In this Issue

Lindsay's 'Prospects for artificial intelligence'

Robert Lindsay has prepared the special issue of *HSM* on artificial intelligence and its organizational/managerial/societal impacts – impacts on human systems management. In his initiatory paper of this special issue he concentrates on predictions and forecasts related to AI.

Managers and businessman in particular are forced to take predictions related to high technology in general and to AI in particular quite seriously. The impacts on managerial practices are already quite significant; to misjudge or to be too late in recognizing the impacts could be quite devastating for (especially American) business and management.

What is remarkable is that they (managers) mostly listen to hardware and software developers, i.e. to people who are among the least qualified to assess social/managerial impacts. Their hardware-bound overstatements are already doing more damage than help. Futurists are not of much help either as they are quite slow in recognizing *actual* trends although their efforts to 'design a desirable future' appear to be without bounds.

Lindsay proposes some rules of thumb which should help to separate the viable and useful predictions from the wild claims and self-inflicted blindness of developers and futurists. These rules amount to something like 'compiled hindsight'.

For example, the larger the proportion of the human population that can perform a given activity, the less likely it is that computer will take it over. This is related to the degree of expertise needed and its availability in the population – thus expert systems are advancing very fast (see special issue on expert systems, *HSM* 4(4)). This rule must be accompanied by another one: analytic skills will be automated earlier than synthetic skills (so that we would not predict that writing novels will be computerized before reading novels).

Another Lindsay rule is that thought is easier than action and that problem-solving skills will prove more easily accessible to computerization than the perceptual motor coordination and delicate controlled movements. Of course affectual 'skills' will be simulated long after cognition and motor skills. AI simply is not hot on trail of developing sentient, emotional beings.

We might also add that very cheap (costwise) skills will initially not be computerized.

Lindsay concludes with seven or so 'sure bets' which should emerge in the relatively short run: expert systems, word processing, teaching machines, quality assurance systems, mathematical proofs checking, automatic software testing, automated scanning of the print media for key ideas, and symbiotic couplings of man and machine (human systems).

Among those 'unlikely to succeed' in the near future are natural language interactions, knowledge systems on purely human experiences, non-interactive decision-making systems, creative and innovative systems, and culture-based human knowledge (like expert systems in diplomacy).

Artificial intelligence should not be confused with artificial thought, understanding and mind – none of it is possible in machines, only *simulation* of intelligence. We should speak of 'as-if-intelligence' or keep it 'artificial', i.e. non-human albeit human-designed intelligence. It is quite remarkable that some proponents of AI still are limited by the artificial simulation of the natural rather than developing the artificial without such self-imposed limits – beyond the natural abilities of humans. Such a noble, unambiguous and undisputable task should be the real domain of the *artificial* intelligence. Can we create artificial intelligence that would surpass rather than approach natural intelligence? Artificial intelligence that could do things which humans never could or would, 'think' thoughts that they perhaps never will. By artificial intelligence we mean the one that is *truly artificial* and not ashamed and uncertain about this attribute. How far away are we from that advancement?

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Mowshowitz's 'Social relations of computers'

Abbe Mowshowitz from The City College of New York has been concerned about the social impacts of computers and information technology over the past decade.

First, Mowshowitz describes 'computopia' which will supposedly bring mankind a higher standard of living, better health care, improved education, higher quality, greater reliability, and lower cost of just about everything. Better quality of life and work for all?

One thing is for sure: in the long run (perhaps not so long) the labor requirements in the factory and in the office are bound to be drastically reduced (perhaps similar to the 24.9 to 4.8 drop in the percentage of the US population engaged in farming during the 1930–1970 period). Thus the employment opportunities in the *traditional* activities will go down but of course *new*, non-traditional activities and types of employment are bound to emerge, as always in the history.

Such emergence of new employments is difficult to see or to conceptualize – we only see those that are *directly* related to computer. Yet, these are the kinds of jobs which are actually going to stop growing first.

Mowshowitz also claims that computers made organizations more rather than less authoritarian. Of course, this outcome, if true, is only temporary as top management more and more has to share its prerogatives – not because of its good will or insight, but because of a sheer and cold necessity in the highly competitive modern world of business.

But computer technology cannot be discussed as something separate and in collision with the society: computer technology is not something apart from society, in fact technology is a form of social relationship itself. Technology and society mutually 'conceive' and determine each other: slavery cannot invent automobiles but one cannot also have slavery when there are automobiles. Similarly, computers are being shaped by society's needs and demands and in return they affect and reshape society itself. Human beings, working in historically defined social settings, have fashioned the computer as an instrument for achieving specific social and economic needs and objectives. Obviously, the impact of such contrivances on the society itself must be far from negligible – it must be much larger than the impact of the automobile. The society changes, profoundly, under the weight of its own product. One cannot manage in a centralized fashion while using a decentralized tool.

Mowshowitz attacks instrumentalism (technology as an instrument to be used as we see fit) and determinism (human choice is embedded in technology itself).

The first makes individual human choice all-powerful, the other makes it practically impotent. The instrumentalist is ignorant of social dynamics while the determinist is overwhelmed by it. Both seem to see technology as hardware/software devices, processes and techniques, not as a social relationship of particular kind.

Mowshowitz especially introduces the cultural dimension of technology, so-called technocultural paradigms. These play their role in determining what decision makers accept as admissible or legitimate. The technocultural paradigms are similar to Kuhnian scientific paradigms, representing a matrix for development and use of technologies. One could add a notion of technological habit which often exhibits extraordinary influences.

One can see how a particular technocultural paradigm dictated that offices were designed even to look as factories and how computers and word processors are changing that into a creative total environment of a new type of work. Actually the whole paradigm of factory (based on extreme division of labor) is breaking down. Another such paradigm, that of computer enhancement of the productivity of service-provider, is shifting toward productivity enhancement of service-consumer.

New understanding of technology is needed: how human needs affect technology development and use? How technology affects and shapes human needs? Mowshowitz takes us a step in that direction.

Minsky's 'remotely-manned economy'

Marvin Minsky was co-founder of the Artificial Intelligence Project and is a former President of the American Association for Artificial Intelligence. Here he is concerned with improving the technology of remote control and its impacts on society. These mechanical hands or artificial manipulators are already becoming quite common in robotics; Minsky extends his thoughts on the

next 20 years of remote control devices.

Minsky calls them 'telepresence' instruments, allowing us to do different jobs in different places – they feel and work like our own hands, and they can be telecommuted. Major areas of benefit, Minsky suggests, are nuclear power generation and waste processing, land and sea mining, space stations construction, all manufacturing, health and safety, transportation, and so on.

Telepresence machines are special kinds of robots programmed in special ways: directly by human actions. Minsky actually proposes a large-scale research and development program for telepresence technology, together with annual budgets and year-by-year schedules.

Major problems with telepresence are currently the clumsiness of mechanical hands (they cannot use a pair of pliers), sensory limitations (no feel), low reliability, and inadequate control systems. All of these can be overcome according to Minsky. Interestingly, an extension of ARPANET is proposed as the Project Network: computer network communication is an integral part of the project: quite a distance from the organization of Manhattan Project for sure.

Minsky rightly explores the notion of telecommuting as intimately related to telepresence issues. He believes that generally the need to travel to work, especially by mass transit, will drop significantly. One argument is that people may not want to stay at home because of the socialization functions of the workplace (playing bridge after or in between). The current workplace must be the worst possible place ever designed by man for social functions, yet it is precisely this 'function' that is being more and more (and seriously) emphasized. Minsky suggests establishing 'work clubs' for those in need.

What is the dark side of telepresence technology? Will the workers perhaps feel alienated? Would it increase unemployment? Well, Minsky seems to understand that we cannot compare future ways with old values. Unemployment itself is undergoing value change in terms of its perception. Young people do not wish to be bound to any single employer, occupation, or even culture. They do not see anything wrong with working from home and three days a week, intermittently. They do not see as attractive being a unionized employee of a large hierarchical auto-assembly plant with little automation, being hauled back and forth by inhuman mass transit systems, torn away from their homes and children for the larger part of their lives, being forced to live and love at the places of their work, etc. Yet, many of the older generation do not seem to have anything better to offer than the uninformed and panicky criticism of high technology. According to Minsky: 'We must try to help those who want to live in the old ways to have their chance, while those who want the new gifts should also have theirs'. There is more of the younger ones than of the older ones for sure. Therefore there is hope.

We should add, as an advice to anti-technologists: Don't design the future for others, especially if you cannot take the responsibility of living in it.

Nilsson's 'AI, employment, and income'

Nils J. Nilsson is the Director of the AI Center at Stanford Research Institute (SRI) International where he has been since 1961. Originally researcher in radar signal detection, he analyzes here the effects of AI on employment and the distribution of income (economists do *not* do such things for AI).

Nilsson also grapples with the problem of Minsky (in this *HSM* issue) that there are some people who would rather work than stay home, use mass transit rather than stay home, and socialize at work rather than at home, and so they are against high technology. Actually, that's what Nilsson is talking about: the impacts of high technology, not just of AI.

Nilsson concludes that AI does offer the potential for achieving substantial reductions in the amount of human labor needed to produce the world's goods and services. Is such paradise-like blessing going to become reality? Or is it to stay just a potential due to the actions of some older but powerful 'old ways' proponents and anti-Keynesians (was it not Keynes who said that the economic problem is *not* the permanent problem of human race?).

'There is no historical evidence that rapid productivity growth leads to loss of jobs' is Nilsson's early quote from Albus. Actually, the US agriculture today employes only 3% of the labor force – all other jobs have been lost in *that* sector. But manufacturing expanded, then services, and now it is the self-service activities which are expanding.

Overall, there are more jobs than ever before. Actually, there is a smaller number of jobs (higher unemployment) in the countries where there is little automation: automation does not cause unemployment, although it causes shifts in employment.

But, more importantly, there are many forms of working and 'working on the railroad' is not the only one or even the most desirable one.

What we are observing is the spread of automation into *all* areas of human activities, including the so-called human services. Under such conditions the traditional concepts of work, leisure and employment do not hold true and are not useful anymore. An increasing part of work income is spent on commuting, day-care for children, automobile insurance, taxes, overinflated services, government and military. Many of these costs would not be necessary if people were allowed to work out of their homes and in a self-service mode. That would stimulate the industry to develop and produce self-service friendly technologies which are currently still hesitant and lagging. Yet, deriving income from capital investments rather than from labor could become a reality for families as they would become new and essential economic units.

The differences between work and leisure are becoming more and more ambiguous: self-service activities, which do not have a proper place in traditional economics, are neither. They represent a new kind of socio-economic activity of man, based on diffused private ownership of appropriate 'home' capital. Then, being self-sufficient in most respects, needing only a fraction of time to be devoted to do work for wages, and generally developing Home as the essential economic productive unit – does not amount to unemployment. Employment (working for others) is not its natural opposite anymore. 'Earning a living' is becoming culturally ingrained rather than an economically forced phenomenon. The more one earns, the more 'living' costs, and the more one must earn. High technology is helping to break this vicious, inhuman cycle. If we can allow machines to do the drudgery for us, if we can gather the courage to stay at home and do things for ourselves rather than buying them in the market, then 'friendship could become a living art again'. The problem lies in the transition and it is the transition that has to be managed. Yet, one has to understand that transition means from something to something else and one has to know what this 'else' is before the transition to it can be managed to the benefit of all.

We cannot allow the dreams and hopes of mankind to become liberated from drudgery and toil, the eternal quest to liberate man from the limits of productive capacity, to be slowed down just when we are at the threshold of being allowed to live, for the first time in history, as human beings should: with dignity, self-reliance, self-realization, and the pursuit of ever-expanding human interests.

Mulsant and Servan-Schreiber's 'New paradigm of health care'

The two medical students from the faculty of medicine of the University Laval are making their case how computer technology can lead not to dehumanization of medicine but to its rehumanization. Medical management is becoming completely transformed: the shift of primary responsibility from the once-omnipotent doctor to the informed patient–consumer.

Mulsant and Servan-Schreiber represent the new generation of medical doctors, starting their studies in Paris, but transferring to Laval in order to pursue their interests in artificial intelligence. They are more concerned about how patients can help themselves than how doctors can help the patients. This reflects the fundamental shift and transition in the traditional practice of medicine, its values and its concerns.

They attack the old 'memory paradigm' (physicians performing, quite arrogantly, their tasks on the basis of memorized knowledge) which leads to increasing specialization and hyperspecialization. The fragmentation of medical knowledge, dominated by human memory, and arbitrary by definition, is the result. Yet, patients do not specialize. Yet, the human mind cannot deal simultaneously with several variables. Yet, human memory is subject to distortion and should not be trusted. Yet, if each specialist is responsible for 'a single organ', nobody is responsible for the whole patient – except the patient himself.

Although the computer is viewed by some as a threat to the personal nature of the doctor–patient relationship, it may be its salvation. The collection,

storage, and retrieval of medical and demographic data by computers should leave physicians more time to consider the personal aspects of patient's care – in particular, the quality, not just the length, of life.

So, Mulsant and Servan-Schreiber discuss the shift from a memory based medical practice to a health care *system* based on problem-solving, in which patients assume a major role. Patients are not passive objects of manipulation of fragmented specialists, but active and the most natural central units of self-care. Technology is making this natural and most human transition possible. But, of course, as with all things of this nature, a new generation of doctors (like Mulsant and Servan-Schreiber) must emerge and, most importantly, a new generation of patients.

The authors describe a number of expert systems concepts in medicine, among them the first automated knowledge acquisition system RX. For the first time in history, a machine is generating medical knowledge by observing and interpreting input data. The transformation has begun.

A strong leadership is progressively rising among the medical establishment confronted by the triple (financial, human, and legal) crisis of the system, and among young physicians who realize the inadequacy of their training to the medical practice they ought to perform. Sensibly, Mulsant and Servan-Schreiber realize that ultimately the incentive toward change will have to come from the users, the patients.

Alternative systems and modes of health care delivery are emerging and patients, for the first time in history, are realizing that they do have a choice, that *they* are the ultimate decision makers, and that they can demand that their doctors operate not from fragmented memory but from the latest systematic knowledge. Patients realize, that the traditional hospital is not the only (or the best) place for acquiring health care – home is increasingly entering as an alternative (and natural) place. The media and medical establishment are still not cooperating with the patient – but that, too, will pass. Young doctors, like Mulsant and Servan-Schreiber, are their assurance and hope.

Holsapple and Whinston's 'Management support'

Artificial intelligence techniques are entering the context of decision support systems (DSS) and rightly so. The essence of management is decision *making*, not decision analysis, and the making of decisions must be assisted and supported. For that, it is important to learn *how* humans go about making their decisions and then amplify (or de-amplify) their processes. The old-fashioned paradigm of arrogance, presuming to tell how the decisions *should* be made, is obviously too remote from the decision support idea, and actually outdated before having the chance to assert itself.

The older generation still vividly remembers the efforts to assess decision maker's 'utility functions', to dictate 'rational' decisions, to usurp the right of knowing what should be. The discipline of 'management science' (and 'decision analysis' within it) were with us for a few decades – and they did not engender decision support systems. Actually, they did everything in their power to stop the natural evolution of DSS as a new paradigm. *Human Systems Management* is recognizing the fundamental, paradigmatic role of DSS and a special issue is in preparation. In this issue, Holsapple and Whinston are providing its useful preview: it is within the DSS area that we can expect to see the most extensive use of AI techniques in providing management support.

It is quite indicative of the inability to comprehend the emerging needs of management, that some experts are still unable to see how DSS surpasses the traditional MIS, how descriptive models surpass the normative models, and how interaction, rather than calculation, is what modern management requires.

Holsapple and Whinston talk about knowledge sytems, i.e. the knowledge about the decision maker's domain, which underlie the DSS. They distinguish at least seven distinct kinds of application-specific knowledge, not just model knowledge and data used by those models (management science paradigm). This is what DSS represents: a transition to knowledge. One can remember EDP (concerned with data) and MIS (concerned with information); it is only now that we are finally dealing with knowledge, via DSS. The next step is *wisdom*, comparative and selective application of knowledge, via HSM (human systems management). The sequence, EDP → MIS → DSS → HSM, is self-sustaining and self-amplifying, there is no need to worry about its long-term realization.

It is extremely illuminating how Holsapple and Whinston manage to discuss DSS and manage-

ment support without ever referring to any of the 'achievements' of OR/MS (or operational sciences). As if the above described sequence is bypassing these earlier methodological attempts. Where OR/MS proponents still truncate their Weibull distributions and refine their simplex start-up algorithms, the world of expert systems, decision support systems, computer graphics, artificial intelligence, distributed computing, robotics, CAD/CAM, flexible manufacturing systems, stockless production, and so on, seems to be passing them by.