Is the software industry environmentally benign?

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A recent Wall Street Journal article by reporter Mike Ramsey characterized the electric car manufacturer Tesla as both a software company and a carmaker. Tesla will soon start to deliver wirelessly to its Model S cars a software upgrade to enable its autonomous driving on the highways. In addition, these cars will be smart enough to figure out at what point it needs to be recharged at the nearest charging station. Google's electric car is already autonomous. It has not been sold commercially yet, but has been extensively road-tested in the United States without an incident. Google car was designed to have no steering wheel, although California regulations may force the company to introduce one for safety concerns. Airplanes have for some time been equipped with sophisticated software to cruise and land completely and safely on their own. Most product manufacturers have been increasingly dependent on powerful software to make the products easier to use, thereby increasing comfort and making user experience more versatile. The Federal Aviation Administration in the U.S. has just permitted Amazon to test small drones in real world situations of package delivery, though for now, the issued permit is limited in scope. It is, however, a good start, and many other companies are anxious to create a new market for package delivery directly to the consumers. Softwares can do amazing things these days that were not imaginable a decade or two ago.

Two of the drivers for technology innovation are new business opportunity and profit potential. The company

Apple computers has created a market for a new product again and again. Thanks to its rapid growth resulting from these innovations, it has just become a member of the Dow Jones Industrial Average Index, replacing AT&T. Apple has also attained the status of the largest company in the world in terms of market capitalization. Its nearest rival is the oil giant, ExxonMobil, which is almost 50 % smaller. Most product-manufacturing companies, although they are heavy users of efficiency-enhancing software, are not themselves in the business of selling software. But more and more the software companies have been making inroads into selling hardware where they find business opportunities. For example, even Microsoft manufactures game consoles. Thus, most companies find themselves somewhere in the continuum from purely software to purely hardware, the trend in the United States, being toward software. With all these innovations making life easier, more productive and more comfortable for man, are these businesses inherently cleaner from an environmental point of view?

In the last 30 years, an enormous amount of wealth has been created by software companies. The benefits are seen every day and everywhere. We rarely post letters in the physical mail box anymore, the job of the typist has vanished from the office, most mechanical devices have become much safer owing to software, gathering knowledge from a computer terminal has largely replaced visits to the libraries, arguments among friends about the veracity of information can be settled in an instant by asking the computer or the smart phone, and so on. Overall we have been more productive because we are faster in achieving tasks. All of these efficiency-enhancing technologies are known as information technology. What about environmental and societal benefits and harms from information technology? There has been no study yet to capture a

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comprehensive account of environment impact of such a huge wealth generation. Perhaps the economic benefits and some of the social benefits are obvious, masking the need to look beyond?

On the surface, the software industry does not show any visible scar on the environment, the way mining, metal plating and finishing, for instance, did. But software does not exist in a vacuum. The explosion of myriads of business and consumption opportunities involving software stimulated the tremendous proliferation of computers and hand-held devices. Without the hardware, the software has no utility. The hardware-manufacturing industry uses natural resources in the form of energy, clean water, heavy metals, and rare earths, and all of these have environmental impacts. Since the growth of the hardware and software industries are interlinked, should a part of the environmental impacts be attributed to software? Consider the concept of supply chain of a manufacturing organization. The environmental impacts of the components that the manufacturing organization derives from the supply chain would be attributed to the products, per the life-cycle thinking. But the problem here is that the products of hardware industry are not exactly in the supply chain of the

software company. In contrast, the software components are also not in the supply chain of the hardware materials in the sense it would be the case for coal in the steel industry. The answer to the question that has been posed for this industry as a whole is difficult to configure. It is easier to answer this question for a particular software company because everything within the company would have to be included in an analysis including its collection of hardware and use of natural resources. Or perhaps the question should be asked differently.

Technologies are generally developed for beneficial purposes. Man can, and many times do, choose to use it for harm. For example, the hand-held devices with the familiar information technology software are used by flash mobs and terrorists to inflict life, property, and environmental destruction. The improper use of technologies for harm has been with us since the dawn of civilization. This is the price we pay for advancements. Advancement of technology is a formidable beneficial force, and no one can stop it, although its progress can be stymied where the incentive to innovate is slim. One can only hope that the antidote to intentional harm planned with a driverless car will also come from software technology itself.