2

The Human Being and Risks

The science and techniques are crystallization of wisdom, but frequently wisdom carries in itself seeds of madness.

Sato Susumu, Kumamoto Hirimitsu

Science and engineering are a crystallization of wisdom, but often wisdom brings seeds of insanity, and, therefore, rapid stormy development of a science and engineering results in a wide spreading of scientific and technical evil [64, 65]. Growing destruction of the environment everywhere over the world, accumulation of nuclear waste products, disasters, such as AIDS, failures and accidents in engineering, crises in economy, the political and information terrorism, etc., are symbolizing this fact. Modern industrial civilization or society of automation and information is characterized by fetishism of money and sciences, alienation of people, and growth of dementia.

A human being and his participation as a risk element stand in the center of typical disasters in the modern world.

2.1 Frauds in business

Let us consider some statistics on frauds in business in the USA [3, 65]. The Chamber of Commerce informed that losses due to wastes of hired workers are estimated $ at 20–40 billion annually. The volume of such stealing is much greater than those by house-breaking, hijacking, robberies, and the usual thefts in total. Federal services estimate the common annual damage by swindle with a sum from $60 up to $200 billion. The losses due to telephone swindle in 1991 in the market were estimated at $10 billion.

The Federal Trade Commission (FTC) and the American Association of Health Insurance (AAHI) estimate at 10% the number of fraudulent accounts on health services in the field of public health services. By the end of the 20th

E.D. Solojentsev, *Scenario Logic and Probabilistic Management of Risk in Business and Engineering*, DOI 10.1007/978-0-387-77946-1_2,

century, fraud in this area caused more than $160 billion losses. By another estimation, fraud is absorbing up to $75 billion of all expenses in the USA on public health services.

Scientific researches show that three of ten workers are looking for possibilities to steal something, three others of ten will steal as soon as they have opportunity, and only four of ten will stay fair in any circumstances. Each year in the USA, 200 million thefts in shops (of goods in sum $11.6 billion) occurs.

According to the Internal Revenue Service of the USA in 1990, the federal government got only 4/5 of all taxes. This underpay of taxes made for $100 billion in arrears. More than 660 ways of evasion from payment of taxes were disclosed.

In the USA, Russia, and other countries, swindle has become one of the main problems of economic safety of the state.

2.2 Errors of personnel

It is notable that not only failures of technical elements of a system result in accidents. A cause of interruption of normal operation may be a single unintended wrong action of an operator or a single omission of a needed action (so-called errors of the personnel), it can also be a combination of technical failures and errors of the personnel.

In history of atomic power stations, more than 50% potentially dangerous incidents (small infringements in work) occurred due to mistakes of the personnel [65]. It should be taken into account that nuclear stations follow the program of quality maintenance, and the required degree of quality of the equipment, the personnel, and auxiliary devices of the "person–machine" dialogue is achieved. The concept of auxiliary devices of the "person–machine" dialogue includes the necessary and sufficient operator's devices for reliable and safe control of the power unit.

Failures of refuel systems of launching rocket systems can be classified as follows: 70% of failures were caused by aging and deterioration of the equipment as a result of long exploitation, 11% of failures were due to mistakes of the personnel, 5% occurred because of constructive defects, 11% were by exploitation factors, and origin of other 3% is unknown [37].

Because the human being is often "a weak component," state of CS and its safety quite often cannot be estimated without taking into account quality of the personnel and working conditions in CS.

2.3 Asymmetric actions of terrorists

The sense of asymmetric actions of terrorists consists in making the greatest harm with the least expense (amidst the expenses terrorists count their own

lives, too). It is sad but today acts of terrorism on potentially dangerous objects and in places of mass accumulation of people are feasible.

Now and in the foreseeable future, as acts of terrorism in the USA have shown (attacks on the World Trade Center in New York and the Pentagon in Washington), in Russia (explosions of buildings by the Chechen terrorists), in Israel (explosions in public places by Palestinian terrorists), etc., mankind is vulnerable to the small radical groups, who are ready to play "not fair."

2.4 Hacker attacks on informational networks

Now we cannot imagine all gaps in protection of our civilization. For example, the level of safety of global computer networks with occurrence of computer viruses changed drastically. The racing of more perfect viruses against more effective antivirus programs is going on. As the role of information infrastructure grows, the given class of risks can become more important. Dangers and risks can proceed from a person — hacker, not being stipulated by any technological necessity.

2.5 Personnel in modern civilization

Here we present the results of the analysis of personnel work in the modern civilization, given by Sato Susumu and Kumamoto Hiromitsu in their book "Re-engineering the environment" [64].

Black boxes. Personnel are also becoming system components like robots for process un-automated on economic grounds. For example, the chemical plants are automated; all physical and chemical reaction processes are divided into unit operations or processes. Each unit operation is considered as a black box, automated, and all unit operations are then integrated and controlled. Of interest are input and output relations for each unit operation, and the internal mechanisms of the operations are often neglected. The control over a unit operation is performed on the basis of various measurement variables such as temperature, pressure, rates of heat generation, and stream flow rates. The unit operation looks like a black box to the human operators. Automation has increased the number of black box systems. This inevitably increases the risk of accidents, due to incomplete understanding of processes inside the black boxes or of the ways of interaction between the black boxes.

Automation is fully based on modern rationalism that

- subdivides the whole into elements,
- neglects qualitative aspects of objects,
- recognizes objects by quantities.

Each element thus becomes a target for investigation, the elements are integrated to form the whole, and the result is controlled by computer. Real

objects, however, have qualitative and quantitative aspects, and the automation cannot fully represent real processes.

Human errors. Automated manufactures require control and monitoring from the control center as well as daily inspection and maintenance of each elementary process. The automated systems are designed in such a way as to monitor each process by control panels in the control room. However, the machine and process may sometimes cause abnormal events that cannot be monitored from the control center. When these events are overlooked, serious accidents may occur.

Consider a chemical plant where unit processes are connected by pipes. Assume that high temperature and high pressure fluids (or gasses) flow through the piping network. Such a chemical plant has a high risk of small leakage of fluids. The leaked fluids may accumulate, and a spark can cause explosions. This type of leakage cannot be detected by indicators on the control panel, and daily inspections are required.

Operator errors are inevitable for current automated systems. Monitoring tasks are monotonous, boring, and leading to loss of concentration. Humans are not good at this type of monotonous work. They find more satisfaction in tasks that require judgments to adapt themselves to changing environments because such tasks lead to learning by experience. Monitoring tasks with such lack of stimulation are confidence destroying and error prone. The human errors do occur frequently in modern automated systems. And the errors symbolize unacceptance of the monotonous monitoring tasks.

A system or a subsystem is shut down by safety devices when a stable technological process is disturbed by operator errors. Failed components and other consequences of the accident must then be repaired to resume operation. Human errors are also characteristic for the processes of shutdown, repair, and resumption. In automated manufactures, experience and expertise are minimized, types of labor are standardized, and the number of expert workers is decreased. Thus, it is difficult to find people to cope with failures and malfunctions. Engineers have less experience in preventing unexpected chain-initiating event from developing into a large accident because each engineer is engaged in desk designs of small portions of the automation system. This fragmentation of knowledge may also be imposed by management, so that an engineer or scientist cannot go off on his own and start a competing design or construction company as he only knows a small part of the complete process.

Automation and intelligence. Some people suppose that automation increases the ratio of scientific or intelligent labor to manual labor. Others claim that blue-collar labor comes closer to white-collar labor by automation; blue-collar workers are replaced by gray-collar workers who are engaged in monitoring tasks; white-collar workers have risen to manage personnel and materials. It is said that automation requires intellectual labor that can only be performed by people with education levels higher than high school graduates.

An opposite view claims that gray-collar labor is literally gray because a stimulus challenging the labor disappeared. It is difficult to improve the human capabilities through gray-collar labor. The monitoring tasks make the nerves atrophy, causing a new form of fatigue unbearable for human beings. Modern labor-related medicine has pointed out that:

- optic nerves cannot sustain long periods of focusing on flat monitor surfaces,
- extensive periods of monitoring may yield diseases such as autonomic ataxia (loss of muscle coordination).

Therefore, monotonous labor typically observed in modern automated manufactures is no less inhuman than severe physical labor. The transition from blue to gray-collar labor does not imply a transition toward more intelligent or more humane labor. The increase of workers with higher education has nothing to do with the ability or the level of intelligence of labor. The tendency of common higher education is a fashion induced by a longer life span, rather than a result of a conversion from heavy-type industries to a light-thin-short-small type of production.

It may seem that system programmers have the best work, as they are the brain and the center of automation of any manufacture. It is the case at the stages of development and implementation of new projects of automation. But after the project is finished, they are forced to leave the manufacture or remain for support of automation system and to perform boring routine work, and may kill time by writing viruses, or by another hacker activity.

Management intensification. As meaningless, inhumane, and isolated labor increases, management is being intensified. In the traditional steel production, management lines were not separated from the technological lines. These two types of lines were united into a technology/management system. Technological skills were important in these factories, and management was performed by various types of technological experts.

Clear separation of managerial and subordinate work is observed in recent reports on the steel industry. In Japan in the steel industry, the shift supervisor is a key person. He, as a "steel man" by definition, has to manage shift members not only at the factory but also at their homes. Monotonous monitoring tasks granted by only the nervous tension, subordinate tasks controlled by a time-table under the mask of scientific management, and increasingly intensive labor drive the shift workers to despair. Worker's feelings are summarized by representative comments, like "It turns out that I am now working three times harder than before." Shift workers are being eroded by the labor intensification; their family life disintegrates, which in its turn causes harmful influences on the worker's performance. Scientific management by the shift supervisor is no longer sufficient. He controls the lifestyles of subordinates after working hours by making the excuse that he is taking care of their families. This style of management is required to push workers to work under conditions that make them lose their stimulus to work.

Increasing routine workers. Automation in steel industries has created various types of routine labor while retaining some types of routine physical labor. The total number of workers has been decreased by automation. However, the number of routine workers increases considerably in subcontract factories. Automation results in increase of the percentage of routine workers. Similar situations are observed in other industries. Rapid automation is in progress in car industries where the number of routine workers increases in assembly lines that are difficult to automate.

Some people predict that in the future, every process will be automated; they consider the current automation as a transition stage. It should be noted here automation replaces routine tasks by machine operations only when such replacements are cost-effective. Some tasks are still difficult to automate. Besides, automation itself creates new types of routine tasks around human-machine interfaces. Computerization increases data input tasks at the input side, and data monitoring increases tasks at the output side. Automation results in reduction of old types of routine tasks and growth of new types of such labor. It is notable that in automation, the total number of workers decreases, but the percentage of routine workers increases.

Third and fourth levels of industry. The reduction of the labor population in secondary industries (mining, construction, manufacturing, etc.) increases the number of laborers in the tertiary industries. The development process follows the transition of ascent from:

- primary industry (agriculture, forestry, and fishing industry) to
- secondary (mining, construction, manufacturing), then to
- tertiary (commerce, distribution, transportation, communication, public relations, education, services, and finally to
- the fourth level (banking, insurance, real estate).

The expansion of third and fourth level industries is not a social needs but a result of oversaturation of the second level industry with labor population. The expansion of third and fourth level industries is evidenced by the flood of various types of advertisement, persistent and irrelevant enticements to buy goods, and excessive numbers of shops, banks, and insurance companies. This inflation yields a transition of worker types from blue to gray and then to white collar. Some people claim that human labor has become more intellectual and less physical due to this transition.

Consider as a typical example a Japanese city bank that is a center of the money market. Today, the city bank is a leading company, but the labor in the bank is not challenging. Many white-collar workers are engaged in the counter services. The cashier at the counter continuously counts money received from customers. The money is handed on until eventually a final worker at a cash desk receives it. At some point of this process, the amount of the money received is printed on a bankbook, relevant data are sent to a host computer via communication link, and the data is processed and stored in the computer. Money withdrawal follows a reverse process. Most bankers are

thus doing routine jobs around the computer. Other bankers repeat routine home public relations (advertising) visits. The bank workers seem to be a bright group of white collars, but their jobs are unattractive, and many bank workers have resigned from their companies.

The third and fourth level industries require many "key punchers." This job requires physical labor because it involves data entry via keyboards. The job uses mental labor because it reads a computer program list. However, such a physical or mental job is restricted to an extremely narrow domain. Such job of "key punchers" results in inflammation of sheaths of tendon of wrist and autonomic ataxia and proves the inhumanity of this job.

http://www.springer.com/978-0-387-77945-4

Scenario Logic and Probabilistic Management of Risk in Business and Engineering

Solojentsev, E.D.

2009, XXX, 450 p. 118 illus., Hardcover
ISBN: 978-0-387-77945-4