



Concluding Remarks at the recent Podgorica Conference

Ivo Šlaus

Dean, Dag Hammarskjöld University College of International Relations and Diplomacy;
Honorary President, The World Academy of Art and Science

Global scientific output doubles in about 9 years,¹ which means that the rate is now five times larger than it was at the time of Newton, Faraday, Einstein and Bohr. Comparing total scientific output with progress in only one discipline—physics, is not correct. The end of science² has been claimed: there are no major breakthroughs beyond quantum physics and general theory of relativity, and theory of evolution. However, less than two decades ago when physicists were concerned with The Standard Model and the Higgs boson, measurement using ESA satellite Planck demonstrated³ that our universe is composed of dark energy (68.3%), dark matter (26.8%) and only 4.9% of ordinary matter. And we still do not understand either dark energy or dark matter. Now, major progress is witnessed in all scientific disciplines. New inter-disciplines are emerging: synthetic biology, artificial intelligence and nano-sciences, as well as new materials—not discovered, but new, genuinely new. Is it necessary to invert Hamlet's words that "There are more things in heaven and in the earth, my Horatio, than are dreamt of in your philosophy" or are there "new materials" in one of parallel worlds of multiverses, which we are somehow imbedded in and/or connected with?

"It is estimated that the increase in our current technological ability will increase more than 500 times in the next ten years."

This article will focus only on two issues: artificial intelligence and beyond biology.

Moore's law* is the observation that a number of transistors in an integrated circuit doubles about every two years. Many studies in ICT show that performance in relation to price doubles every 18 months. It is estimated that the increase in our current technological ability will increase more than 500 times in the next ten years. The future technology will come faster than expected. It is likely that at some point in time—not too distant—machines will be smarter than humans, that which is referred to as technological singularity.⁴ Kurzweil anticipates humans merging with machines,⁵ whatever it means! Diamandis considers the

* Moore, G.E. (1965). Cramming more components onto integrated circuits. *Electronics*, pp. 114–117, April 19, 1965. The Economist, March 12, 2016: The Future of Computing: "In 1971 the fastest car was capable of 280km/h and the tallest building—The New York Twins had 415m. Intel launched first commercial microprocessor, the 4004 containing 2,300 transistors. A modern Intel Skylake processor contains 1.75 billion transistors. If cars and building would "improve at that rate, the car could make run at 0.1 speed of light and buildings would reach half the way to the Moon. Today 3 billion people carry smartphones, more than those having access to adequate sanitation. Improvement in computer hard work came to an end. The future of computing improvement is in three other areas: i) software e.g. AlphaGo program playing the ancient game of Go defeated the world champion (there are more possible board positions in the game of Go than there are particles in the universe [it is estimated that the total number of particles in the observable universe is 10⁸⁰]). To prevail AlphaGo relies on "deeplearning" technology modeled on the way the human brain works, ii) cloud, the network of data centers and iii) new computing architecture—specialized chips optimized for particular jobs.

future of unimaginable abundance.⁶ Consequently, economy is rapidly changing. Classical industrial production will be unnecessary, since the advanced 3-dimensional printing will allow printing of complex products at home, so most of the distribution channels from a factory in the land with cheap labor to the supermarket store will not be necessary. Now 4D printing is coming: products that will be able to modify themselves in time. The most important component will be the algorithm for printing. Similarly, machines would perform other daily tasks, and their performance would depend on the algorithms. Today the classical software industry amounts to about \$500 billion (about 0.5% of global GDP) and is growing at about 2%, faster than the rest of the economy.⁷ Almost all areas of human activity will need intelligent algorithms that will control machines. Methods of artificial intelligence and other advanced machine learning tools are already used in many areas of life, and their applications are expanding rapidly. Significant paradigm changes in computing are forthcoming and the most promising seems to be the so-called quantum adiabatic computing. An example of a 1000-bit quantum computer based on quantum annealing was developed by D-Wave Systems.⁸

Chimera, part human-part animal beings, existed in folklore and fiction. Now they are a reality. Chimerism within a species occurs naturally in nearly all animals. Inter-specific chimeras rarely exist in nature due to the unlikelihood of specific conditions required. In 1989, scientists at the University of California, Davis breached this barrier and created the first artificial chimera, a sheep-goat hybrid dubbed the “geep”. Such research into chimeras elicited little public attention and outcry until August 2003, when Hui Zhen Sheng at the Shanghai Second Medical University created the first human-nonhuman chimera. Sheng and his team removed the genetic material from some of the cells in a rabbit embryo and inserted human DNA, creating a human-rabbit chimera.⁹ J. Craig Venter Institute transformed one kind of bacteria into another—a completely synthetic organism was created.¹⁰ Biological research and these results prompted Lord Martin Rees to bet: “By year 2020 an instance of bio-error or bio-terror will have killed one million people.” (Unfortunately, laboratory accidents happen much more frequently than the public knows! Take the case of the Bio-error in Sverdlovsk in 1979!)

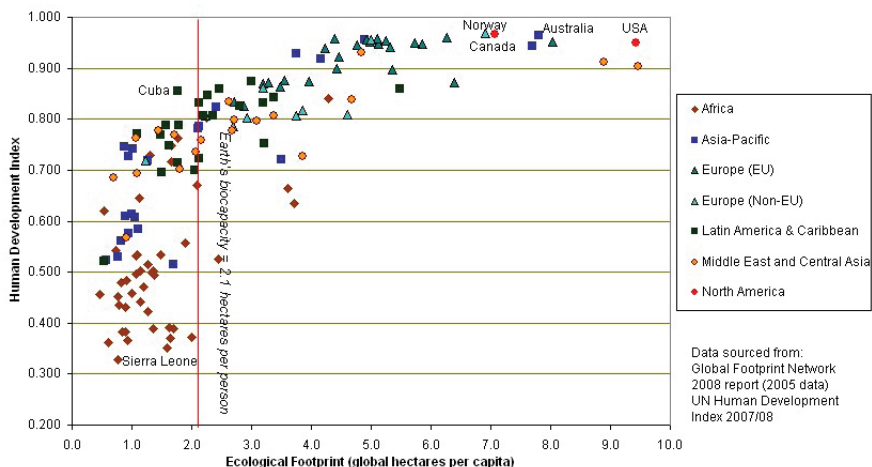
Most technologies have dual-use, many can be misused, many have been and are misused, weapons and Technologies of Mass Destruction for example, and Alexander Likhotal stresses that it is not science but ignorance that is responsible for misuse of science and technology.¹¹

The new economy is an algorithm economy with sustainable abundance comprising new materials and new processes and therefore, the development of quantum algorithms and synthetic biology will have to be addressed requiring an educational paradigm change from a culture of standardization to a culture of creativity.¹² While most schools prefer logical intelligence, many young people are abundant in other types of intelligence, the significance of which is often lost on schools. This challenge will magnify as we approach the singularity, because creativity will become more important. The nature of scientific progress does not allow predicting specific discoveries, so it is difficult to direct educational systems towards specific knowledge and skills that would be necessary in the near future. In spite of this uncertainty, it is obvious that a more creative individual will have a comparative advantage in a more advanced society. Also, it is important that each person has a chance for a creative contribution to society, which is useful both to the total economic output as well as for the

psychological wellbeing of that person.* One can truly conclude that our contemporary society is characterized by knowledge explosion.¹³

The opening sentence from *The Tale of Two Cities* is “It was the best of times, it was the worst of times” describes our contemporary world: it is the best ever: our knowledge—possibly our understanding—tremendously increased, life expectancy increased, quality of life is higher than ever, but our contemporary world is not sustainable, it is self-destructing: natural and human capitals are being destroyed at a fast rate. Wars and violence, as well as chaotic migration are destroying human and also natural capital. Though significant results have been achieved such as the end of colonialism, the end of the Cold War,¹⁴ and many successful international treaties, we are still faced with 20,000 nuclear missiles most at hair trigger alert, with chemical and biological weapons of mass destruction, terrorism, chaotic migrations[†] and blatant violation of international laws.

Figure 1: Human Welfare & Ecological Footprints Compared



Source: Vancouver, Canada: School of Community and Regional Planning. The University of British Columbia. OCLC 41839429.

Climate change already has huge negative consequences and it could be worse if unchecked.¹⁵ Ecological footprint is 50% larger than our Earth can tolerate[‡] (the stupidity of our contemporary development is best shown in the Fig above—a bare 10% improvement in HDI causes a factor 3 deterioration in ecological footprint) and while humans forgive sometimes,

* A. Zidanšek and I. Šlaus, see SDEWES conference, Piran, June 2016

† Knoema; Forcibly displaced people worldwide (May 23, 2016): it is estimated that over 30 million persons are displaced, twice as many than less than ten years ago!

‡ Rees, W. E. (October 1992). “Ecological footprints and appropriated carrying capacity: what urban economics leaves out”. *Environment and Urbanisation* 4 (2): 121. doi:10.1177/095624789200400212; Rees, W. E. and M. Wackernagel (1994) Ecological footprints and appropriated carrying capacity: Measuring the natural capital requirements of the human economy, in Jansson, A. et al., Investing in Natural Capital: The Ecological Economics Approach to Sustainability. Washington D.C.:Island Press; Wackernagel, M. (1994). *Ecological Footprint and Appropriated Carrying Capacity: A Tool for Planning Toward Sustainability* (PDF) (PhD thesis). Vancouver, Canada: School of Community and Regional Planning. The University of British Columbia. OCLC 41839429.

and God always, Nature never forgives.* Though humans should endeavor in colonizing space, it is important to appreciate that the colonization of space is a much more difficult task than the departure from Eastern Africa was for our forefathers. Earth is our home, as beautifully emphasized in “Laudato si, mi Signor”, Pope Francis Encyclica[†] presented by Chancellor Archbishop Marcelo Sanchez Sorondo.

*“There is no
wealth but life!”*
– John Ruskin

“Building peace and prosperity is a long and slow process and considerable success has been achieved. But it only takes seconds to destroy that peace.”

Human capital, including individual and collective creative capitals, is being destroyed by us, by our current institutions and by our laws, by our ill-conceived self-interests, by our greed and by our prejudices. Th. Pogge estimates¹⁶ that 423 million persons have died of hunger from 1991 till 2013. This is larger than the number estimated by Rummel of persons killed by their own governments in the 20th century, which is about 200 million, or persons killed during WWII. “This economy kills!”[‡] Too many people live in slavery. It is estimated[§] that close to 50 million persons today live in slavery, 30% more than a year ago. Is this a result of the fact that 95% of the gain went to the richest 1% after the world’s recovery from the recent economic crisis?¹⁷ When we hear that children die from hunger and that there are slaves, we tend to push it to some distant, unknown country. Yet, though my own country and Montenegro are among the countries with smallest percentage of slavery, just 0.4% of their respective populations, the figure is still a shocking 17,000 slaves in Croatia! Indeed “This economy kills!” According to Oxfam, 62 individuals control the same wealth as 3.5 billion poorest persons. Inequality is bad for the economy: A recent OECD study showed that enriching the richest instead of increasing the income of the poorest slows down the economy.¹⁸ Various proposals to combat this include: reduction of taxes for the wealthiest[¶] and a universal basic income,^{**} which seem to be good “solutions”. Inequality¹⁹ and unemployment destroy human capital and suffocate economic development.

Addressing crucial issues related to economy, full employment and globalization is the need of the hour. Six years ago, the World Academy of Art and Science initiated research and endeavor toward a new economy based on human dignity and sustainability.²⁰ The striving for the idea of a new economy is much older. One should never forget that Adam Smith was a moral philosopher. Sinking of SS Central America in 1857 prompted John Ruskin to switch to economics. Arguing against Malthus and Ricardo, Ruskin wrote: “The real science of political economy, which has yet to be distinguished from the bastard science, as medicine

* Farmer to Pope Francis

† Pope Francis, *Laudato si*, Encyclical letter, May 24, 2015 and officially published on June 18, 2015

‡ Pope Francis: *Evangelii Gaudium*, Nov 24, 2013

§ Walk Free Foundation, www.walkfree.org

¶ *The Economist*, January 2, 2016, “Be serious”

** *The Economist*, June 4, 2016, “Basically flawed”

from witchcraft, ... is that which teaches nations to desire and labor for thing that leads to life.” And Ruskin concludes, “There is no wealth but life,”²¹ which foretells a recent statement by the UN “People are the true wealth of nations.”²² Putting it in numbers, human and natural capital are for most of the countries much larger than the manufactured capital (we devote so much time to), e.g. for the USA inclusive wealth is over 100 trillion, while manufactured wealth is less than 20 trillion.²³

The 70th anniversary of the UN is marked by two significant results: Transforming Our World: The UN Agenda 2030, also known as Sustainable Development Goals (SDGs)²⁴ unanimously accepted by the UN GA on September 25, 2015 and the Paris Agreement on Climate Change,^{*} actually an important segment of SDGs. Both documents are expressions of core values necessary for survival, for human-based world. We in the World Academy are proud that several years ago, following our work on new economy and full employment as well as our endeavor to abolish war and any form of violence, we initiated an encompassing endeavor: A New Human-based and Humanity-based Paradigm. We realized that the contemporary world has truly dangerous enemies: destruction of natural and human capital—destruction of trust, extremely high unemployment and income inequality—economic, political and above all moral crises. Building peace and prosperity is a long and slow process and considerable success has been achieved. But it only takes seconds to destroy that peace. Let us not forget the words of President D.D. Eisenhower: “Every gun that is made, every warship launched, every rocket fired signifies in the final sense a theft from those who hunger and are not fed, those who are cold and not clothed. This world in arms is not spending money alone. It is spending the sweat of its laborers, the genius of its scientists, the hopes of its children.” The old approach “they” and “us” does not solve anything.²⁵ Our endeavors are just at the very beginning. They do demand more research and much more understanding. It is not the work of one person, not even an organization, or scientific enterprise, not only of the UN. It is a joint endeavor of all of us, all 7 billion, all sovereign countries, scientists throughout the world, scholarly institutions, academies, business, laborers and trade unions. It is gigantic. It is comforting to realize that the pillar of this endeavor is deeply rooted in us—in the Golden Rule, in all major cultures, in our biology and in our history and it is the guarantor of our future.²⁶

Author Contact Information

Email: slaus@irb.hr

Notes

1. R. van Noorden, Nature, Newsblog (May 7, 2014), Lutz Bornmann and R. Mutz, arXiv:1402.4578 (Feb 2014)
2. John Horgan, The End of Science, Facing the Limits of Science in the Twilight of the Scientific Age, New York, Broadway Books (1996)
3. Planck Collaboration: Planck 2015 results XIII: Cosmological Parameters, arXiv:1502.01589, Astronomy and Astrophysics manuscript (February 9, 2015), Joint Analysis of BICEF2/Keck Array and Planck Data, P.A.R. Ade et al, Phys. Rev. Letters 114, 101301 (March 9, 2015)
4. Ulam, Stanislaw (May 1958). “Tribute to John von Neumann”. 64, #3, part 2. Bulletin of the American Mathematical Society. The concept of singularity is traced back to J. von Neumann in 1950s.

* Paris Agreement on Climate Change negotiated by representatives of 195 countries, opened for signature on April 22, 2016, signed by 177 and 15 ratified it. Agreement will enter into force when 55 countries representing at least 55% of GDG emission have formally joined it. The process is expected to be completed by 2020. About ten countries account to about 50% of GHG emission.

5. R. Kurzweil, *The Singularity is Near: When Humans Transcend Biology* (2006), Penguin Books The concept of singularity is traced back to J. von Neumann in 1950s.
6. Diamandis, P.H., Kotler, S., *Abundance: The Future Is Better Than You Think*, Free Press, 2012.
7. Gartner, Press Release, Stamford, Conn., March 31, 2014, see also <http://www.gartner.com/newsroom/id/2696317>.
8. D-Wave, *Quantum Computing: How D-Wave Systems Work*. D-Wave Systems, Inc., 2016, see also <http://www.dwavesys.com/quantum-computing>
9. Ying Chen, ...Hui Zhen Sheng et al, *Cell Research* 13 (2003), 251-263
10. D. Gibson et al, *Science Express*, (May 20, 2010)
11. Alexander Likhotal's recent article in *Eruditio*. Cross reference to it.
12. Robinson, K., *Creative Schools: The Grassroots Revolution That's Transforming Education*, Viking, 2015.
13. Adair J.G., Vohra N., The explosion of knowledge, references, and citations. *Psychology's unique response to a crisis*. *Am Psychol.* 2003 Jan; 58(1): 15-23.
14. Marin Katusa, *Colder War*. Wiley Casey Research (2015)
15. *Climate Change, Synthesis Report 2014*, IPCC, Geneva, Switzerland
16. WHO, Th. Pogge, *Metaphilosophy* 36 (2005) 182; Th. Pogge, *Poverty, Human Rights and the Global Order, Framing the Post-2015 Agenda* (2012); Th. Pogge, *Global Justice Program*, Yale University, www.yale.edu/macmillan/globaljustice/index.html
17. G. Kuo Petravić, *Inequality in our capitalist society*, American Center for International Policy Studies - amcips.org, 2015 (to be published; OXFAM, <https://www.oxfam.org/.../2016.../Davos-62-people-own-same-half-worl...>; www.dw.com/en/oxfam-report-wealth-of...worlds.../a-18985985
18. OECD, *Tous concernés: Pourquoi moins d'inégalités profite à tout*, 2015
19. R. Wilkinson and K. Pickett, *Spirit Level* (2009), Bloomsbury Press
20. O. Giarini, G. Jacobs, B. Lietaer and I. Šlaus, *Cadmus* 1 (2010): 9-27
21. Schumacher Center for a New Economics, David Boyle, *The Birth of the New Economics*, April 20, 2016
22. UNDP, *Human Development report (2010) The Real Wealth of Nations*
23. Sir Partha Dasgupta et al, *Inclusive Wealth Report* (2014), UNU-IHDP, UNEP
24. UN GA, *Transforming Our World, The UN Agenda 2030 for Sustainable Development*, unanimously accepted on September 25, 2015
25. I. Šlaus, H. Gurgulino de Souza, W. Nagan and G. Jacobs, *Our Common Enemies and Our Best Friends*, *Cadmus*, Vol 2, Issue 3 (Oct 2014) iii-iv
26. R. Axelrod and W.D. Hamilton, *The Evolution of Cooperation*, *Science* 211 (March 27, 1981) 1390-96, see also: R.L.Trivers, *The Evolution of Reciprocal Altruism*, *Quarterly Review of Biology* 46 (1971)35-57, J.M. Smith and G. R. Price, *Nature* 246 (1973) 15-18; Lee A. Dugatkin, *The Altruism Equation, Seven Scientists Search for the Origin of Goodness*, Princeton University Press (2006); see also U. Segerstrale, *Nature's Oracle, Life and Work of W.D. Hamilton*, Oxford University Press (2013)