

Globalization and Offshoring of Software

A Report of the ACM Job Migration Task Force

William Aspray, Frank Mayadas, Moshe Y. Vardi, Editors

Executive Summary and Findings



Association for Computing Machinery
Advancing Computing as a Science & Profession

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Why this Study?

This study reports on the findings of a Task Force established by The Association for Computing Machinery (ACM) to look at the issues surrounding the migration of jobs worldwide within the computing and information technology field and industry. ACM initiated this study to provide a deeper understanding of the trends in, and the forces behind, the globalization and offshoring of software. Because ACM is an international educational and scientific computing society, the study approached the issue of offshoring of software from an international as opposed to a United States-centric perspective. Moreover, the task force that conducted the study comprised not only computer scientists (ACM's traditional constituency) but also labor economists and social scientists from around the world. We believe that this approach, and this perspective, are unique. Most reports on globalization and offshoring are produced either by governments or national organizations, and thus provide an inherently national perspective, or by consulting firms in pursuit of their own or their clients' business interests.

The primary purpose of the study is to provide ACM's 83,000 members, the computing field, the IT profession, and the public an objective perspective on current and future trends in the globalization of the software industry so that ACM members can better prepare themselves for a successful future in the system, software, and services portion of the global information technology field. We also believe this extensive study will be of value to those shaping the policies, priorities, and investments any country must make if it desires to remain or become a part of the global software-systems-services industry.

Scope of the Study

This study reports on the current state of globalization and offshoring of software and related information technology (IT) services. (*Outsourcing* refers to having work for a company done by another organization. *Offshoring* refers to having this work done in another country, whether or not it is done by part of the same company.)

The report is focused primarily on software systems work carried out in developing countries for export, as opposed to work done in a developing country for their local market. The ACM Task Force reviewed existing reports and data from around the world, and heard in-person from many

experts, on issues relevant to globalization and offshoring. In the process, the Task Force took an in-depth look at the following:

1. The economic theories and data that underpin our current understanding of the forces shaping globalization today and in the future.
2. Offshoring from the perspective of different countries—both developed and developing.
3. Offshoring from the perspective of different types of corporations.
4. The globalization of computing research.
5. The risks and exposure that offshoring engenders.
6. The implications for educational systems throughout the world.
7. The political responses to the opportunities and disruptions that accompany globalization.

Each of these areas is explored in detail in a chapter of the report.

Findings and Recommendations

In reviewing many existing reports, data, theories, and perspectives, a number of key findings and recommendations emerged.

- 1. Globalization of, and offshoring within, the software industry are deeply connected and both will continue to grow. Key enablers of this growth are information technology itself, the evolution of work and business processes, education, and national policies.**

The world has changed. Information technology is largely now a global field, business, and industry. There are many factors contributing to this change, and much of this change has occurred within the past five years. Offshoring is a symptom of the globalization of the software-systems-services industry.

This rapid shift to a global software-systems-services industry in which offshoring is a reality has been driven by advances and changes in four major areas:

1. *Technology*—including the wide availability of low-cost, high-bandwidth telecommunications and the standardization of software platforms and business software applications.
2. *Work processes*—including the digitalization of work and the reorganization of work processes so that routine or commodity components can be outsourced.
3. *Business models*—including early-adopter champions of offshoring, venture capital companies that insist the companies they finance use offshoring strategies to reduce capital burn rate, and the rise of intermediary companies that help firms to offshore their work.
4. *Other drivers*—including worldwide improvements in technical education, increased movement of students and workers across national borders, lowering of national trade

barriers, and the end of the Cold War and the concomitant increase in the number of countries participating in the world market.

2. Both anecdotal evidence and economic theory indicate that offshoring between developed and developing countries can, as a whole, benefit both, but competition is intensifying.

The economic theory of comparative advantage argues that if countries specialize in areas where they have a comparative advantage and they freely trade goods and services over the long run, all nations involved will gain greater wealth. As an example, the US and India have deeply interconnected software industries. India benefits from generating new revenue and creating high-value jobs; the US benefits from having US-based corporations achieve better financial performance as a result of the cost savings associated with offshoring some jobs *and* investing increased profits in growing business opportunities that create new jobs. This theory is supported to some extent by data from the US Bureau of Labor Statistics (BLS). According to BLS reports, despite a significant increase in offshoring over the past five years, more IT jobs are available today in the US than at the height of the dot.com boom. Moreover, IT jobs are predicted to be among the fastest-growing occupations over the next decade.

Some economists have recently argued that in certain situations offshoring can benefit one country at the expense of another. While debate continues about this aspect of theory/policy, the majority of the economic community continues to believe that free trade is beneficial to all countries involved, though some argue that globalization may lead to technology leaders' losing their current dominant position.

In any event, economists agree that even if a nation as a whole gains from offshoring, individuals and local communities can be harmed. One solution to this potential negative impact is for corporations or their governments to provide programs that aid these individuals and their related communities in once again becoming competitive. The cost of such "safety-net" programs can be high and, thus, difficult to implement politically.

3. While offshoring will increase, determining the specifics of this increase is difficult given the current quantity, quality, and objectivity of data available. Skepticism is warranted regarding claims about the number of jobs to be offshored and the projected growth of software industries in developing nations.

Data for making good decisions about offshoring are difficult to obtain. Government data as collected are not very helpful and do not adequately address the specific issue of offshoring. The objectivity and quality of other data sources, especially the data in reports from consulting firms

and trade associations, is open to question, as these organizations may be serving their own agendas. Projections are always more suspect than data on current employment levels.

It is very difficult to determine how many jobs are being, or will be, lost due to offshoring. The best data available are for the United States. Some reports suggest that 12 to 14 million jobs are vulnerable to offshoring over the next 15 years. This number is, at best, an upper limit on the number of jobs at risk. To date, the annual job loss attributable to offshoring is approximately 2 to 3 percent of the IT workforce. But this number is small compared with the much higher level of job loss and creation that occurs every year in the United States.

Thirty percent of the world's largest 1000 firms are offshoring work, but there is a significant variance between countries. This percentage is expected to increase, and an increase in the amount of work offshored is consistent with the expected growth rate of 20 to 30 percent for the offshoring industries in India and China. Almost all estimates are based on reports from national and international consulting firms and, thus, subject to scrutiny.

- 4. Standardized jobs are more easily moved from developed to developing countries than are higher-skill jobs. These standardized jobs were the initial focus of offshoring. Today, global competition in higher-end skills, such as research, is increasing. These trends have implications for individuals, companies, and countries.**

The report considers several case studies of firms and how they are addressing offshoring, including software service firms in low-wage nations and four types of firms in high-wage nations: packaged software firms, software service firms, entrepreneurial start-up firms, and established firms outside the IT sector. These cases show that the amount and diversity of work being offshored is increasing; and companies, including start-ups, are learning how to access and use higher skill levels in developing countries.

One example of a higher-skill area now subject to global competition is computing research. Historically, the bulk of this research was carried out in only a few countries - countries with high purchasing-power-parity adjusted gross domestic product (PPP GDP) and with a relatively large percentage of PPP GDP devoted to research and development. This situation is changing rapidly and the trend looks inexorable. Many companies have established research centers in multiple countries. Most of these companies retain strong research operations in their home country. This fact, combined with increasing national research investment in India and China, is leading to both an increase in the total worldwide investment in research and a wider distribution of research activities around the world.

People are by far the most important asset in research. The historic advantage held by Western Europe and the United States is not as strong today as in the past, given the developments in the graduate education systems in China and India, increased opportunities for research careers in those countries, and the rising national investment in research. The United States, in particular, faces a challenge in its inability to recruit and retain foreign students and researchers in the numbers it did in the past. Its dominance in the research area is likely, therefore, to be challenged.

Finally, while there is no way of ensuring lifetime IT employment, there are steps that students and IT workers can take to improve their chances of long-term employment in IT occupations. These include obtaining a strong foundational education, learning the technologies used in the global software industry, keeping skills up to date throughout their career, developing good teamwork and communication skills, becoming familiar with other cultures, and managing their careers so as to choose work in industries and jobs occupations less likely to be automated or sent to a low-wage country.

5. Offshoring magnifies existing risks and creates new and often poorly understood or addressed threats to national security, business property and processes, and individuals' privacy. While it is unlikely these risks will deter the growth of offshoring, businesses and nations should employ strategies to mitigate them.

When businesses offshore work, they increase not only their own business-related risks (e.g., intellectual property theft, failures in longer supply chains, or complexity arising from conflicting legal environments) they also increase risks to national security and individuals' privacy. Businesses have a clear incentive to manage these new risks to suit their own interests, but nations and individuals often have little awareness of the exposures created. For example, many nations have adopted commercial off-the-shelf (COTS) software and Internet Protocol technologies in IT-based military systems and critical infrastructure systems. Many COTS systems are developed, in part or whole, offshore, making it extremely difficult for buyers to understand all source and application code. This creates the possibility that a hostile nation or non-governmental hostile agents (terrorist/criminal) can compromise these systems. Individuals often are exposed to loss of privacy or identity theft. Bank records, transaction records, call center traffic, and service centers all are being offshored today. Voluminous medical records are being transferred offshore, read by clinicians elsewhere, stored and manipulated in foreign repositories, and managed under much less restrictive laws about privacy and security than in most developed countries.

These risks can be managed by companies and governments through the use of risk mitigation strategies. For example, businesses should minimize access to databases by offshore

operations and encrypt data transmissions; offshoring providers should be vetted carefully; companies should have security and data privacy plans and be certified to meet certain standards; and service providers should not outsource work without the explicit approval of the client. Nations can adopt stronger privacy policies, invest in research methods to secure this data, or work on the development of nation-to-nation and international treatment of both the data and how compromises will be handled.

6. To stay competitive in a global IT environment and industry, countries must adopt policies that foster innovation. To this end, policies that improve a country's ability to attract, educate, and retain the best IT talent are critical. Educational policy and investment is at the core.

Building a foundation to foster the next generation of innovation and invention requires

- Sustaining or strengthening technical training and education systems,
- Sustaining or increasing investment in research and development, and
- Establishing governmental policies that eliminate barriers to the free flow of talent.

Education is one of the primary means for both developed and developing countries to mount a response to offshoring so their workforces can compete globally for IT jobs. In fact, education has been a primary enabler of offshoring in the developing countries. India has responded rapidly to the educational needs of its software export industry, especially through its private universities and training organizations. China is addressing the educational needs of its software industry through centralized planning.

There are, however, problems with both the Indian and Chinese educational systems. India provides poor quality higher education outside its top tier of universities, the quality of the faculty is uneven, research opportunities are not generally available to either students or faculty, and there is a tension between providing a good education to a limited number of people and providing access for all. The Chinese system is burdened with an emphasis on rote learning, a reward system for faculty that has not yet been transformed fully to reward research by faculty and their students, and problems moving from a central planning to a competitive funding system that rewards merit and entrepreneurship.

Developed nations can use education as a response to offshoring in order to protect national interests. It can, however, be complex for a nation to address offshoring through education for several reasons: educational systems are complex, with multiple degrees and multiple majors preparing one for an IT career; the nature of the software work that is being offshored is changing rapidly; it is difficult to forecast national supply and demand needs for software workers; governments can only indirectly affect supply and demand in many nations; and it is difficult to translate an educational response to offshoring into practical curriculum reform. For example, the

United States educational system is still trying to understand how to change its curriculum to address application domain knowledge, a global workplace, and maintaining its innovative edge. In addition, the United States faces long-term challenges from falling interest and skills in math and science programs in its primary education system. The European Union is struggling with the implementation of the Bologna Directive to achieve a single European educational framework.

There are some general principles that all countries can follow to mount an effective educational response to offshoring:

1. Evolve computing curriculum at a pace and in a way that better embraces the changing nature of IT.
2. Ensure computing curriculum prepare students for the global economy.
3. Teach students to be innovative and creative.
4. Evolve curriculum to achieve a better balance between foundational knowledge of computing on the one hand, and business and application domain knowledge on the other.
5. Invest to ensure the educational system has good technology, good curriculum, and good teachers.

Conclusion

Globalization of, and offshoring within, the software industry will continue and, in fact, increase. This increase will be fueled by information technology itself as well as government action and economic factors and will result in more global competition in both lower-end software skills and higher-end endeavors such as research. Current data and economic theory suggest that despite offshoring, career opportunities in IT will remain strong in the countries where they have been strong in the past even as they grow in the countries that are targets of offshoring. The future, however, is one in which the individual will be situated in a more global competition. The brightness of the future for individuals, companies, or countries is centered on their ability to invest in building the foundations that foster innovation and invention.