military are working together to insure that such miscommunication does not occur.

2. Nuclear reactors are dependent on the electric power grid for electricity to operate their control rooms, their security doors, and the pumps that circulate cooling water. If the grid goes down, there are back-up generators. But usually there is diesel fuel for only a few days. However, nuclear reactors require that cooling water be circulated for several years. If the water stops circulating and boils off, the reactor melts down and releases radiation into the atmosphere.

3. Chemical plants, refineries, and pipelines have many embedded systems. I believe that dangerous plants that have not been repaired, and the repairs tested by an independent party, should be shut down for the century change, and restarted very carefully thereafter. In the summer of 1999 there is not yet a consensus that this precaution is appropriate.

4. Manufacturing is vulnerable to a shortage of parts. Shipping is threatened by a late start and because many ships are based in countries that have not been working on y2k.

5. Modern cities are made possible by water treatment plants and sewage treatment plants. These plants use embedded systems and require electricity and telecommunications. If utility systems fail, high rise buildings could become uninhabitable. If heating systems fail for several days in the winter, pipes may freeze. People then lose water. When the pipes thaw, the buildings sustain water damage. If there is widespread damage, years may be required to repair the housing stock. Furthermore, if people lose water, they may drink from rivers and lakes. There might then be a health care emergency.

6. If governments are unable to function, decentralization may occur, with the possible rise of local mafias, rather like what has happened in recent years in Russia.

HOW WE MIGHT ESCAPE ILL EFFECTS FROM Y2K

There are several ways whereby we may escape the dire consequences of y2k, described above.

1. There may not be as many date-sensitive embedded systems as we presently believe. However, the companies that are working on repairing embedded systems say that they have never found a company without some embedded systems problems (Heerman, 1998).

2. Date-sensitive embedded systems may not do anything critical. That is, there may be equipment failures, but the organization continues to function. However, the companies working to repair embedded systems say that there are almost always one, two, or three "show-stoppers" in every factory – systems which, if not repaired, would cause the plant to shut down (Heerman, 1998).

3. All of the essential equipment might be fixed in time. An increasing number of organizations report that they have completed their year 2000 projects. And many other organizations are nearing completion. However, about 40 percent of small businesses in the U.S. plan to "fix on failure." And about 40 percent of town and county governments, which are usually in charge of water treatment, had not yet started to work on y2k as of the spring of 1999. Furthermore, the large companies, which have been working the hardest to repair or replace their vulnerable equipment, seem to be falling behind in their repair efforts (Feder, 1999).

4. The last possibility is that our "fix on failure" efforts are highly successful. Work-arounds are performed quickly and effectively. Ripple effects are not serious; the failure of a few companies does not cause the failure of other companies. Disruptions overseas, where y2k has not been regarded as a serious concern, do not have a significant impact in the U.S. Personally, I think this outcome is unlikely, but it is a matter of judgment.

WHAT I HAVE DONE

Since June 1997 when I read the article in Newsweek, "The Day the World Crashes" (Levy and Hafner, 1997), I have been working on the year 2000 computer crisis. I operate a listserv on y2k for academic colleagues in the U.S. and in other countries. I have built a website with the help of student assistants. I have published articles (Umpleby, 1998a, 1998b, 1999) and I have lectured on y2k at conferences in several countries. I have lobbied for attention to the issue within my university and my neighborhood community. With others I have organized a series of panel discussions on y2k beginning in March 1998. I have encouraged students to write papers and do group projects on y2k. I have participated in briefings for managers of government agencies, corporations, and associations. Other members of the Research Program in Social and Organizational Learning have published books and newsletters and lectured and consulted widely regarding y2k.

A ROLE FOR UNIVERSITIES

So far the y2k activities of universities have focused primarily on fixing their internal equipment. However, the education, service, and research functions of universities suggest a greater role for them. In terms of education, the general public needs to understand the problems that may arise and how to prepare. A great deal of community organizing is needed in order to be sure that all members of society will be cared for. Universities can render public service by providing occasions where local utilities and emergency planning professionals can share information with the public so that contingency plans focus on the areas of greatest need.

In terms of research, y2k can be seen as an unprecedented opportunity. For the next several months the interconnections within modern society will be revealed as never before. As systems break down, we shall learn what other systems depend on them. For social scientists interested in action research, y2k presents a unique opportunity to test theories and methods. I suggest that social scientists be asked to predict what they think will happen and why. These papers could be presented at a conference in September 1999. At a second conference in April 2000 we could compare the predictions with events. Furthermore, those engaged in efforts to increase awareness and to prepare organizations could be asked to describe what they did, why they chose the methods they chose, what they expected to happen, and how their expectations were confirmed or refuted. Papers by authors from different countries could be compared. My hypothesis is that papers by Americans will be pragmatic and action oriented whereas papers by continental Europeans will be more abstract or theoretical (Mueller, 1998). By taking an experimental approach to y2k, we could greatly increase our understanding of the ways we perceive and seek to influence social systems.

Y2K AND THE SYSTEMS SCIENCE COMMUNITY

I think there are several reasons why Y2k is a particularly appropriate topic for the systems science community to become engaged in.

1. It is important. People around the world will be affected (Marcoccio, 1999; Peterson, et al., 1998; Yourdon and Yourdon, 1997).

2. It is interdisciplinary. Thoroughly understanding y2k requires knowledge of technology, management, economics, politics, psychology, anthropology, and of course systems theory and cybernetics.

3. It is the frame problem on a grand scale. The frame problem is the second order problem of choosing the most appropriate conceptualization of a problem. Here are two examples. First, a software engineer designs a payroll system and is very careful to correctly build in deductions for taxes and the pension system. But he uses a two-digit date for the year and the software malfunctions at the end of the century. This is the frame problem in that his conceptualization of the task was incomplete. Second, President Clinton in his January 1999 State of the Union address said that y2k is a big, big problem and that small businesses and state and local governments in particular need to be working on it. However, later that week he and Al Gore and others in a panel discussion on Medicare proposed using some of the budget surplus to support Medicare 15 years in the future. But the y2k literature says that Medicare will not be functioning a year from now due to software problems. This is the frame problem in the form of lack of appropriate connections being made in the mind. From now to the end of the year no decision at any level should be made without considering the context of y2k.

4. Those who have worked on the year 2000 computer crisis are intrigued by issues of learning, adaptation, and participation in families, communities, organizations, nations, and the world as a whole. Those who are interested in cognition and are concerned about other people will find it a rewarding topic to investigate. As a case study to engage students in systems thinking, y2k is unsurpassed.

REFERENCES

Feder, Barnaby J. "Big Companies Falling Behind in Year 2000 Repairs, Survey Says," *The New York Times*, May 17, 1999. See www.year2000.com/releases/Nfcap5_18_1999.html

Heerman, Bill. Experiences of Tava Technologies, www.tmn.com/~frautsch/cargill.txt, 1998.

Kelly, Russ, "What the Experts Think," www.russkelly.com/experts.html, 1999.

Levy, Steven and Katie Hafner, "The Day the World Crashes," *Newsweek*. June 2, 1997, pp. 53-59.

Marcoccio, Lou. "Year 2000 Global State of Readiness and Risks to the General Business Community." http://gartner5.gartnerweb.com/public/static/aboutgg/pressrel/testimony1098.html, March 26, 1999.

Mueller, Karl. "The Epigenetic Research Program: A Transdisciplinary Approach for the Dynamics of Knowledge, Society and Beyond," Institute for Advanced Studies, Vienna, Austria, Sociological Series # 24, March 1998.

Peterson, John L., Margaret Wheatley, Myron Kellner-Rogers. "The Y2K Problem: Social Chaos or Social Transformation?" *The Futurist*. October 1998, pp. 21-28.

Umpleby, Stuart A. "Will Universities Continue to Operate in January 2000?" *On the Horizon*. May/June 1998a, pp. 13-14.

Umpleby, Stuart A. "A National Action Plan for Y2K Recovery," in Alain Wouters, Philippe Vandenbroeck and Douglass Carmichael (eds.). *The Millennium Bug, The Year 2000 Computer Crisis*. Louven, Belgium: Acco, 1998.

Umpleby, Stuart A. "Y2K: An 'Autopsy' of Modern Society?" *Science*. Vol. 284, 21 May 1999, pp. 1273-1274.

U.S. Department of Commerce, "The Year 2000 Problem and the Global Trading System," http://y2k.ita.doc.gov/y2k/y2k.nsf, 1999.

U.S. House of Representatives, Y2k Report Card, www.house.gov/reform/gmit/y2k, 1999.

U.S. Senate, Special Committee on the Year 2000 Technology Problem, *Investigating the Impact of the Year 2000 Problem*. www.senate.gov/~y2k. February, 1999, 164 pages.

Webster, Bruce. "The Predicted Impact of the Year 2000 Problem in the United States," www.wdcy2k.org/survey, 10 June 1999.

Yourdon, Edward and Jennifer Yourdon. *Time Bomb 2000: What the Year 2000 Computer Crisis Means to You!* Upper Saddle River, NJ: Prentice-Hall PTR, 1997.

top of this page