# Reasonable Best and Worst Case Scenarios

*In this article the author addresses the whole area of predicting the Y2K crisis. He gives the reader the social effects of the problem that may eventuate plus a basis for helping us evaluate the best case and worst case scenarios. According to the author, the worst thing you can do is sit around and do nothing, especially if you are a programmer. How are we going to answer people afterwards when they ask what we did to prevent this crisis?*

by Michael Goodfellow

Unfortunately, even if you understood everything about the technical aspects of Y2K, there's no way to make a definite prediction about what will happen in 2000. Until the testing phase gets underway, even companies doing Y2K fixes won't have a definite idea of what will fail. The same goes for government projects. Software projects almost always miss their deadlines. And of course, companies and organizations who have not done anything about Y2K have no idea how badly they will be hit.

Even if you knew the status of every Y2K project, there's no economist who could say definitely how such a massive number of simultaneous failures would affect the economy. Even when things are going smoothly, economic forecasts are notoriously unreliable. The worldwide financial crisis of 1998 proves the point.

So take this article with a grain of salt. Nevertheless, these scenarios represent my best guess, informed by my technical understanding of Y2K and the status of Y2K projects as reported in the press. Some assumptions we can safely make are as follows:

* Many small and medium-sized businesses will not be ready, since they have not started yet. 50% have responded to surveys that they have no intention of doing any Y2K fixes. Since this is in the US and Europe, where Y2K awareness is high, expect Asia to be at least as bad. This cannot help but cause supply-chain problems for larger companies.

* Many departments of the US federal and state governments will not be ready, since they have large systems and have not made sufficient progress by the end of 1998. Worldwide, expect governments to be seriously affected. Tax collection is especially vulnerable. It is date-intensive, run on big mainframe systems with old software, complicated, and tied into companies throughout the economy.

* Most people who are affected by the bug will not understand it. They won't have a feel for why it happened, what it takes to fix it, or how long it takes to fix.

* There will be lawsuits over Y2K problems. Fear of lawsuits will continue to cause large companies to avoid disclosing accurate information. Payment of lawsuits will be a major expense as problems develop in 1999 and 2000.

## Social Effects

Up until now, I've written mostly about the technical aspects of Y2K. At least as important are the social aspects. How we react to this problem, both before and after the event, will determine a lot of the outcome.

Some things to consider:

*1. Panic.* Even without a real problem, panic before the event can cause serious damage. There is not enough cash in circulation for everyone to withdraw their money from banks (not to mention that the banks don't have enough assets in reserve.) There is not enough food in grocery stores to allow everyone to stock up a month's supplies. There is not enough gasoline in gas stations for everyone to fill up their car on New Years Eve. Any kind of panic will create shortages, and this will tend to feed the panic. The best way out of this is to not panic in the first place. Some societies will be less prone to panic, and will do better. Some will trust the pronouncements of their governments and experts, and will calm down. Others will have big problems, even before the Y2K bug hits.

*2. Confidence.* Our economy is basically run on the purchase of luxuries, not necessities. Even basic purchases like food, shelter and transportation have a luxury aspect. We buy fancier food (or eat out), a bigger house or a nicer car than we really need to buy. Our jobs and income depend on other people doing this as well. This is a very unstable situation. If confidence drops, people will buy less, cutting out luxuries. This will cause companies to lay off workers,

which tends to further depress confidence. Either before or after Y2K if there is a collapse of confidence, the economy will be badly hurt. This is not hypothetical. Look at Japan, where people are sitting on large savings accounts and refusing to spend, because the outlook for the economy continues to be bad. This is one of the factors that have left them in recession even years after their stock market crashed.

*3. Litigation.* After the Y2K damage is done, lawsuits will start flying. This is how we as a society assign blame. Many people have estimated that the cost of defending companies which are sued, or paying damages, will exceed the cost of the Y2K repairs.

## A Reasonable Best Case Scenario

Let's assume there is no panic in 1999. This is not as unreasonable as it sounds to doomsayers. After all, people rebuild their houses in earthquake zones after a quake, or in flood zones after a flood. If they are complacent about known disasters, how can they take unprecedented ones  like Y2K seriously? Plus the whole thing is hard to explain exactly, and makes for poor TV. The experts contradict one another, and the doomsayers look a bit wild-eyed. It's easy to file this in the silly category along with stories about asteroids hitting the Earth.

So we go through 1999 this way. Techies, CEOs and government officials are getting more and more nervous, but most of the public is blissfully unaware. Look for insider selling of company stock, especially in the high-tech sector. Lots of conferences and contingency planning. There are some cash withdrawals, some people heading for the countryside, but not enough to matter. Lawyers are sharpening their knives.

Failures start early and increase during the year as programs start working with dates after 2000. Companies and governments have trouble budgeting; ordering from suppliers for dates in 2000 is a problem. Perhaps booking air travel for 2000 becomes a problem. Expect problems around the first of the year, as a large group of programs start to look ahead  into 2000. Another group of problems will occur around April, at the start of the new fiscal year.

Big companies are getting rough with their suppliers. Suppliers that can't prove they are Y2K compliant are cut off. Software companies are late with Y2K fixes and cause howls of protest. There are big effects on the stocks of individual companies. The market as a whole is uncertain.

New Year's Eve. Systems start to crash in the evening since 7:00 PM Eastern Standard Time (New York time) is 12:00 Greenwich time. In Asia, there may be a second set of crashes after midnight.

Let's assume the biggest companies have their act together. Power plants and big customers go down here and there across the US, Europe and Asia, but the grid stays up. The phones stay up. Things are probably not this good everywhere in the world. That would just be too much to ask. So assume some Country X loses its power and phones. Since this is a best case scenario, assume it's not a major player in the world economy.

There's probably an industrial accident (or dozens) in places around the world. An embedded system does the wrong thing, and a fire starts at a refinery or something. Still, on TV it looks like we did pretty well. New Year's Day comes along and people crawl out of bed.

Behind the scenes, things are more of a mess. Lots of 24-hour, 7-day companies have seen their systems fail. Non-working cash registers

in stores, bad inventory systems in warehouses, messed up schedulers for shipping and transportation, stalled process control equipment. On Saturday, the 1st, government programmers come in to work to check out systems. Most systems are failing in some way.

From the technical discussions we've gone through, you can imagine what this is like. Some computers were turned off before the holidays. Some refuse to start up (crashes in the operating system software.) Others start fine, but when application programs like accounting or payroll packages are run, they crash. Some programs run, but produce nonsense output. Some programs work fine, except they don't allow the user to enter dates in 2000. There's no time for going back to source code and fixing the bugs. Instead, workarounds are tried. The clocks are set to different dates. Sometimes this works, other times not. In the worst cases, running the programs causes databases to be corrupted (written with bad data). This can mean going back to backup copies of the database, losing transactions already entered that day.

Fixing this will be frustrating. A system will go down. You start it up, it crashes again. You find a problem and start up, but it crashes somewhere else farther down the line. You fix that problem and start again. And so on. Gradually, you get something useful. There is going to be a lot of yelling—"Where's the manual for this thing?"! Customer support lines are swamped, so most people don't get through. Web sites with Y2K information are also slow due to high loads.

Your local retail outlet or supermarket is also in a fix. They have no technical support people, and can't switch back to manual methods (products only have a barcode, not a price tag). Store managers are staring

at manuals and trying to get their systems to run. They don't have Internet connections to use for downloading upgrades. Perhaps, they think to set the dates back on the system. Perhaps that works. They are very upset.

Billing systems are a shambles everywhere. They are either crashed, or spitting out bills for a zillion dollars, or refunds for a zillion, etc. This is when programmers really get expensive. Nearly every company in the industrialized world is screaming "Get my systems back online! I'll pay anything!" Unfortunately, programmers are simply not available at any price.

All software companies are under intense pressure to make fixes available for free, immediately. There's a lot of yelling and finger pointing. Microsoft and the other deep pockets are named in virtually every Y2K lawsuit, as well as in large class-action suits. Court cases play out for years. There are calls for the government to "do something."

Within a few days, production slows at most big companies. Once they have their own systems limping along, they send out SWAT teams of their own programmers to fix supplier systems. Small companies switch to manual systems where possible. Medium sized companies are hardest hit. There are delays and frustration everywhere, but goods do get produced and distributed.

Tech stocks drop rapidly on the stock market, as do the big manufacturers, and some insurance companies. Some companies go bankrupt, and the supply chain is affected even more. The worst effects take months to show up. A medium-sized recession starts due to drops in productivity. Japanese banks blow a few more rivets, but hold. Programmers and lawyers do well financially.

Long-term software companies lose a lot of reputation. People become even more cynical about the effectiveness of government and big business. Y2K is used as an object lesson when people talk about the dangers of high tech. This is the best case.

## A Reasonable Worst Case Scenario

No one knows what it takes to start a fad or a panic. It might take only a general increase in the amount of talk about Y2K. I think it will take a concrete event that affects (or at least impresses) the average person. Some possibilities:

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\* The NRC announces that since safety systems cannot be guaranteed, all nuclear power plants will be shut down in late December, to be re-certified. They announce that blackouts on the 1st are virtually certain, especially in the Northeast, where nuclear plants supply 40% of power. They hope to have the plants back by summer, when the high demand season starts.

\* Or, the airlines announce that due to insurance coverage problems, or FAA decree, all flights are cancelled for the first few days of 2000. Flights will resume when air traffic control systems have been fully tested. Vacationers all over the country are affected.

\* Or, a state governor announces that the since loss of services cannot be ruled out, and communications can't be assured, he's requesting that the National Guard be positioned ahead of time in the major cities of the state to prevent looting.

None of these things produce panic by themselves. They do draw the attention of the public, and the media. All the scare stories get more coverage. Even the optimists are saying there may be problems, and that you should keep some food and cash on hand. When pressed, they can't rule out a disaster.

*Panic Stage I*: The public begins to withdraw serious amounts of cash from banks. Appeals for calm from bankers and regulators don't help. The general feeling is "What else would they say, even if they knew about a problem?"

*Panic Stage II:* Cash is in short supply. You go to the ATM and it's empty. The grocery store can't cash checks or make change. This is because there is only about $2000 per household of cash in circulation. Most of that is already in everyday use. There's not much room for a big increase in the demand for cash. The Federal Reserve can print more cash, but knows that feeding the demand would only harm banks. So they let cash become scarce. They advise that people pay by check or credit card. Cash businesses (fast food) are hurt badly, and so are the poor (people without bank accounts). These real hardships only make good TV and feed the panic.

*Panic Stage III:* Once lines appear at banks, everyone starts to take this seriously. There are runs on all kinds of commodities. Non-perishable items disappear off grocery shelves. By the end of December, grocery stores are empty, and are mobbed whenever a shipment comes in. In the last week of December gaso-

# Best and Worst Case Scenarios

line becomes impossible to find. Needless to say, stock markets start crashing around the world. This does not help.

Failures in systems increase throughout 1999. By the end of the year, the media is covering each new problem. TV news magazines are running stories on how the IRS will not be able to function for months, sending the budget deeply into the red. Medicare will not be ready. Hospital administrators are quoted as saying that hospitals will close in that case.

"End of the World" groups are growing much more active, and are being covered by the press, along with survivalists (especially, programmers who are survivalists). In this crisis atmosphere the end of the year arrives.

*New Year's Eve.* Starting in the evening in the US (12:00 Greenwich), power and telecommunications systems start to have problems. Not every embedded system or control program fails, but enough do to shut down a sizeable number of power plants. Once a minimum is reached, the rest of the grid will crash due to inability to handle the load. Eventually, power is out nearly everywhere in the US, Europe and parts of Asia. Some power comes back within a day or so, and there is limited power within each region by the end of the week. Within two weeks, most of the grid is back. Nuclear plants are shut down completely, if not down already. This is a major problem in France (affecting all of Europe) and Japan.

Telephones might take longer. Some equipment has emergency power, but not the offices (and computers) of programmers (not sure this is true). Not until electrical power is partly restored does serious work get started on rebuilding the phone system. Some parts of the network come back quickly, but others require significant workarounds. Complete tele-

phone coverage is not restored for a long time. Everyone is in a panic on New Year's Eve, and when the power goes out. Many people assume the worst. Just before, and especially after, power is lost, the biggest short-term problem is the rioting. Everyone else is in a panic on New Year's Eve, and when the power goes out. Many people assume the worst. Just before, and especially after, power is lost, many people assume the very worst. US cities begin, especially, per decades. It is dangerous to be in a major US city, at least near rioting over again. With power and other systems out, fighting fires is difficult. Instead of arranging power and people attempting to fight the fires is difficult. Between Roads are blocked with people trying to flee the cities. Between major highways is traffic. Even accidents close off major highways. Cars stuck in traffic behind accidents, run out of gas. In several US towns in Europe both the panic and the riots will be worse than in Europe or in Asia. The US has its own cities rot for years. They will be hit hardest by cash shortage. The cities, already seen as dangerous without power, will become hellholes without power. Anyone with will be desperate. Anyone with a gun will take a car. Inner city residents will abandon them that they go to the countryside is not safe haven. People don't want to watch over their own home to escape to a place to wait before and then back to escape fields and drink. Anyone to have to a meeting think would claim have the same country side as that have. The survivalist type is not as common. Distrust of the government and of experts is widespread in the US. Once the panic starts, official pronouncements will be ignored. Millennial religious movements are much more common in the US. This will add a unique element to the panic, and to the riots.

In the next few days, fires are put out and cars are towed off roads to open the cities to supplies. Food stations are set up by the military. Banks and stock markets are closed for weeks. Necessities like coal and grain are moved by government order. Within a couple of weeks, food stores reopen, and some cash comes back into the market.

It's immediately clear that a major depression has started, due to the bank runs, the utility and other system failures (which have stopped all commerce in its tracks), and the physical damage. Confidence has collapsed for the moment and must be rebuilt. Morale is terrible and the cleanup goes slowly.

As calm is restored and people try to pick up the pieces, systems failures finally get addressed. Compared to my best-case scenario, assume that small and medium-sized businesses which did not address Y2K are hit hard. No amount of tinkering with dates will get their systems back. Programmers are working hard, but a majority of small companies are left waiting. Small businesses have been delayed by utility failures (one to two weeks) and systems failures (perhaps another month or more). They have been without suppliers or customers or bank credit for weeks. Many just close their doors. Supply chain disruptions follow, and major companies suspend operations. Government and most businesses are forced to reduce operations and cut their size drastically. Huge numbers of bankruptcies follow. The economy shrinks rapidly.

Government action is required to get banks to reopen. Once money is flowing again, international currency markets can be reopened and new values for currencies established. They will probably swing wildly at

first. With currency values stable, some international trade can resume. The depression will last for years.

A third party candidate will win the US presidency in 2000. Politically, the losers will be the internationalist, big business Republicans. The computer industry and high-tech in general will be scorned. Politics will be populist, protectionist and anti-technology. Nationalist and Green parties will do well in Europe.

Remember that this is the worst case. Very few people are injured or killed even in this horrible scenario. A lot of wealth is destroyed however.

## Factors that Influence the Outcome

In my opinion, there are three main factors that influence the outcome of the Y2K crisis:

*Panic.* Any level of panic that does not cause bank runs can be dealt with. Once there are bank runs, I can't see anything stopping a full-fledged panic. However, it might happen well before the end of 1999, which would give it time to die down.

*Power Failures.* Worldwide, this may be no different than other utility failures. However, I think the combination of a power failure and a panic is especially dangerous. In the US, I think it will definitely lead to riots, and then to heavy damage to the cities.

*Supply-chain problems.* Y2K failures can snowball. Shutdowns by a few suppliers will cause a big company to stop production, which will affect other suppliers. A little bit of this just leads to a drop in productivity, the same as with a storm or an earthquake. A lot of this leads to bankruptcies and recession.

These three factors could play out differently in different countries. All combinations could occur. A depression started in the US, Europe or Asia

would spread worldwide.

*Minor panic, minor power failures, minor supply problems.* This is my best case scenario. There are still lawsuits, and loss of productivity from dealing with systems failures. A recession begins.

*Minor panic, minor power failures, major supply problems.* If banks collapse in a major country (due to bankruptcies, not Y2K bugs) or if disruptions slow international trade, this could cause a depression.

*Minor panic, major power fail-*

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*The primary effects will be economic, within the range of recession to depression. So much remains to be done, especially worldwide, that I think we can rule out the "bump in the road" scenario.*

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*ures, minor supply problems.* If everyone were warned ahead of time that there would be blackouts, and people did not panic, this might not be much worse than the best-case scenario. Supply problems would be added to and the recession would be deeper.

*Minor panic, major power failures, major supply problems.* The effects are the same as "Minor, minor, major", but with a deeper recession. Power failures without panic are just another supply problem. A serious one though.

*Major panic, minor power failures, minor supply problems.* If we had a panic before the event, but

bank runs were limited by the amount of cash in circulation, it would not be too bad. At midnight New Year's Eve, when power stayed on, everyone would laugh it off and start to celebrate. Cash would rush back into banks after the 1st. Stock markets would still have crashed however.

*Major panic, minor power failures, major supply problems.* A roller coaster—panic, relief, economic disruptions, bankruptcies, recession.

*Major panic, major power failures, minor supply problems.* This would be the same as the worst-case scenario below. Panic plus power failures will cause riots and arson, devastating cities in the US. A serious loss of confidence follows. A depression in the US will spread worldwide.

*Major panic, major power failures, major supply problems.* This is my worst-case scenario. A worldwide depression begins, probably worse than in the 1930's.

## What Should we Do?

As the end of 1999 approaches, businesses and governments can take some preventative measures. Backup copies should be made of any important data before the end of the year. Computers should be shut down over the 1st wherever possible, to avoid crashes during the transition from 1999 to 2000. Even if a business is 24-hour, consider shutting it down and restarting. This will be costly, but will avoid the situation where things are failing right and left, and there isn't enough staff to handle all the emergencies that come up. After the start of the year, systems can be brought up one at a time, as people are available to fix them.

Some people may read all this and think that there's no point in fixing their own systems, since everything will be such a mess anyway. This is wrong. Whenever the economy

starts to pick up again, you will want these systems to work. The more effort you put in before 2000, the faster your systems will come back.

Since panic is such a big factor in the outcome, steps should be taken to prevent it, or reduce it once it starts. I would advise that you learn about Y2K so you can speak knowledgeably about it. Follow the news so you can give specific examples of things that have been fixed, and things that can go wrong. Don't pass rumors. If you are in a position to manage a Y2K project, follow the recommendations in the section above, "A Strategy for Fixes." In general, start thinking about what you are going to do to calm people down. I don't think a speech will do it. You need something to actually show people (customers, reporters, or your boss.) Setting the clock forwards to 2000 before you have to strikes me as a convincing demonstration that you don't have a problem. Writing speeches and vague press releases strikes me as a waste of time.

Finally, there's the question of stocking up cash, food and supplies. How much of this you should do depends on how bad you expect things to be. If you expect my best-case scenario (a recession), you don't need to do much of anything in the way of stocking up. You might want to shift money out of stocks.

If you expect my worst case (panic followed by worldwide depression), you might want a couple of weeks of food, and some cash. You'd definitely want to be out of the stock market.

Many people commenting on the Internet feel the worst case is a complete collapse of the economy, with all the resulting disasters, including widespread food shortages. Let me point out a few things about this.

* To believe that people starve, you have to assume that the economy will completely collapse, the govern-ment will collapse, the military will collapse, and that everyone will just give up.

* If people do starve in large numbers, it is unlikely that you will survive the chaos that ensues. Stocking up just makes panic-induced shortages worse in the case where things are not going to collapse completely.

* If food production or distribution stops, stocking up food buys you a few months of survival. When your food runs out, you are unprepared to farm, and it's the wrong time of year anyway. So you starve a little later.

* If you really think industrial civilization is going to end, the cheapest way to prepare is to book a vacation in India around the 1st. Actually, any place with a lot of subsistence farmers will do. They are not computerized.

Note the worst thing you can do is sit around doing nothing, especially if you are a programmer. How are you going to answer people afterwards when they ask what you did to prevent this?

## Conclusion

I haven't written any updates to the above document. I mostly wanted to provide background so that people could understand other things they read about Y2K. None of the above background material has changed. For more recent information, you can check out the Senate report, which is linked from my home page at <http://www.best.com/~mgoodfel>.

The Senate report was a bit of a milestone, because it concentrates so much status information in one place. Also, since it is from a Senate Committee, it carries more weight with most people.

My bottom line hasn't changed. Y2K cannot be predicted in detail because there's too much information that simply isn't available. And even if it was available, no one understands the world economy well enough to make a detailed prediction. I still think that the primary effects will be economic, within the range I predicted (recession to depression). So much remains to be done, especially world-wide, that I think we can rule out the "bump in the road" scenario.

At the other extreme, we can rule out the survivalist-style preparation that only makes sense if you think that utility failures will be widespread and long lasting. Although that can't be totally ruled out, what little information is available argues against it. However, if you are going to stockpile, do it now, so that you won't be contributing to panic buying later in the year.
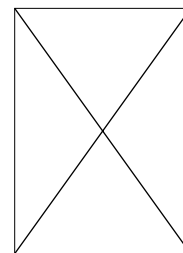


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