QUALITY OF GOALS – A KEY TO THE HUMAN-ORIENTED TECHNOLOGY

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ABSTRACT

A kind of an essay on some social and ethical impact of new technologies has been given in the first five sections. The next two sections bring a study on quality referred to the software process. Then some ethical issues are presented in the context of IT development and computer applications. The need for a quality of goals has been emphasized. Human objectives should gain the top position, especially in a coming post-computer era. Some conceptual research in the topic of quality of goals has been suggested to safe humanistic values.

INSTEAD OF AN INTRODUCTION

The exhibition "Planet of vision" presented on EXPO 2000 in Hanover (Germany) pointed out some social utopias in 20th century. One of them showed a large city where millions people stand their good chance. Nowadays many previous inhabitants of large cities prefer to escape from all town inconveniences and to move out to green suburbia. The other utopia promised jobs for everybody or at least for those who are skilled enough – not true in practice, again. Next, a hope that a technical progress would result in a decrease of work – actually people are busier at their work than ever before.

In general, it is been a great hope (expressed and represented mostly by business circles) that any technically possible product or solution will be socially accepted and even much desired. The last statement seems to be false but it still holds good. In my opinion, a new utopia was born. Some of its essentials are as following:

- Technical progress brings only benefits for its consumers
- Proposals of information technology may satisfy everybody
- Informationalization means always social progress
- IT products may improve everything
- Multiculturalism is within one's grasp
- Face-to-face relations may be replaced by electronic media
- Sitting all day long at a computer screen causes no health problems.

Strong points of IT solutions are well known. Their enthusiasts cannot imagine to start talking loudly also about weak points. New technologies have not decreased the bureaucracy so far, rather just the opposite. A progress in the computing technology continues to accelerate but at the same time people realize social threats of it.

Computing technology changes more and more forms of work, teaching, and every-day-life. Unfortunately, each technical achievement becomes obvious after some period of time. Also IT products may delight people no longer. Computers may share ups and downs of prior technical inventions, which are just useful tools today, like vehicles, vacuum cleaners, or factory robots. So it is time to start talking about the post-computer era like we often use a term of the post-industrial era although the industry has not disappeared, of course.

POSITIVE VS. NEGATIVE SOCIAL AND ETHICAL IMPACT OF IT

From a global point of view, computing techniques and presence of Internet have initiated considerable changes on a scale of the whole world. From among many achievements and practical issues, which form a wide spectrum of positives of IT results, one may chose the most essential ones and express some crucial statements accepted today:

- Knowledge has been highly valued and even admired.
- High education and practical skills have received wide recognition.
- Results of technical progress may be fast expanded around the world.
- Computer networks provide quickest means of communication in a global scale.
- Fast communication makes business and life easier.
- Awareness of being a citizen of only one world has become more and more a remedy to make it smaller and less hostile.
- Representatives of various nations and organizations cooperate in a distributed mode in almost all areas of activities – like university research staff, employees in global corporations, international teams in scientific and social ventures, and so on.

On the other hand, growing dependency on the computing technology may possibly cause even a disaster in a technical sense, the same as an electrical power blackout, for example. It may happen accidentally or may be intended by some anti-global individuals or organizations. Taking into considerations, on a high level of abstraction, only social impacts one may form a long list of possible wrong effects:

- Next step towards so called mcdonaldization [Ritzer, 1996] of society; the step caused by a constant focus on effectiveness, standardization, repeatability, and fastness – all of them referred to any sort of activity.
- Progressive loneliness of society members, each of them well equipped with a computer.
- Lowering creativity of passive screen-watchers.
- Possible incompetence and thoughtlessness of some users of an informational supermarket.
- Replacing face-to-face relations by technical means in e-commerce and e-learning [Begier, 2000], and losing a chance to follow good personal patterns.
- Farther development of bureaucracy supported by IT.
- Lack of privacy parallel to the growing number of various databases.
- Replacing a joy of being a citizen of a global village by a fear that each step in the Internet is possibly monitored and tracked.
- Deepening gap between the rich and the poor part of society.
- Ignoring ethical principles [MacIntyre, 1966] in a context of growing competitiveness.

It's not my intention to describe problems in black and white or to propagate just skeptic opinions. For example, the lack of good personal patterns is a problem noticed in many areas of living, not just among computer users. It seems to be worth considering all together, positive and negative impact of the mass use of IT products. To recapitulate, the professional and ethical responsibility has to be strengthened [Chroust, 2000] across all 'computer' community, including designers and users of computer applications.

HUMAN ASPECTS IN THE CONTEXT OF IT PRODUCTS

Societies are under the pressure of marketing activities and mass media, which strongly depend on the number of commercials. Also universities and scientific conferences are supported by companies of the IT profile. So everything concerning computers must be OK and the reliable critics has rather small chance to appear. A modern patronage and some forms of political correctness may also be seen as new sources of indoctrination and may restrict unconstrained thinking.

Software authors are often not able to look at their products from distance. They do not seem to be interested in it. But a tendency to 'do not touch' any social problems related to applying IT products is no longer valid. Citizens are forced to behave in a way that the authors of information systems and computer applications have designed, often ignoring human predisposition and habits, his/her likes and dislikes, and so on. Documents concerning tax return and National Insurance are also good examples of it.

A person is supposed not only to learn how to use computer systems but she/he should adapt himself to the mode provided by the new technology. The computer-centered technology in its core encourages users to act and work individually, to believe computer records, to trust a content of any document, etc. And as a consequence, it forces people to adapt to IT products and rarely adjusts products to human beings. So the real question is – are users supposed to act just like human robots as an addition to computers?

Software designers verbally declare their efforts to protect multiculturalism against a domination of one culture. But this care is usually reduced only to the language translation [Chroust, 2000]. The first aim of any IT products is to increase an effectiveness of work, usually ignoring any other values, which are important in some cultures. One good example of it is a focus on a superior value of a whole community in a contradiction to the role of a separate individual. Feelings of safety and consciousness of a membership of a given community play a great role.

Products of IT technology are not only modern tools – all together may be also seen as a mirror of western civilization. The Huntington's clash of civilizations may become a fact sooner than we may expect. Modern inventions may be useful to achieve quite different goals than the intended ones. And let us do not forget that all development of computing techniques has been driven by grants of the military sector of economy.

A NOTION OF COMFORT AND SELF-SERVICE

From the very beginning a notion of comfort in a civilized world has gone hand in hand with a social division of labour. To some degree it was not contradictory to the efficiency of work. It appeared more convenient to hire one more worker than to do many various activities by the same one. This approach has been also applied to the home duties. It also results in many direct contacts between people. But maybe it is not true any more.

Self-service has already replaced salesclerks in supermarkets and removed human staff from most gas stations. Using e-business people do by themselves all activities performed earlier by clerks – just making hotel reservations, ordering any goods, using home banking applications, applying for many things, and so on. By the way people are supposed to learn how to use so many various systems when at the same time a professional clerk operates only one or two. At the beginning mentioned above solutions may even amuse some people, especially those who are proud to keep up modern technologies. When the time goes on the same users will realize that their distant activities bring profit to someone else. There are mainly economic reasons to pass clerks' duties on to clients. It is profitable but it works only on a local scale of one company. Societies face all problems of unemployment and later, of social underclass.

A notion of comfort includes also sense of having time to work and time to spare. High effectiveness often means flexible working hours. The last term is just the today's euphemism since it simply means to be ready to work all day long. Also tele-working means to be always busy.

Probably many people are even not aware of the manipulation they are involved in. There is a focus on quantitative criteria although a lot of words have been told about quality. Quality has been mostly identified only with a large number of anything (goods, income, points in tests, graduates, etc.). Maybe a society is rather close to the mcdonaldization (where everything ought to be standardized and effective) than to the better quality of living.

EDUCATIONAL SELF-SERVICE AT UNIVERSITIES

The problem, how to provide higher education for more and more students has been reported not only in Poland. Educational problems need new solutions. Computing technique has been applied or at least is supposed to be widely introduced in education. There is also impossible to run a university without IT systems. But does it mean that it's now a time for educational self-service?

It is the question: can educational computer program, videotapes and teleconferences cause the same desired effects as direct meetings at seminars? The president of Harvard University, Lawrence Summers doesn't worry that online education might displace traditional schools. In the interview for the Newsweek magazine (March 26, 2001) he really doubts that *there will ever be a substitute for personal interaction between a teacher and a learner.*

One should distinguish enthusiastic declarations from real possibilities. Many students do not read any printed books in practice but at the same time they are optimistically supposed to read electronic publications from the Internet.

Is the goal of education at the university level to produce just human 'robots' packed with information and knowledge of a theoretical background, and mastering some skills? University is supposed to educate an intellectual elite of a society. Apart teaching about a given domain of study the university should produce so called public intellectuals, which are prepared to take over a leadership in a society. Graduates are supposed to act for a community.

The following features should be developed among others:
- Ability to provide quality in any area of activity
- Creativity
- Respect for many cultures
- Responsibility for himself and for others
- Openness to new ideas and other cultures
- Skills in a team work in contrast to an individual style of work
- Familiarity with technical culture.

Using IT in an educational process may result in a extra cult of technique and technical devices. A young user may easily believe that technical achievements are superior to any other forms of human activities. So it is a short way to ignore those communities who are not world leaders in technology. Disrespect of other societies is, at least, against a political correctness. An educational process is supposed to school oneself in humility and politeness, also towards unknown cultures.

Any modern process is supposed to be effective. The common measure of effectiveness is time. Nevertheless, higher effectiveness may result in a simplified product. The criterion of fastness may fail in the educational process. Dehumanization of education may lead to change, in general, life conditions to more dehumanized forms.

From the social point of view, mass education at the university level may produce people jobless in the future and maybe also next generation of the leisure class [Veblen, 1899] in its modern version. In general, any occupation, concerned with power, politics, religion, war, hunting, and entertainment, is representative for the leisure class, which does not process any material goods in its activities. At any times in the history, leisure class has carefully preserved its privileged position which has been superior to the rest of society.

QUALITY IN TERMS OF TQM AND ISO 9001

Edwards Deming [Deming, 1982], one of the best-known advocates of quality has suggested the quality-oriented way of production. Continuously improved quality will result in a long-term prosperity of a company. Going further, everything you may produce and sell is an appropriate thing. Deming prescribes neither the social needs nor what needs to be done to match them. The only criterion of a quality is an increased market share of a given product and a profit. It does not make sense to revise principles of the market economy – just goals and intentions of some projects need some concern with their social effects. Especially projects, which deal with any social sphere, like education, health care, social securities, and other kind of insurance.

Total Quality Management (TQM – this abbreviation became the well-known term in the mid-1980s) put an emphasis on the process to provide quality of products and places responsibility for the quality of a process primarily with the owners of the process. So TQM is a management approach to success on a market. Customer satisfaction is its fundamental idea. All employees of a company are supposed to participate in quality activities like improving processes and the culture of work. The TQM approach specified and applied first in motorcar industry has been widely accepted in other domains and organizations, and adapted to the software production, too.

The underlying essence of the ISO 9000 series of standards [ISO 9001:1994 and all family of quality standards and their 'derivatives'] applied to software development is that the supplier must establish the quality system that should be described and completed, controlled, constantly improved, and effective. The ISO certificate has become a common required document and it does not often work as a distinguishing mark of preference.

Quality management and the client-oriented policy are recommended in the new version of quality standards, namely ISO 1901:2000, which underline the importance of client's requirements and expectations. The today's standards encourage to the process-oriented approach to develop, use, and improve the quality system. Well-known method of the PDCA cycle (Plan-Do-Check-Act) is recommended with reference to processes. Ongoing improvement of all processes should result in a better quality of products and services.

SOFTWARE QUALITY

The international standard ISO 9126:1991 defines software quality as the totality of features and characteristics that bear on its ability to satisfy stated or implied needs. The same standard says that software quality may be evaluated by characteristics of its functionality, reliability, usability, efficiency, maintainability, and portability. Each of them is a set of attributes that may be assessed and measured.

The question is how to build in the good quality characteristics into a software product. With respect to the quality of software several categories of recommended solutions are suggested [Dunn, 1994]:

- Leadership, starting from the top
- Software measurements, analysis of measurements, and dissemination of the results of analyses
- Planning of continuous quality improvement
- Continuous upgrading of the skills of the programming staff, and involvement of the staff in quality improvement
- Continuous upgrading of software engineering practices and tools
- Assessing the results of software quality improvement processes (and comparing the results with those of others)
- Working closely with customers.

The recipe is given how to build a quality system in the case of the software process [Oskarson, 1996]. All employees must be involved in that system to meet quality requirements. All activities are to be up-to-date documented. The conformance to the 20 elements, specified by the ISO 9001:1994 standard, has been required. They are worth recollecting and interpreting their meaning for the software process [Schmauch, 1995]:

(e) Management responsibility – the quality policy must define responsibilities, authority, and interrelations.

(f) Quality system – it must be established, documented, implemented, and carefully maintained; the manual defines all quality procedures.

(g) Contract review – there are documented procedures to ensure that requirements specified in the contract are understood and agreed by organizations of the supplier and of the customer.

(h) Design control – design reviews and verification procedures are to assure a customer that results of the design phase meet the expectations for the product; it applies also to design changes.

(i) Document and data control – defined procedures serve to control all documents and data available only to the right people.

(j)   Purchasing – there are procedures to ensure that any parts obtained from outside the organization also meet the specified requirements.

(k)   Control of customer-supplied product – specified procedures are applied to the products supplied by the customer.

(l)   Product identification and traceability – there must be procedures for identifying and tracing the product during all stages of production, delivery, and installation.

(m)   Process control – the software process must be continuously monitored to ensure the specified input requirements are to be met.

(n)   Inspection and testing – ensures that all required testing is completed and documented.

(o)   Control of inspection, measuring, and test equipment – ensures that test tools serve their intended purpose.

(p)   Inspection and test status – test status of the product must be identified since there are many test stages and iterations.

(q)   Control of nonconforming product – there must be procedures that specify what to do when a product does not meet its requirements, including defects discovered after the product is delivered to a client.

(r)   Corrective and preventive action – there must be procedures to invest the causes of defects and to initiate corrective actions.

(s)   Handling, storage, packaging, preservation, and delivery – all parts of the product are stored in a safe, secure, and controlled place.

(t)   Control of quality records – quality records must be identified and carefully stored to demonstrate when necessary and to improve the effectiveness of the quality system.

(u)   Internal quality audits – qualified personnel is provided to carry out periodic internal quality audits, which determine that the quality system is being used and that is effective.

(v)   Training – training needs should be identified for each of the involved employee; required training activities are planned in advance.

(w)   Servicing – there are required documented procedures for correcting defects and any nonconformity found in the product after its delivery.

(x)   Statistical techniques – metrics and measurements used during development should be correct and accurate enough to determine the quality of the product and the appropriateness of the quality system.

Software must conform to the specifications. It must be suitable for the intended application and satisfy its users. Many solutions and methods have been adapted from other engineering disciplines (decomposition of a process, prototyping, providing modularity, Quality Function Deployment, verification and validation built into the software process, and others) and applied successfully in the software process [Begier, 1999]. A general assumption, still underlying any computer application, is that users are working in a very disciplined manner and they are carefully acting according to procedures, designed by software developers. Can we trust it, in general?

INVOLVING ETHICAL ISSUES INTO OBJECTIVES BEING CHALLENGED

To recapitulate two above sections, standard elements of the ISO 9000 refer to the requirements carefully specified at the very beginning of the software process. There is only a great hope that a purchaser, especially in the case of great public or other statewide information system, is able to express all requirements directly.

There is still no answer to the basic questions – what are the goals underlying the given order? Is the required software product really good for the society, in general? What will be the price for possible social losses (in health or accepted habits, etc.), to the detriment of common goods? Satisfying standards does not mean getting the better society, or at least to secure human objectives in a modern society. Otherwise, IT products may support wrong ideas and improper requirements.

When Henry Ford invented the assembly line and applied it in his motorcar factories it was found as a great achievement and worldwide progress in technology. But later people stop marveling at it and didn't want to perform the same activities at their work, year by year.

It is far not enough to specify only requirements for a given software product. Maybe it would be better not to build this product and use it at all. The words 'effective' and 'fast' cannot always be synonyms of the good and valuable. It's time to formulate human objectives in general. Quality criteria should refer to goals not only processes and their results.

Sociologists together with application designers might seek for an answer to the question – what features of IT products do their nonprofessional users complain of? An interdisciplinary research is needed to solve some noticed problems: poor ability to communicate with other people (those who order pizza via Internet instead of

meeting and talking together), superficial interests, lack of responsibility, weak personality, tendency to imitate someone else's idea rather than to show an own creativity, etc.

Universities have had a very positive influence on their native and foreign students. So there is a new challenge for universities – to predict some dangers for society and to initiate preventive activities on a large scale.

Social aspects of applying software refer to the language used by computer users. A language means a culture. Different language means also a different culture not just words. So there is a need to organize multicultural versions of software to avoid a suspecting of discrimination.

The language used by internauts is very poor. Often it is simply a jargon. Computer users are younger and younger. Computer software propagates one culture, with a focus on purchasing and admiration of technical products. A domination of one culture has always lead to conflicts.

What is a paradise for technocrats (IT products generate a lot of figures, reports, documents, etc.) may be not the same for the others. Using Internet has become an element of the e-business. Commercials included on www pages may suggest that a human being is a new kind of *homo oeconomicus*, which is only intended to buy goods on a market. The simplified view of a society resolves itself into the statement – the more buyers, the better business, which, in turn, means only happiness in a global scale. There is a danger that some unexpected event caused by followers of the opposite outlook upon life may break down this idyll.

QUALITY OF GOALS – A CHALLENGE FOR SOFTWARE ENGINEERING

Software engineering adapts many techniques and procedures applied in other technical disciplines. The software process usually is still far from satisfactory although a lot of words have been said about quality.

The new proposal is not to limit quality features to those basic six, specified in the standard ISO 9126, which refer mostly to technical aspects of a software product. We should specify quality criteria in much wider meaning than it's been practiced so far. First of all is the concern for quality of goals.

A term of a risk means a possibility of unwanted consequences or losses, which may occur. These factors should not be limited to software supplier and its purchaser directly. Users are more and more the common peoples who indirectly use software but directly may suffer from software defects or weak points! So the list of risk sources should contain not only technical risks but also risks that are the opposite of human and social goals, their reception and ethical attitudes.

Risk management is an important area of activities of software engineers. Risk identification is a basis of the risk management and it refers to technical and business factors of the software process. There are recommended seven generic categories of risk [Pressman, 1997]: product size, business impact (of an organization of the purchaser), customer characteristics, process definition, development environment, technology to be built, staff size and experience.

Software quality used to be referred to the quality policy. There are four levels of the quality policy [Fleurquin, 1998]: testing, quality control, quality assurance, and quality management. All of them are focused on the software process again. There is a suggestion to add one more level: quality of goals.

It is still a hope to respect an individualization of needs and even taste. Let us start asking users, including indirect software users, for quality of IT products. Quality and ISO certificates have been not intended to serve mainly as a marketing trick. Although it would be hard to specify what constitute the quality of life, some efforts in this direction may help to avoid losses and troubles. A free development of an individual may be in conflict with a computer style of living – spending a lot of time at the screen and acting to fulfill standardized templates and forms.

HUMAN-ORIENTED APPROACH IN A POST-COMPUTER ERA

IT does not contradict the human-oriented approach, in general. On the large scale there is no monopoly in any area of human activity. Next generations of computer systems are expected to adapt in high degree to individual requirements instead of adapting people to IT requirements. The right of choice does not mean only a chance to choose one of the computer options.

There is a new belief that people want to spend all their time at work and at home sitting at computers. Interpersonal relations are still as important as earlier. The famous psychologist, professor Philip Zimbardo form Stanford University says that the percentage of shy people in our population exceeds 50% just because of an isolation when using computers. A chance to develop an individual style of work, habits, and living should be the main goal.

It is a right time to say good-bye to the mentioned at the beginning new utopia and to begin living in a post-computer era. So it is worth reassuming what is valuable in today's information technology and what are its barriers. Probably a common humility along with some criticism may help predicting new needs and realizing next inventions.

Some conclusions and critical remarks have born in my mind after due consideration of software process and as results of several students' team projects. Some research concerning quality policies and risk management has been conducted. I would like to share these experiences with people, who are able to look at things from some distance, remembering the well-known Pavlov's effect. Maybe the cooperation of software designers with sociologists, psychologists and even philosophers, should become an every day practice.

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