Paul Baran (1926-2011), Inventor of the Internet, Who Has Made Humanity Communicate,

The Internet Cathedral, Internetization, Infostrada, and Globalization

Andrew Targowski¹,*

*WESTERN MICHIGAN UNIVERSITY, Haworth College of Business, Department of Business Information Systems, President of the International Society for the Comparative Study of Civilizations (2007-2013), Kalamazoo, Michigan 49009, USA

Abstract

The purpose of this investigation is to define the historic roots of the Internet and its implications in the 21st century. The interdisciplinary, civilizational methodology is applied to evaluate the evolution of the Internet. Among findings are; the possible atomic war in 1962 led to the conceptualization (by Paul Baran) and development (as the Internet Cathedral) of the Internet to communicate “a day after.” Later it was split into two nets; Milinet and Internet. Behind the Iron Curtain the similar project led to the launching a pilot INFOSTRADA, later adapted as the Information Superhighway in the U.S. Today, the Internet communicated the whole world. It empowered individuals, organizations and the society. The society is particularly strengthened by the dissemination of negative feedback as “Occupy Wall Street” movement. It has been developing since the Internet triggered Global Economy and allowed for outsourcing jobs to countries with low labor cost. Practical implications suggest that individuals like the Internet but the Western Civilization is losing its leading role in the world due to the activation the Asian societies and taking over Global Economy. Social implications require certain corrections in modus operandi of the Societies, depending too much upon the Internet. Since people communicate more but having less to say. The findings of this investigation are original and go beyond of a traditional approach to research of the Internet.

© 2012 Published by Elsevier Ltd. Selection and/or peer review under responsibility of CENTERIS/SCIKA - Association for Promotion and Dissemination of Scientific Knowledge Open access under CC BY-NC-ND license.

* Corresponding author. Tel.: +0-000-000-0000 ; fax: +0-000-000-0000 .
E-mail address: andrew.targowski@wmich.edu
1. Introduction

On 27 October, 2011, Paul Baran was inducted the Pantheon of Polish Inventors and Discoverers. This Pantheon bears the names of Nicolaus Copernicus and Ignacy Łukasiewicz, the earliest and the most famous Polish inventors. Paul or Pawel† Baran is a great successor to these world discoverers and pioneers in the development of modern civilization.

Thanks to him and the new method, the Age of Science was triggered (XVII-XVIII), whose foundations were subsequently laid by Johannes Kepler (1571-1630), Gottfried Leibnitz (1646-1716), Isaac Newton (1642-1772), James Watt (engineer, 1736-1819), Charles-August de Coulomb (1736-1806), G.W.F. Hegel (1770-1831), Charles Darwin (1809-1889), Louis Pasteur (1822-1895), Ignacy Łukasiewicz (chemist, 1822-1882), Maria Skłodowska-Curie (1867-1934) and others. Following these inventions and discoveries, the Industrial Revolution followed (19th century) and, thanks to that civilizational process, we – humans – have been enriched by the engine, aeroplane, computer, microscope, medications, and the Internet.

We live better and longer lives, on average 2 to 3 times longer than our ancestors used to live 1000 years ago, when Poland was established (A.D.966.

2. Polish Roots of Paul Baran (from the U.S)

Paul Baran was born on 29 April, 1926 in the Polish city of Grodno (he died on 26 March, 2011 in Palo Alto, California at the age of 84). Grodno is a city created in the 10th century, where the summer palace of the king (Fig.1) had was located in the 15th and 17th centuries. The little Paul had several siblings, and each was born in the same house, but in another country.

Fig. 1. The summer palace of the King's of the Polish-Lithuanian Commonwealth, Grodno, in the 15th and 16th centuries, where King Stefan Batory stayed; Paul Baran was born in this city in 1926.

†. It the Polish equivalent of the English name Paul.
Grodno is a city located on the so-called Polish Eastern frontiers, where Polish peaceful multiculturalism was born within the Polish society‡. Poland of the 1920s was in a serious economic crisis; therefore, in 1928 the Baran family emigrated from Poland in search of a life deprived of hunger, unfortunately, jumping out of "fire onto a frying pan," because in 1929 the United States was swayed by the Great Depression. Young Pauli became Paul, and his youth was spent at the grocery store helping parents who were selling Polish sausage and the like Polish delicacies in the city of Philadelphia.

3. Paul Baran - as an Engineer

Paul Baran graduated as an electrical engineer from Drexel University (1949), Philadelphia. Then as a young engineer he took his first job at Eckert Mauchly Computer Company, where he worked on the first models of computers for the pioneering computer corporation UNIVAC. It was a very good experience for him, since in 1946 J. Presper Eckert and John Mauchly built the first American ENIAC computer at the Moore Electrical Engineering School of the superb University of Pennsylvania, Philadelphia. Needless to say, the computer UNIVAC I was the first commercial computer in the U.S. The City of Philadelphia is probably an important place here as this was where the young Baran was involved in design together with the most prominent pioneers of the American computers. In 1955, Paul Baran, married Evelyn Murphy and moved to Los Angeles where he worked for Hughes Aircraft in the field of radar systems. In the evenings he did the graduate program at the University of California, Los Angeles. He graduated in 1959, and wrote a thesis in the field of digital recognition of written characters.

4. Baran’s Proposal for a Day After in Case of a Nuclear Attack

In 1959, having just been conferred the title of Master of Engineering, Paul Baran took a job at the RAND research center (from the Research ANd Development) of the United States Air Force in Santa Monica, in a distant suburb of Los Angeles. His first project concerned the telecommunications system that could survive a nuclear attack.

In 1958, Nikita Khrushchev became an energetic prime minister, and in 1959 Fidel Castro won in Cuba. Meanwhile the U.S. tested the hydrogen bomb in the Bikini Islands, which was conceptualized by a Pole, Stanislaw Ulam, an immigrant from the famous Polish school of mathematics in Lvov. No wonder that at RAND, (since 1959) Paul Baran was working on the "indestructible" telecommunications system, which should work the day after a nuclear attack to ensure the integrity of the state of the United States. It was found that the previously used system of High Frequency (HF-High Frequency) would not survive the attack. Baran decided to improve radio communications on long waves (AM). He showed that the distributed system based on magnetic relays (then used), could survive the attack because it had a good redundant topology. His new topology was tested with positive results in the air base near the city of Rome in upstate New York. Baran published the results of this RAND project in 1964.

‡. Research on this topic was conducted by Maria Barbara Topolska (2009).
5. The 1962 Cuban Missile Crisis is Answered by Paul Baran

The military confrontation between the West and the East took on a new, more aggressive turn, when in the summer of 1961, the United States began to test the Soviet Union over a divided Berlin. In the same year the Soviet Union managed to construct the Berlin Wall. In 1961, the unfortunate landing of some patriotic Cuban expatriates took place in Cuba. In response, to protect the Communist regime on the Island, the Soviet Union began installing medium-range missile launchers in Cuba in 1962 and sent 10,000 Soviet military advisers to this island. In this way the Cuban crisis began, which continues to this day (2011).

In the U.S. it was realized that it could lead to a nuclear war and one must prepare the country to operate on the "day after." Therefore, RAND was commissioned to design such a telecommunication system which, despite the destruction of the country, would be able to function and afford communication among people and authorities. This task was partially assigned in 1961 – 1962 to Paul Baran, who since 1959 had worked at the Center on systems that would demonstrate a high probability of surviving a nuclear attack.

P. Baran asked himself the question: "What is the minimum requirement for a telecommunications system, which could survive nuclear attack?" He calculated that the U.S. radio network for long-wave (AM) might transmit messages if at each node a digital logic system was installed that would control the 'traveling' message, which must be able to find an address of the destination. Military leaders said that this network did not have enough bandwidth. Therefore, P. Baran developed the following principles of self-directed messaging within a telecommunications network (Baran 2003):

1. The network cannot be centralized.
2. Each network node must have at least two adjacent nodes.
3. The network must have a surplus of nodes (redundancy), ex., each node should be associated with more nodes than are needed.
4. Messages should be organized in separate packages (ex. the electronic envelope).
5. Messages should be digital rather than analog.

Baran principle that the network cannot be centralized is based on the structure of the human brain. This idea was given to him by a neurosurgeon at MIT, who told him "If you cut off a piece of the human brain, another part takes over the functions that have been cut off." "The brain is simply a distributed network of interconnected neurons."3 Hence, are the roots of the solution to organize messages into packets (digital envelopes) which contain addresses and know how to travel through the network, as self-guided. The Inventor has developed a fast algorithm for the storage and transmission (store-and-forward) of packets through the distributed network. Such a network has no central point, thus consists of quasi-autonomous sub-networks, which operate independently from other sub-networks that were destroyed or damaged.

The former U.S. telecommunications network resembled a radial pattern of streets in Paris, while the Internet is like the street grid of Manhattan, downtown New York. It is worth mentioning that the radial arrangement of Paris was specifically designed in the period of 1852-1870 by the Chief of Police George-Eugene Haussmann, so that the police could easily suppress the manifestations of people, which since the French Revolution (1789) had (have?) been the nightmare of the French authorities.
Baran’s concept was accepted as ARPANET [Advanced Research Projects Agency, (ARPA)] by the Department of Defense in the 1960s. In the autumn of 1969, SDS Sigma 7 computer at the University of California, Los Angeles, was the first node IMP (Interface Message Processor) of the ARPANET, thanks to Leonard Kleinrock. Then the SDS 940 computer with a hypertext at Stanford University, designed by Doug Engelbert had been connected as the second node. The IBM 360/75 computer was another node at the University of California, Santa Barbara. The University of Utah then plugged its computer DEC PDP-10 to the ARPANET.

On 6 December 1969, all nodes were connected to one another. The first message was sent by Charley Kline, a student of prof. L. Kleinrock’s at UCLA, on 29 October, 1969 at 10:30 PM. In this way, the concept of packet network was tested in practice.

6. The Internet Cathedral

In 1972 P. Baran founded a private company CableData Associate, which was to consult the ARPA and its ARPANET. In the same year, P. Baran recommended that the Department of Defense split the ARPANET into two nets; the MILINET (for military), and INTERNET for civilian purposes. His recommendation was accepted, but it was put into practice only in a few years – in 1983.
The Internet was created like a cathedral - in contrast to the churches. A cathedral, is usually built by several successions of parish priests, and sometimes over decades or even hundreds of years, as the famous Basilica of the Holy Family was initiated by the architect Antonio Gaudi in 1882, and yet was not finished until 1926, when the architect died. According to the estimates in 2010, its construction had reached 50 percent of completion (?). The development of the Internet was a contribution by dozens of Internet pioneers who were adding new layers to the latest solution.

This process of developing the Internet is illustrated on a model in Figure 4. The Internet was conceived by Paul Baran as a communication system in the event of a nuclear war, which would keep the United States functioning. Over time, the Internet has become a universal system of instant info-communication among people on Earth.

7. Approach to Communicating Behind the Iron Curtain in Poland

It is worth noting that the Americans designed the ARPANET network for a military (secret) purpose. It was not until several years later that this network - the Internet as a civilian network – emerged. But we in Poland planned to launch a universal data network - INFOSTRADA, where users would be citizens and workers of organizations.

In 1972, it was very difficult to push forward the development of INFOSTRADA in Poland’s totalitarian
system of governance. Despite this obstacle, the National Bureau of Informatics (Krajowe Biuro Informatyki-KBI) managed to sign the agreement with the Ministry of Communications to launch in 1975 the first three nodes of INFOSTRADA as the diameter of Gdańsk - Warsaw - Katowice. An American corporation Singer contributed $1 million dollars to be allowed to gain some experience from this Polish experiment. The company sensed that Poland had a good idea and wanted to possibly use it in the U.S. The Singer Company mentioned INFOSTRADA in the Computer Weekly, as a result of which Mexico's Presidential Office turned to the KBI for additional information. Ever since, INFOSTRADA aroused considerable interest in the world, because it was of civil nature, providing info-communication services for the citizens and civilian organizations.

INFOSTRADA would lead to the development of an informed rather than information society, which is the goal of many countries of Western Civilization in the 21st century (Targowski 2001). But, the Communist authorities feared losing control over the information flow within the society. Some academics, collaborative with the regime, criticized the network as allegedly "not optimized" and "ineffective." It was done on purpose to impose censorship on it; its name was then changed to KASTOR (resembling motor oil rather than a communications network). Soon the authorities stated that since there were no users of INFOSTRADA, network must be closed. And it was closed.

Fig. 5. The Polish Universal INFOSTRADA network (The Targowski Model, 1972)

The Polish communist authorities quickly got to realize the type of political danger of INFOSTRADA network, and in this respect were far ahead of the contemporary China and other dictatorships that are censoring the Internet today in the early 21st century.

After all, the Polish Communist dictatorship collapsed in 1989, when the volume of underground press
(information) exceeded the volume of the official press and the Solidarity movement was well informed about the events in Poland and abroad. Perhaps the process of INFOSTRADA’s operations would only accelerate the erosion of the Polish communistic regime.

Despite the passage of 39 years of the INFOSTRADA initiative, Poland does not yet have a similar network. Since the Internet is not an accurate replacement of that network. But it is not the right place to continue this kind of discussion.

8. Effects of the Internetization and Technopoly

The universal Internetization in the 21st century (the value of Paul Baran’s invention) is spectacular and in fact enjoys a great appreciation by most of its users as a remedy for all socio-economic diseases? And indeed, the model of the Internetization, depicted in Figure 7 shows a number of benefits, but it also contains many disadvantages.

![Fig. 6. Advantages and disadvantages of the Internetization in the 21st century](image-url)
The advantages include the following:

- Empowers users,
- Empowers organizations,
- Empowers global business,
- Empowers the society in reacting to negative issues.

Some disadvantages, in developed nations, include:

- Increased unemployment, caused by the outsourcing of manufacturing,
- Decreased income of the middle class,
- Triggers economic crisis due to the above-mentioned causes,
- Prompts political crisis due to the above-mentioned causes,
- Activates civic unrest, due to the above-mentioned causes.

It can be concluded with a high degree of rational intuition that the Internetization has led the Western Civilization to its fall and a transformation into a Global Civilization, which is mostly beneficial for developing countries and disadvantageous for developed ones. However, the “99%” of the population of the developed countries do not agree with this state of affairs. That leads to riots, and possibly to a social revolution (“Occupy Wall Street”), by way of which the kind of democracy and capitalism that we now know and practice today will be corrected?

Perhaps we shall soon see whether this correction is positive, and therefore whether the Internet as the main perpetrator is the positive macro-scale technopoly (Postman 1992), into which it has placed mankind?

9. **Paul Baran, as a Great Inventor, Who Had a Great Opportunity and Used it Well**

Paul Baran’s Awards:

- IEEE Alexander Graham Bell Medal (1990)
- Marconi Prize (1991)
- Bower Award and Prize for Achievement in Science (2001)
- Fellow of the American Academy of Arts and Sciences (2003)
- National Inventors Hall of Fame
- National Medal of Technology and Innovation (2007)
- UCLA Engineering Alumnus of the Year (2009)

Paul Baran always emphasized his Polish roots. The undersigned had the honor to attend the ceremony of him being awarded the Medal of the American-Polish Engineering Association in Detroit in 2003. Then we both exchanged remarks about his work on the Internet, and over my INFOSTRADA in Poland.
Fig. 7. Paul Baran - Internet pioneer is decorated with the National Medal of Technology by President George W. Bush (10 August 2008).

The Internet concept of P. Baran is next to the invention of the airplane and computer engineering concepts as the most important ones in the 20th century. Poles have always "manipulated" somewhat with our planet. First, Nicolaus Copernicus changed the view on the rules of its turnover. Being a priest, he fought against the Church’s dogma of the centrality of the Earth. 500 years after him, Paul Baran made the Earth a "common" planet of all people.

Fig. 8. Andrew Targowski (INFOSTRADA 1972 and Paul Baran (Internet 1962) in Detroit in 2003

10. CONCLUSION

1. The invention of the Internet in 1962 and recommendation to make it accessible (by Paul Baran) for the public (1972-1983) triggered the Global Civilization and changed how humans communicate. This invention can be compared to the invention of print in the 15th century, which triggered the development of knowledge and modern world.
2. The consequences of the invention of the Internet should be also very profound as print’s benefits but it is too soon to say whether some negatives can be profound as well.
3. It is possible to perceive the world-wide one civilization (integrated by the Internet) but “unlikely soon and undesirable? Since the cultural diversity is wonderful asset of humanity” (Blaha 2012).
4. A model of the Internetization should be further investigated how to apply the Internet wisely at the enterprise level.

References