1. Introduction

Historically whenever a new technology has been introduced it has been greeted both with acclaim for the ways in which it will improve our lives and concern about the ways in which it will displace workers; computers are no exception.

The first example of this distrust of new technologies came at the very beginning of the industrial revolution when workers, realizing that they were about to lose their jobs to machines, attempted to destroy the machines by throwing their wooden clogs, called sabots from the French, into them. This gave rise to the word sabotage.

The word computer was originally used to mean people (almost universally women) who used mechanical calculators to add up long lists of numbers. The American Computer Museum has a photo of hundreds of these human computers sitting in a large room calculating accounts for the Marshall Fields Department Store. By the 1950s the machines called computers were essentially giant calculators, and one of the things that they did was to replace these human calculators.

The question in these notes is whether, overall, computers have increased or decreased the workforce, and the effects of factors like globalization and outsourcing.

2. Productivity and Work Week

It is accepted that computers have been the primary cause of huge increases in productivity throughout the industrialized world over the last 50 years. How to handle this increase in productivity has varied significantly between different cultures and countries.

In the US the increases in productivity have not led to decreases in the work week, and in fact the work week for the average worker has increased, and also far more people are
working (in particular women). So what has happened is that revenue has increased significantly, which means that there is more money to spend. In most cases a lot of this increased wealth has gone to the workers, and so people work as long, or longer, but can buy far more as a result. This, of course, also helps the world’s economy. Some analysts are concerned as to whether or not overall happiness has increased, because although people own many more objects at their homes, they spend far less time there to enjoy them.

Other countries have taken different approaches. In 1993 the European Union passed a limit of 48 hours per week, which was the maximum that any worker could be expected to work, including overtime. In 1998 the French socialist government passed a law limiting workers to a 35-hour work week, which applied to all government employees and to companies with more than 20 workers. Subsequently the French law, called RTT for Réduction de Temps de Travail, was modified by a conservative government to let workers in private companies earn up to 13 hours in overtime, bringing them up to the EU maximum.

The goal of RTT was to reduce unemployment since reduced hours would presumably require that companies would make up for the missing hours by hiring more people. Although there was some increased employment due to RTT it was not as much as had been expected, mainly because renegotiated labor contracts led to increased efficiency. However polls show that over 80% of French workers still support the RTT 35 hour law. Despite this, overall the country has become concerned about many of the protective rules that apply to the workforce, and when Nicolas Sarkozy won the French presidential election one of his major platforms was to bring French labor laws more in line with other countries. The labor unions have reacted with riots in Paris, and it is unclear whether he will be able to get his new laws passed.

In May, 2005, a rule was proposed in the European Union which would allow workers to opt out of the 48 hour maximum work week (which is called the Working Time Directive) but the rule was defeated. This was considered a significant victory for European unions, and a defeat for the business organizations which had proposed the opt-out rule. The Head of the Confederation of British Industries (CBI), Sir Digby Jones, said “The issue was about ‘freedom of choice.’ People who just do five hours a week overtime and use the money for a holiday. All I want to know is who's going to pay them for the money they lose? The European Parliament has learned nothing about the challenge of globalisation. Presumably these are the same MEP’s who will be complaining about employers relocating to China and India in the years to come.”

Sir Jones’ comments emphasized one of the major points in the debate, namely the fear of outsourcing to other countries.

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1 Members of the European Parliament
3. Outsourcing

Outsourcing first showed up in manufacturing, where the US was steadily driven out of large market areas as production was moved overseas, typically to Asia. Computer scientists weren’t particularly worried because our field required so much education and the US was far ahead in this area. Even though huge numbers of people came from overseas to study in the US on F-1 visas, most of us stayed in the US and helped fill a job market that was very short of employees. This so called brain drain was of far more concern to countries like England than it was to the US.

The changes were subtle. The first was when the US made it far harder for most students to come under the F-1 visa, and insisted on the J-1 instead for students from some countries, including India. The F-1 student visa is fairly easy to convert into permanent residency and then citizenship, and nearly all of us stayed. With the J-1 student exchange visa it is far harder for the student to stay in the US, and so suddenly the US was a training center for international students who would return to their countries fully trained and able to help to establish computer-based industries that could compete with the US. The second change was that the other countries now had the infrastructure that would make it possible for them to dramatically increase their education in computer-related technologies, and they, beginning with India, made the investments in education that would let them build a huge and well trained workforce.

Recently the US administration has proposed changes that will significantly cut student loan and grant programs, which will reduce the number of young people who will be able to attend universities. Other countries are doing the opposite and dramatically increasing university slots, in particular in technology areas.

The result of all this is that a huge industry has been built around the world, in particular in India but also expanding to other countries, where programming will be performed at much lower cost for American companies. Three years ago I, along with the College Director of Development, visited the manager at American Express who was responsible for the programming to process their online credit card systems. She was an MSU Computer Science graduate, and we wanted to encourage her to hire students from MSU. She told us that she doesn’t do any new college hires any more. She hires some senior people to do high level system design, but all of her programming is now done in India. She had adjusted her own schedule so that it was possible to call her programming team managers in India before she leaves work each evening.

The biggest offshore site currently is in Bangalore, India. They claim to have 150,000 software professionals, and since they have 91 IT colleges they are rapidly producing more. Some of the companies that have operations in Bangalore include Oracle, IBM, Intel, SAP, Texas Instruments, General Electric, Motorola, HP, Sun Microsystems, Novell, and Netscape. Their state government claims, with justification, to be IT friendly, and companies like Advantage-India\(^2\), based in Bangalore, make it very easy for

\(^2\) http://www.advantageofindia.com/pages/1/index.htm
companies to move operations there. To add to the attraction Bangalore is located in
south India with good weather, and thousands of miles from the conflict areas like
Kashmir.

By comparison, Micron, which is a significant employer of MSU students, and which
gives a large amount of scholarship money each year to MSU’s Computer Science
Department, for years have said that outsourcing is not in their best interest. They have
given two reasons for this. 1. they said that if they hired the best of the best then they
could be more productive than average outsource programmers, and so they could more
than make up the cost difference. 2. they said that they were concerned that different
views about intellectual property in some of the outsource countries could lead them to
lose the trade secrets that they need to compete and to stay ahead of the competition.
Unfortunately financial pressures at Micron seem to have led to a change of policy in the
company, and in 2007 they laid off a large number of employees and began to consider
outsourcing. I don’t currently (December, 2007) know whether they have initiated it yet.

The sudden impact of outsourcing was particularly brutal on new college graduates.
Companies outsourced many of their programming groups, which put a lot of
experienced programmers on the street. When companies wanted to hire new people they
had a choice between the traditional approach of hiring people straight out of college or
hiring newly unemployed experienced people who would often take dramatic cuts in
salary because they had families and house payments, so could often be hired at the same
cost as an inexperienced new graduate. Now that effect has largely worn off. Most
companies that wanted to outsource whole groups made the decision to do that a few
years ago at the height of the trend, and so now the new graduates are finding that they
can get jobs again, due to new positions and retirement vacancies. Also, the increase in
defense opportunities has created jobs that can’t be outsourced. As a result, hiring has
now improved again. While we don’t currently see many signing bonuses and ridiculous
salaries for our graduates, the national picture looks good.

Other forms of outsourcing include 24-hour software development where, for example, a
team in the US will work on a project for eight hours, then pass it to programmers located
one third of the way around the world, then again to another group another third of the
way around the world, and finally back to the US to complete the cycle. In some
countries a local form of 24-hour development occurs where programmers work in 8-
hour shifts, throughout the 24 hour day. The first that I heard of this was when I got a
phone call after 6 pm from one of our former Russian students who had returned to
Moscow, where he had a job. After a bit it occurred to me that it must be really late at
night in Moscow, and he told me that he worked the graveyard shift from midnight to 8
am. This obviously saves on overhead, since it provides a 3-1 saving on computers,
office space, etc.

I’m expecting that outsourcing will continue to expand. India is already concerned about
losing outsourcing market share to other countries, with China being the biggest new
challenger. However their operations are still expanding rapidly because of the increase
in the size of the overall worldwide outsourcing market. Tata Consulting Services, which
claims to have been the pioneer of the IT revolution in India, has now gone worldwide. For example they employ over 10,000 IT consultants in 41 offices in the US and Canada, including in Missoula after buying a Montana company in 2006.

4. Organizational Changes

When computers first began to be critical to operations in companies most companies attempted to maintain their existing organizational structure as much as possible, which meant that they had a hierarchical structure with a President or CEO on top, with Vice Presidents below, working down through a departmental structure to the line workers. Maintaining this structure meant that the sales department had their own programmers, the manufacturing departments had their own programmers, etc. At most companies this structure was usually replaced fairly quickly with a separate IT department, where all of the programmers, network engineers, etc., were located. This meant that the departments had to use some kind of payment to internally hire programmers when they needed them. They often found that it was cheaper to hire in their own programmers as consultants, and the organizational structure became very chaotic.

The most common structure now is that the IT Department still exists, but it is just responsible for infrastructure, which means the network, ordering consistent computers, upgrading and maintaining computers, etc., and programmers are assigned to specific departments.

Computers, and hence the computing administrative structure, have worked their way throughout the structure of every organization. This has acted as a catalyst for more flexible organizational structures which are usually claimed to be more efficient.

Another change which has been made possible is Just in Time Manufacturing. It used to be that companies had huge warehouses where they had products that they had made and were trying to sell, and also parts needed to manufacture new products. While I’ve been a faculty member I’ve visited Tektronix a number of times. The last time that I visited, a few years ago, their old warehousing area had been sold and was now a Nike building. Looking at the production area, say for scopes, each scope produced went through the assembly line with its bar-coded order form, and the line used the form to determine which options should be added and even which manuals to put into the box. So nothing was manufactured until it had been bought. Their outgoing warehouse had been replaced by the loading dock. Also, their computers constantly tracked their manufacturing and so could estimate what parts were needed from other sources. They ordered new parts so that they showed up just in time for when they were needed.
5. Telecommuting

Initially telecommuting was limited to the very top people in companies. For example, one of the founders of Qualcomm has lived in Bozeman for a number of years and telecommutes back to San Diego. When I originally asked him how he could do this he said that it was because he had a single digit employee number.

Now telecommuting has become far more common at all levels of companies, but it has severely stressed some management systems. Mike Quinn has eight advantages and eight disadvantages of telecommuting, mainly from the company’s perspective, which you should read.

Most employees love telecommuting since they can stay at home and work, and can avoid possibly hours of travel to and from work. A negative, however, is that employee monitoring at their homes, as well as in the office, has increased significantly. E.g., the Automobile Association in England was criticized by unions in November 2005 because they now monitor their tele-marketers to ensure that they don’t take more than 82 minutes each day for lunch, tea, and bathroom breaks.

6. Consulting

Companies often find that their workload isn’t steady, but rises and falls as new projects come and go. This gives them two choices; either they can employ enough people so that they can handle the peak loads, which will mean that people won’t have much to do during the lulls, or they can hire enough people to handle the low loads and then rely on overtime and/or using consultants when the extra work times happen.

Another reason for hiring consultants is when a company has a short term need which cannot be covered by their permanent personnel. E.g., if they need a Perl script to process a new Web page, but have nobody in the company who knows Perl, then it isn’t worth the expense to hire a new employee whose expertise is Perl or to train an existing employee in Perl, and so the cheapest and best option is often to hire an outside consultant.

The benefit to the company of using consultants is that their overhead is usually very low. They will pay the consultants on contract but usually won’t be covering costs like medical benefits, retirement payments, or even computers and office space. They do, however, lose a lot of the administrative control that they have over their own employees.