# Information Society And The Intelligent Systems Generation

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*In this overview paper we analyze basic laws and properties of the information society in general, and its introduction in Slovenia. It is claimed that information society initiated the emergence of primitive network intelligence demonstrated through intelligent assistants on the Internet. One of the key reasons for emergence of the new software generation is the growth of the Internet, and the other information overload. The introduction of intelligent systems, and particularly intelligent agents in Slovenia is analyzed. Finally, the EMA employment agent, one of important intelligent agent applications in Central Europe, is described in detail.*

## 1  Introduction

Information society is often seen as another step in the progress of human civilization. We are moving from post-industrial society and economy into information society and information-technology dominated economy. Changes essentially influence the way we work and live. By 2002, it is predicted that over 80 million Europeans will have access to the Internet, and that 5 % of EU gross domestic product will be affected by the use of digital systems. Great trends are expected in the Internet commerce. In 1998, nearly $8 billion sales were generated in USA by around 9 million American households. In comparison, only $1.2 billion were accounted for online shopping in Europe. Europe was and is significantly lagging behind USA. But in 1999, Europe progressed much faster. Forecasts predict that 500.000 e-commerce-related jobs will be created within the next few years. Each year, Web sales to consumers are expected to grow by 70%. This growth is expected to be exponential for a couple of forthcoming years.

The technological basis of the information age is the Internet with its constant growth (Etzioni 1996; http://www.cio.com/WebMaster/metcalfe1.html).
Another important improvement is the emergence of network intelligence that represents a natural step in the computational evolution heading towards more helpful, adaptive and creative programs. These programs are essential for humans because without intelligent assistants we can not cope with information overload.

At the same time, the pace of progress is so quick and unpredictable in details that we can not determine future in any detail. What we can do is to recognize major information society laws (Lewis 1998; Metcalfe 1997) as described in Section 2. These laws are related to electronics, informatics, and the Internet. In Section 3

and 4 we analyze Slovenian introduction of information society and intelligent systems. The first major application of intelligent agents in Slovenia, the EMA employment agent, is described in Section 5.

## 2  Global Information Society

Information society is by definition global, however, its implementation is to a large extend dependent on the GNP of a particular country. Therefore, while the state and the pace of progress depend on each country, the basic information society laws stay valid for the global world.

**Moore's Law** (http://www.whatis.com/mooresla.htm) describes a constant trend in chip properties. The chip capacity doubles in a time span from 1.5 to 2 years depending on the type of particular performance of a chip. The formula is:

$$Performance(new) = Performance(old) * 1.5\ time$$

where "time" is the number of years.

The basic property of the law - the constant exponential growth - remains unchanged over several decades (Moore 1975, Hamilton 1999).

**Metcalfe's Law** (http://www.cuug.ab.ca/~branderr/csce/metcalfe.html) says that the value of a network is proportional to the square of the number of nodes, connected by the network:

$$Value = K * nodes^2$$

In other words, the bigger the net, the square bigger the value. "K" is a constant.

**Sidgemore's Law** determines the growth of traffic over nets. The law says that the traffic doubles every three months:

Traffic(new) = Traffic(old) * $2^{(4\ time)}$

**Andreesen's Law** says that the cost of bandwidth is dropping exponentially and inversely proportional to Sidgemore's law:

Cost(new) = Cost(old) * $1/2^{(4\ time)}$

**Lewis/Flemig's Law** describes the network type of capitalism. It denotes nearly "friction-free economy" in the sense that there is small marginal cost and a huge shelf space. The exponential growth indicates that a genuine new market idea will get awarded by huge profits. But in addition to quick rise, an exponential decline is expected when new, more advanced systems appear on the market.

The equation describing the law is:

MarketShare(time) = $1/(1+ K * B * time)$

where "K" is a constant. The "B" parameter denotes the learning parameter.

**Rules of the thumb:**

**Put on the Internet all your information and information activities.** This law means that it is cheaper to put information and information activities on the Web sooner than later (Petrie et al. 1998). Not only it is indeed cheaper and more cost-effective than when done in a standard way, it is also the only way to go along with competition.

**The cyber-world doubles fortune.** Besides the material world we actually live in, the cyber-copy of our world matures. Since the introduction of the cyber-world in effect tends to double activities and money in circulation, stories of reach youngsters or rich Internet population in the developed countries are well grounded by a general trend. It also guarantees further growth of the developed world despite saturation in other human activities, which are related to classical material world. Another important trend is that our information systems on computers are becoming more and more a cyber-copy of ourselves.

**Side-effect of information society is information overload.** In infosphere we have to cope with more and more information from one month to another in order just to stay competitive. As a consequence, the information overload causes disappearance of free time, it causes the brain overload and decrease in classical human social life.

**Information society demands intensive information knowledge for successful leadership.** It is commonly accepted that there is a huge gap between existing knowledge of top executives, politicians and other leaders, and the desired knowledge for successful managing and leadership (O'Leary 1997). The gap is higher in Europe than in USA, and higher in Slovenia than in EU.

**Information society belongs to all of us.** In a democratic society there are several institutions cooperating in the process of governing and creating strategic directions. Among essential institutions of democratic societies are civil institutions (Borenstein 1998). Information society is by definition a civil society although governmental institutions typically implement it. An example would be Clinton's advocating of information highway or several governmental information society projects in Europe; e.g. Bangemann's reports (http://europa.eu.int/comm/ dg03/speechba.htm). In countries like Slovenia, lacking richness of civil society structures developed in decades of Western democracy, the introduction of Internet is a major inhibitor of faster progress.

**The Internet is the most democratic and free media in the world.** This was legally established with the American Supreme Court decisions about pornography and free speech on the Internet. In the simplest way it can be observed as a fact that pornography (inside "reasonable" limits) is allowed on the Internet and not on TV. It also means that anarchy and even criminal organizations can exploit this freedom, but the freedom of speech is accompanied by the fact that in such a case sooner or later we are going to hear things we don't like. Whatever the case, the Internet is the most democratic media humans ever had. While countries differ in their social and economic order, the Internet enhances democracy and civil society regardless of their previous level.

**The Internet and information society are our hope for the future.** There have been many technological innovations that spurred human progress. For example, we speak of the "iron age" historic period. These days we speak of the "information age" or of the "information society" age. Not only new technology changes the way we live in the technical sense; the changes are essential also in the way society functions (Negroponte 1998). At the same time, the world of computer systems we use is rapidly changing due to the massive introduction of information activities. The trend is towards more user-friendly intelligent systems.

## 3 Slovenia and IS

The introduction of information society and intelligent systems in Slovenia was accompanied with problems of all kinds. Slovenia is one of independent countries that emerged from former Yugoslavia. In those turbulent

transitions, funds for science continued to decrease for at last 5 years. Having in mind that there are only a couple of computer R&D institutions in the country with sufficient critical mass of educated stuff, the introduction of information society looked bleak.

Surprisingly, the progress in turbulent times was faster than anticipated. There might be at least two reasons: first, Slovenia lacked state institutions and by not being burdened by old institutions, new ones could be more up to date. Second, due to the inevitable conflict in the independence days the Internet played substantial role in helping to inform and thus motivate public opinion in the West. The introduction of information society started with the introduction of the Internet at the Jozef Stefan Institute (http://www.ijs.si) as result of a long-term cooperation with the Cern European Laboratory for Particle Physics (www.cern.ch/CERN/Technology/ index.html). Soon, the use spread through universities and schools. The major Internet provider was (and still is) ARNES (http://www.arnes.si/).

After transformation into a market society, the economy trends changed to positive, but several state firms still faced substantial problems. Foreign investitures often bought firms and soon afterwards transformed research departments into production units. As a result, 45% of researchers and developers in the Slovenian R&D sector moved into other sectors.

Universities and research institutions were not as heavily stressed because of transition problems. University stuff even increased while for example the major research institute, the Jozef Stefan Institute with over 900 employees declined to 700.

The initial fast growth of the Internet hosts was slowed down after majority of governmental institutions got connected. Private institutions and individuals followed cautiously. Another important indicator is the number of people earning money through the Internet. While Bill Gates and CEOs of major computer companies dominate the list of world's richest, Slovenian computer professionals seldom appear on the list of nation richest. While in the developed countries an Internet generation of rich youngsters emerges, this phenomenon is substantially less present in Slovenia. Unlike in the developed countries, Slovenian political and partially business leaders often belong to the computer hardly literate generation. As a consequence, the real progress of information society is not as fast as it could be.

Overall, unemployment rate in Slovenia has grown up substantially in the last 10 years, especially in the first transition years. In recent years the unemployment in Slovenia is stable - with 125.000 unemployed and 2.000.000 inhabitants the unemployment rate is close to European average.

On the other hand, Slovenia is currently one of the most perspective candidates for joining the European Union based on political stability and economic parameters. It borders Italy, Austria, Hungary and Croatia (see Figure 1). GNP is roughly 10.000 US $. The number of computer connections to the Internet per capita is close to average in Western Europe. In recent years, all economic trends tend to be positive (with the exception of 7% inflation and growing depth). Even science and research, while not as supported and worshiped as they should be, are facing better times.
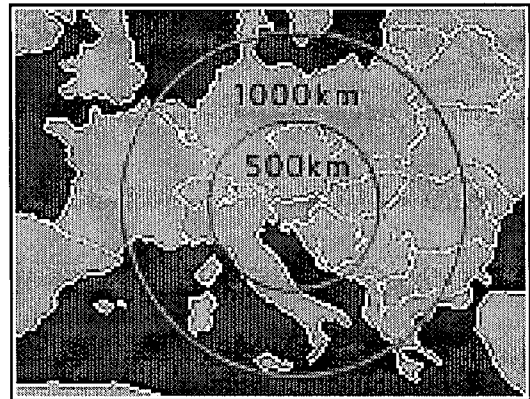


Figure 1: Slovenia's position in Europe.

Today, practically all schools from universities to elementary schools, all research and development institutions, and large majority of other governmental institutions are connected to the Internet. Several R&D conferences are more or less strongly related to the introduction of IS in Slovenia: "Information society" http://ai.ijs.si/is/indexa99.html, "Electronic commerce", Infos, ERK, Informatika etc.

In 1999, the major improvement has been in the mobile phone area. The number of mobile phones is expected to soon overcome the number of classical telephones.

## 4 Intelligent Systems

Intelligent systems are computer systems aimed at developing advanced user-friendly systems that work in real-life environments (Goonatilake, Treleaven 1995; Bielawski, Lewland 1991). The Internet is the media enabling substantial advantages for intelligent systems (Etzioni 1996; Etzioni 1997). Intelligent systems use a wide variety of artificial intelligence techniques typically implemented on top of classical modules (Bratko, Muggleton 1995): rule-based systems, production systems, expert systems, fuzzy logic systems, neural networks, memory-based reasoning. Advanced systems often combine various methods into one hybrid or integrated system (Gams et al., 1996). The emphasis of intelligent systems design is on combination of AI methods and engineering techniques enabling construction of systems performing practical tasks better than classical systems.

Intelligent agents (Bradshaw 1997; Mueller 1996) are a special branch of intelligent systems, capable of learning,

adapting to the environment, to each specific user, and to each specific situation as much as possible. According to Pattie Maes (Maes at al. 1999) intelligent agents are an important step ahead in humanising computers. Intelligent agents represent personal assistants collaborating with the user in the same environment (Maes, 1994; Minsky, 1987; 1991). Intelligent agents are basically intelligent interfaces providing specific utilities of the system while the core of the system is typically an Internet based query or database system. Unlike passive query languages, agents and humans both initiate communications, monitor events and perform tasks. The essential properties of agents are autonomy and sociability (Bradshaw 1997; Jennings, Wooldridge 1995; 1997; Etzioni, Weld 1995).

Intelligent systems have been developed in a couple of SW centers in Slovenia, among others in the Department of intelligent systems (headed by Prof. Ivan Bratko) at the Jozef Stefan institute. One example is an intelligent system for controlling quality of the Sendzimir rolling mill emulsion (Gams et al. 1996). Practically all national production of rolling steel is manufactured through this machine. The application represents one of major national intelligent system in regular industrial use. In addition to this application, the department has in the last ten years designed around 10 intelligent systems now available on the Internet http://turing.ijs.si/Ales/katalog-a/KATALOG-A.html.

## 5   The EMA Employment Agent

In 1993, the first agent was designed in Slovenia - IOI, an Intelligent Operating Interface (Hribovsek 1994; Gams, Hribovsek 1996). The basic task of IOI was correcting typing errors and providing help for users communicating with the VAX/VMS operating systems. IOI is an intelligent agent able to learn, adapt, and communicate in a relatively complex environment with human users. Its most important property is self-learning through observing the user performing tasks in the environment. Later, IOI uses accumulated knowledge through user experience to advise new users. The system thus performs a task similar to MS Office Assistant with the essential difference that knowledge in Assistant is coded in advance while IOI constructs most of its knowledge through user observation.

IOI is implemented as a 2000-line program in Pascal with parts of it written in the VAX/VMS command language. The IOI agent was implemented as a research prototype only, however, its flexibility and adaptability as a personal intelligent agent have shown reasonable improvements over classical systems. The most positive properties as observed by users in the testing period, are: IOI is easy to use, it does not demand specific knowledge, is easy to learn and use, and is very transparent. These favorable properties are typical intelligent-agent properties. Two other major intelligent

agents developed in Slovenia are Personal WebWatcher (Mladenic 1998) and Ema (Gams et al. 1998).

The EMA project (see Figure 2) started seven years ago as an R&D project "An Integrated Information System for Employment in Slovenia" to provide help regarding unemployment problems. The project was partly funded by the Slovenian Ministry of Science and Technology and partly by the Employment Service of Slovenia (ESS). The system consists of two parts; one is applied at the Employment Service of Slovenia (http://www.ess.gov.si/English/elementi-okvirjev/F-Introduction.htm) where one gets basic information about employment activities in Slovenia, about ESS, and about interesting employment functions. The top part of the system is the EMA agent. For the last three years, the system was further developed as part of the INCO-Copernicus Project: 960154, cooperative research in information infrastructure, CRII (http://www-ai.ijs.si/~ema/proj.html). The intelligent system/agent EMA with a natural language interface consists of several modules.
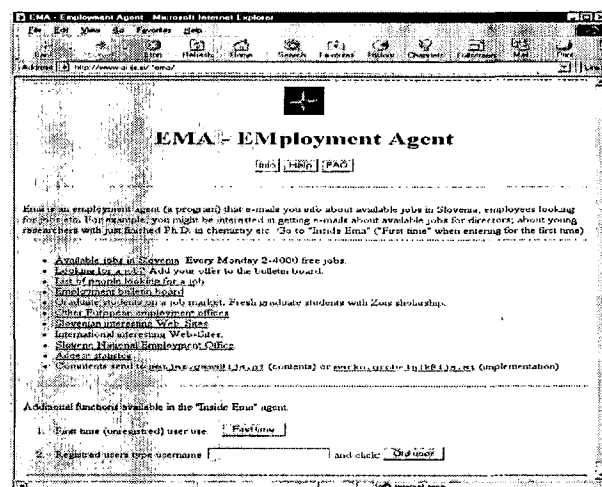


Figure 2: The first version of the EMA employment agent was among the first in the world to offer substantial amount of nationally available jobs on the Internet.

A user has to identify with a username (note that here security is not very relevant) or through a favorite/bookmark list. EMA has four basic functional modules: storing patterns and ordering mails regarding vacant jobs, available workers, it enables storing and observing interesting WEB sites chosen by users, and enables matching jobs and workers. EMA is a "classical" agent providing user-friendly information upon demand or when it notices relevant information for each particular user.

The system is a 15.000 lines program written mainly in C, partially in other languages. Together with text and data it occupies 30 M on a disk.

EMA receives data as limited Slovenian text (with the exception of bulletin boards with language independent

free input) and translates it into English. The translation is based on a dictionary consisting of up to four words observed before in the employment data. New combinations are in the worst case translated as direct word-by-word translation and stored for further overview by humans. Stored combinations are sorted by frequency and translated by humans if reasonable. In addition, the translation system looks into the morphology dictionary to capture different forms of the same words. Finally, a spell-checker submodule corrects spelling errors. The translation is currently not yet at the level performed by systems translating between larger European languages, however, it is sufficiently good to enable understanding since the syntax is quite limited.

In the next stage, the text is transformed into appropriate computer readable forms and HTML forms as outputs. Two speech modules transform the data into speech. The English speech system is based on the Microsoft agents. We have designed our own Slovenian speech module (Sef et al. 1998).

The EMA agent was and still is among most successful applications of intelligent agents in Slovenia. In the first year of its implementation, our country was the third in Europe to offer national employment information through the Internet. At that time, we were the first country in the world to provide over 90% of all nationally available jobs on the Internet.

# 6   Conclusion

Without any doubt human civilization further evolves into information society. We are able to establish certain laws and rules of this development while specific details and further progress remain enigma to all of us. Intelligent systems and agents through the Internet and partially through PCs form the new software generation, the intelligent systems generation. While this generation still lacks true human intelligence and consciousness, the primitive network intelligence emerges consisting of intelligent assistants capable of autonomous and social activities (Munindar 1997; Mylopoulos 1997).

In Slovenia, one of the countries wishing to join European Union, information society is perceived as a global phenomenon and as a major technological field which can bring us fortune or stagnation. The essential question is whether the existing or at least the forthcoming generation of political and business leaders will fully embrace the information-age rules of the game.

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