EARTH SYSTEM – ENVIRONMENTAL SCIENCES

The Innovation Biosphere

Planet and Brains in the Digital Era

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Foreword

Innovation Biosphere is a very interesting title for a new book intended to raise thoughts beyond the ordinary. And that is what we need – thoughts beyond the ordinary, and courage to bring disruptions into reality.

Challenges in innovation processes arise from the past, but the future is not its linear extrapolation. Solutions can only be found by considering innovation as a way of daring to seek the unexpected: daring to see beyond the surface of "obvious" solutions, daring to make a real paradigm shift.

This book presents numerous examples of new ways of thinking and their results. I hope that these examples will ignite even more ambitious goals, and target those goals by combining our knowledge across the whole spectrum. Innovation has to make things happen, and very often the real innovation happens in cross-disciplinary approaches, and in mash-up processes where (positive) collisions of ideas and knowledge ignite new solutions.

In that context, courage and curiosity are both needed. To be able to manage the path to the unknown, a good way to proceed is by experimenting, and rapid prototyping in real-world settings with real people. Only then we can see what is having a real impact and what is scalable. That very approach is also, of course, suggesting that many of those experiments and prototypes fail. However, the most important is to fail fast, as then the limited resources can be focused on the more promising approaches and their scale-up.

This book helps us to pose the right questions and to be curious about alternative approaches to the obvious short-term wins. In my view, some of those are: which are the true limitations of our biosphere? Which are the true limitations of ecosystems? How to engage all the stakeholders to a common vision? How to create the safety net in innovation ecosystems for experimenting the new in our seeking for the unexpected?

The rapidly changing technology landscape that we are living in is also very well described in the present book. That landscape, much enabled by modern ICT development, creates possibilities for new types of societal behavior and new value creation processes on both societal and individual levels.

Modern technology which creates, for example, human spare parts, augmented reality and robotization are all very important when painting the picture of our future.

Today, the unemployment problem is an issue in Europe, but, essentially, all work that can be described as well-defined processes can be robotized or automated, sooner or later. The "human work" is something where we are at our best; collaborative work requires creativity. This includes both physical and non-physical work. We are facing a major societal challenge here. For example, which are the new jobs we cannot even imagine yet, and how is the overall work–life equation developing in an inclusive way?

Hence, innovation policy needs to look beyond the obvious questions (and the obvious answers in the short-term) to respond to megatrends. In Europe, we have most of the components for proper innovation systems and their governance in place, but the systemic view should still be reinforced. The innovation pyramid has to be reversed; the users having their say in the solutions to be up-scaled. This, together with the experimentation in real world, is creating the frame for new innovations and disruptive approaches, e.g. Open Innovation 2.0.

Living Labs (or any open innovation ecosystem) interlinked with other same-minded sites can be very powerful drivers for large-scale solutions engaging all stakeholders. Let us use that opportunity better,

interlinking bottom-up approaches with the target to find pan-European solutions and concepts. We in Europe have the unique asset in our diversity and high education level.

I wish all the readers of the book an inspiring time, and hope that they will begin to look beyond the obvious, to make innovation real in their own innovation ecosystems.

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March 2015

Introduction

Our planet Earth is located in the ideal region of the Milky Way galaxy in the solar system. This zone contains just the right concentration of chemicals and other elements needed to support life. The planets' position in the Universe and their movements play a vital role in the Earth's ecology. Ocean tides are caused by the gravitational interaction between the Earth and the Moon. The Earth's perfect tilt and spin causes the annual cycle of seasons, moderates temperatures and allows for a wide range of climate zones. The Earth's path is almost circular, keeping us roughly the same distance from the Sun year-round. The Sun is the perfect "powerhouse" that emits just the right amount of energy. A magnetic field and an atmosphere serve as a dual shield protecting living things from potentially deadly forces emanating from the Sun. The atmosphere, which is a blanket of gases, keeps us breathing and provides additional protection. An outer layer of the atmosphere, called the stratosphere, contains ozone, which absorbs up to 99% of incoming ultraviolet (UV) radiation. The ozone layer helps to protect all forms of life from dangerous radiation. The amount of stratospheric ozone is dynamic, adapting to the intensity of UV radiation rises. The atmosphere also protects us from a daily barrage of debris from space that burn up in the atmosphere. However, the Earth's shields do not block radiation which is essential for life, such as the heat and visible light. The atmosphere even helps distribute the heat around the globe, and at night the atmosphere acts as a blanket, slowing the escape of heat. Natural water, carbon, oxygen and nitrogen cycles replenish and cleanse the planet's air and water supply.

The biosphere is also called the zone of life. According to the National Aeronautics and Space Administration (NASA), it is "the portion of Earth and its atmosphere that can support life". Like the shell of an egg, the biosphere is a very thin layer, or zone, that encompasses our planet.

The biosphere consists of living things and the environment – the atmosphere, the land and the oceans – from which they derive the energy and nutrients needed for life. For instance, plants capture solar energy and use it to convert carbon dioxide, water and minerals into oxygen and food. Humans and animals take in oxygen and food and return carbon dioxide and other matters to the environment. This cycle repeats itself and everything recycles. Thus, the biosphere can sustain life indefinitely. We will use this metaphor for innovation systems acting in harmony with the environment.

Innovation has always been a part of human activity. The main motivations for innovation are the improvement of our life, scientific satisfaction, demonstration of creativity or know-how, invention of new businesses, and becoming rich and famous. However, each new product, technology and process has an impact and consequences on the development of economy, the living and the planet. The first awakening on the state of the planet was raised during the intensive industrial revolution in the 1960s, but nothing was changed.

Within the complex economic context, innovation is considered as a potential answer to the crisis. Facing the economic, social and environmental challenges required a different approach from those that worked well in the past for the industrial era is required. Perhaps it is an effect of crisis, but people are more creative. The European programs since the 1980s have produced a lot of extraordinary projects and results. Nevertheless, their visibility should be improved to facilitate the transformation of these promising results into products and services. Many countries focus on entrepreneurship but the conditions for success are not always understood by politicians who want growth and jobs without investment into new laws facilitating development of activities, such as lower taxes and employment flexibility to help bypass the "Death Valley".

Innovation concerns all fields; however, the politicians consider information and communication technologies, biotechnologies, nanotechnologies and applications related to health as the most promising

areas. Nowadays, facing challenges requires connection and synergy with other innovations – in politics, society, education and behaviors.

Other skills apart from the traditional ones are also required to succeed in innovation. There are some schools teaching innovation with various points of view, but they mostly teach traditional 20th Century innovation. Initiatives are encouraged and experiments are conducted without measuring the impact of invested money and energy on improving the economic situation. Politicians would like the immediate results of their financial investment on selected institutions; however, they have to focus on the right persons and actions.

Science and innovation have the power to transform our lives and the world we live in – for better or worse – in ways that often transcend borders and generations: from the innovation of complex financial products that played such an important role in the recent financial crisis to current proposals to intentionally engineer our Earth's climate. The promise of science and innovation brings with it ethical dilemmas and impacts that are often uncertain and unpredictable: "it is often only once these have emerged that we feel able to control them". How do we undertake science and innovation responsibly under such conditions, toward not only socially acceptable but also socially desirable goals and in a way that is democratic, equitable and sustainable? Responsible innovation challenges us all to think about our responsibilities for the future, as scientists, innovators and citizens, and to act upon them [OWE 13].

Innovation focuses mostly on function, and takes little consideration of the impact. Researchers want to discover, while inventors (all categories) think about the services their invention may provide. Businesses and their investors expect to make money through sales. This model of traditional innovation from the previous century is followed by many. Today's context is different: the market is global, full of competitors and opportunities. This situation requires the overall innovation.

The environmental impact of innovation is not really taken into account from the beginning, except perhaps eco-innovation projects.

Current trends, such as sustainable development and corporate social responsibility (CSR), mainly focus on social and environmental aspects.

Can we really target sustainable development in a global world of greedy economics designing products to throw away? Reparation is impossible because of often changing standards and lack of spare parts. Planned obsolescence [CAS 13] and manipulation of customers lead to accumulation of waste and waste economy. Advertisement-based business models empowered by Internet make customers unhappy with what they have and push them to buy something newer and "better" right now (consumerism). The ISO 26000 standard has been provided for companies to guide them on socially responsible behavior and possible actions. However, the process is complex and is not yet adapted to start-ups or small and medium enterprises (SMEs). Too many events and actions are simply "green washing" without a real value, except perhaps the improvement of a company image. Like knowledge-based business several years ago, the eco-business is growing today. CSR principles and rules are followed by eco-design and integrated into product life management (PLM) and lifecycle assessment (LCA).

We can observe a knowledge economy paradox – many are overeducated, and this knowledge and the past knowledge are under-used. Education is not planned as a function of the market requirements. There is the risk of knowledge lost, lack of transfer in the case of retirement or turnover.

In France, after 30 glorious years, the economic and social crisis deepens. Many French have a complex with the language (they are afraid to speak English). French is recognized as an European language but, for example, the application for funding must be written in perfect English. Only a few French individuals are actively involved in the European policy and governance. The French are gifted for inventing great things but they have no talent for business. In consequence, many interesting projects do not have any economic impact. For example, the French service in artificial intelligence was the best in the world in the early 1990s.

Politicians believe that innovation must leverage the growth and stimulate job creation. The PhD students and unemployed people are encouraged to create their companies while the conditions for success are not provided. Politicians are "disconnected" from the field and lowering funds for innovation are not always given to the right persons; the return on investment (ROI) is not measured. The user-driven innovation policy may improve this situation. Only politicians are invited to Organisation for Economic Co-operation and Development (OECD) discussion groups.

Many focus on short-term business despite the planet protection. The economic trends such as globalization, capitalism and consumerism should be changed; but apart from individual innovation by necessity or awakening, nothing has been done. Globalization has amplified immigration and promoted multicultural aspects; therefore, their value must be understood and managed.

The quick development of technology also has social impacts, such as isolation in ubiquitous screens, virtual friends, and theft of time and personal data. Advertisements cultivate the attitude of "needing" and games influence behavior.

The fashion for "innovation" and "future" involves the important factor of "time" – innovation challenge is intended to not only improve our lives (not disturb) but also to let us have more time for our family and other activities.

The objective of this book is to awaken the consciousness concerning the necessity to take into account not only the economic and social impacts but also those that impact the natural ecosystems. We wish to popularize the use of artificial intelligence approaches and techniques with the aim to conceive user-friendly and useful applications that can really help humans in their work instead of replacing them and switching off their brains. Learning from nature and applying this knowledge to innovation may reduce its impacts and risks, and promote sustainable innovation dynamics.

Chapter 1 sets the scenery. It presents an overview of the current innovation fields, their interactions and their playgrounds and gives some available elements of their impact.

Chapter 2 provides the readers with the main definitions and spectrum of innovation. It describes the eco-innovation process and discusses conditions for a balance. The main barriers and paradoxes are also discussed.

Chapter 3 deals with the most important challenges both for the present and future from the global, European and French perspectives. The main elements of policies are given to explain their contributions in order to face these challenges.

Chapter 4 describes the main experiments around the world aiming to amplify innovation by involving more players. Discussion about how they take into consideration the impact follows the storytelling. It puts emphasis on the measuring of the effects of innovation and the ways of evaluating the results.

Finally, Chapter 5 discusses the major advantages of biomimicry and proposes conditions for sustainable future.

Abbreviations and Acronyms

ADEME: *Agence de l'Environnement et de la Maîtrise de l'Energie* (French national agency for environment and mastering of energy)

AKARI: Architecture Design Project – project for designing a new generation computer network architecture supported by the National Institute of Information and Communications Technology (NICT) of Japan

ANR: *Agence Nationale de la Recherche* (French National Research Agency)

AREVA: Global company for nuclear and renewable energy. Available at: http://www.areva.com/

BMW: Bayerische Motoren Werke, manufacturer of automobiles and motorcycles. Available at: http://www.bmwgroup.com

CIRAD: French research centre working with developing countries to tackle international agricultural and development issues. Available at: http://www.cirad.fr

CISCO: Cisco Systems. Available at: http://www.cisco.com/

CRM: Customer Relation Management

CSR: Corporate Social Responsibility

EC: European Community

EU: European Union

EPISIS: European Policies and Instruments to Support Service Innovation

GDP: Gross Domestic Product, the monetary value of all the finished goods and services produced within a country's borders in a specific time period. Measures total income received by a country's residents within a given period

IBM: International Business Machines

IC: Intellectual Capital

IDATE: Organization conducting studies in the field of broadcasting and telecommunications. Available at: http://www.idate.org

INRETS: *Institut National de Recherche sur les Transports et leur Sécurité (French national institute for transport and safety research)*

IP: Intellectual Property

IPR: Intellectual Property Rights

ISDN: Integrated Services Digital Network

IT: Information Technology

LCPC: Laboratoire central des ponts et chaussées

MRI: Magnetic resonance imaging

OECD: Organisation for Economic Co-operation and Development

P2P: Peer to peer (business)

PCB/PCTs: Polychlorinated biphenyls and polychlorinated terphenyls

PME: *Petites et Moyennes Entreprises* (Small and Medium Enterprises)

PSS: Product Service System

RFID: Radio Frequency Identification