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SAFE AND SUSTAINABLE INNOVATION IN GERMANY - THE STEINBEIS APPROACH

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Abstract. *The paper deals with the new concept of safe and sustainable innovation proposed by Steinbeis in Germany. The concept is based on three main premises. Firstly, the innovation can be considered safe only if both designed as such (also over the life-cycle), and perceived as such by the stakeholders. Secondly, the innovation is sustainable only if it is designed in such a way that it will be resilient when facing also new and emerging challenges (even the unknown ones). In other terms, it is sustainable if resilient. Thirdly, modern innovation should be smoothly embedded into the "shared economy" and "Industry 4.0".*
Such a concept is developed and implemented by Steinbeis as a bottom-up approach. The paper explains the above principles and show their application in the example of the Steinbeis Advanced Risk Technologies Group, as a subset of the large Steinbeis Network (over 1,000 centers word-wide).
Keywords: *risk, resilience, sustainability, innovation, share economy, indicators.*

1. INTRODUCTION –THE INNOVATION PARADOX

In declarative terms, there would be hardly possible to find today a company or institution ready to admit that "their innovation is not safe". And yet, the industrial safety records clearly show that the modern innovation is often not safe, or at least not perceived as such. Examples of technologies like fracking, nanotechnologies, autonomous driving, internet of things, unmanned drones, underground storage and similar, big data, or genetically modified food technology, show that concerns among the stakeholders are significant and the accidents do happen. Improved safety, on the other hand, normally implies higher costs, and this higher cost can hamper the competitiveness of industrial products or technologies. Therefore, there are always some trade-off made.

Europeand the EU in particular have consistently promoted their technology as responsible and inherently safe, making out of it a marketing advantage. But faced with the fierce global competition and pressured by the agreements like TTIP[1] the European companies consider shifting the trade-offs from the precautionary principle to the evidence-based approaches [1],[2]. But the evidence for a new technology or new products is normally not available – the years are often needed to note the creeping or hidden adverse effects of a new technology (e.g.asbestos).

The above leads to a paradox: everyone is for the safe innovation in the declarative terms, but insisting on safe innovation can hamper the innovations as such, by making it more expensive and less competitive.

2. STEINBEIS – THE INNOVATION AS THE CORE BUSINESS

Steinbeis[2] is one of the several large network organizations in Germany. It is positioned in the technology transfer (innovation) part of the bridge connecting the fundamental research (in Germany covered by organizations like Helmholtz[3] or Max Planck Institutes[4]), over the applied research (e.g. the research performed in Fraunhofer Institutes[5]), and the direct industrial application (i.e. full-scale technology transfer).

Steinbeisis one of the world's most successful providers of know-how and technology transfer.The Steinbeis brand stands for the successful transfer and sharing of know-how and technology for over 30 years. Steinbeis builds made-to-last bridges between

[1] *http://ec.europa.eu/trade/policy/in-focus/ttip/*
[2] *www.steinbeis.de*
[3] *http://www.helmholtz.de/en/*
[4] *http://www.mpg.de/short-portrait*
[5] *https://www.fraunhofer.de/en.html*

the source of knowledge and the area of application. Steinbeis operates in dependently of state backing, always adhering to market rules with all the services it provides. The organizational foundation of our success is based on entrepreneurial transfer processes for which Steinbeis assumes personal responsibility, underpinned by decentralized operations that are coordinated through a centralized framework.

Steinbeis has currently an international network including over 1,000 so-called transfer enterprises (Steinbeis units) worldwide, in 46 countries[6], each operating at the same time as an independent organization/company and a part of the overall system. This network encompasses 6,000 experts, each contributing to the network with their specialist knowledge and working on individual challenges in interdisciplinary teams to genuinely add value and thus facilitate the success of Steinbeis. As such, Steinbeis offers technology and management competence from a single source across a unique spectrum of fields, making its services available to partners and clients of all sizes in all kinds of areas. In doing so, it acts as a troubleshooter or service provider in the fields of consulting, research and development, training and continuing professional development.

3. STEINBEIS ADVANCED RISK TECHNOLOGIES GROUP

Steinbeis Advanced Risk Technologies Group (R-Tech) is the cluster of units belonging to and/or linked to Steinbeis. The group of Steinbeis units working in the area of "Advanced Risk Technologies" deals with multiple aspects of risks, risk engineering and risk management appearing, for instance, in:

- petro-chemical and process plants
- power plants and energy supply
- material technologies, especially advanced material technologies
- new & alternative technologies.

Main aspects of risks dealt with are:

- risks in/of innovation (e.g. risks of unexpected side-effects)
- risk of non-performance or performance below expectations (e.g. risks of system or component failures)
- risk of adverse/unexpected effects and impacts(e.g. on public health and/or environment)
- risks over the life-cycle of products and technologies (e.g. unexpected problems in decommissioning or recycling phase)
- project risks, especially ininnovation, R&D and new technologies oriented projects.

Organizing Europeanand national stakeholders, promoting and supporting technology transfer, introducing new approaches to the risks and their management, developing specific methods and tools are examples of these activities. R-Tech is also one of the founding members of European Virtual Institute for Integrated Risk Management EU-VRi. The institute (www.eu-vri.eu) is an EEIG (European Economic Interest Grouping). The group is capable to cover the above topics either on its own or in close co-operation with Steinbeis network, European Virtual Institute for Integrated Risk Management (EU-VRi), Virtual Institute of Knowledge-based Multifunctional Materials (KMM-VIN), European Technology Platform Industrial Safety (ETPIS) and other networks (all involving over 2,000 persons and over 500 companies). The activities of the R-Tech group involve projects and activities on industrial, national, EU, and international level,tackling,e.g.:

- integrated management of risk related to new technologies (FP7 project iNTeg-Risk)
- risks of impacts and/or non-performance of nanocontainer technologies, new bio-fuels in aerospace industry (Alfa-Bird), slurry coating technologies (FP7 projects MUST and Particoat), etc.
- governance and regulatory aspects of risks in industrial plants falling underthe EU Seveso directive (EU project F-Seveso).

In order to provide the optimal service and results, the R-Tech group has dedicated units for specific area of "advanced risk technologies"such as:

- technology transfer
- education
- R&D
- industrial services ("business-oriented")
- EU-related issues

Large web-based system such as iRiS (Integrated Risk Management System) and its derivatives have been developed for the petroleum and power industries and have been applied worldwide.

R-Tech has participated in many international standardization activities yielding a number of innovation standardization documents, the most prominent of these probably those leading to new EN standards in the area of risk-based inspections, risks of new technologiesand patents in the area of nanotechnologies [4],[5].

4. BASIC PRINCIPLES OF SAFE AND SUSTAINABLE INNOVATION

The new concept of safe and sustainable innovation proposed by Steinbeisin Germany is based on three main premises.

- Firstly, the innovation can be considered safe only if both designed as such (also over the life cycle), and perceived as such by the stakeholders.
- Secondly, the innovation is sustainable only if it is designed in such a way that it will be resilient

[6] *In Serbia, there are currently two Steinbeis franchise units, in Novi Sad and Kragujevac, dealing with modern energy technologies ("Steinbeis Energy Technologies", Novi Sad) and education in the area of Risk Engineering and Management (The Steinbeis Transfer Institute Kragujevac, a franchisee of the Steinbeis University, Berlin, Germany).*

when facing also new and emerging challenges (even the poorly known or even the unknown ones). In other terms,it is sustainable if resilient.

- Thirdly ,modern innovation should be smoothly embedded into the "shared economy" and "Industry 4.0". Such a concept is developed and implemented by Steinbeis as a bottom-up approach.

5. ENGINEERING SAFETY VS. RISK PERCEPTION – THE RISK PARADOX

Looking at the safety of known and widely used technologies (e.g. those used in process and production industry) one can see the general tendency of decreasing of direct accidents. This decrease generally follows the same pattern (Figure 1):

i. The risks reduced thanks to the maturation of the technology itself – faster in the beginning, slower later;
ii. The risks are reduced thanks to better management – the processes in which the technology or products are used are better managed;
iii. The risks are reduced thanks to the improvement of the safety culture–the employees accepting safety as the normal constitutive part of the process (and not,e.g., as an imposed measure);
iv. The risks are reduced influencing the cognitive capacity of the stakeholders –defaults in the process are defined in sucha way that the "right (also unconscious) behavior" is promoted and cognitive biases promote, not hamper, safety.

The final results of the above steps is the de facto reduction of accident rates and related risk. As a paradox, this reduction, especially in developed societies like EU does not lead to higher acceptance of innovation and new technologies. Instead the public aversion towards some of the risks (e.g. many risks related to terms as "chemistry" or"nuclear") increases.

The usual solution, used often in the past, to promote communication and "explain" the facts, does not lead to more trust and better acceptance.

The question is often then posed: how to solve the problems of aversion and rejection of communication? No panacea is available, but at least on the technical side, it helps to show that "no matter what happens" the new technology and the systems using it or being based on it will behave safely and even in a case of an accident recover quickly. This concept is nowadays largely accepted as the "resilience analysis", accompanying the process of risks governance and risk management.

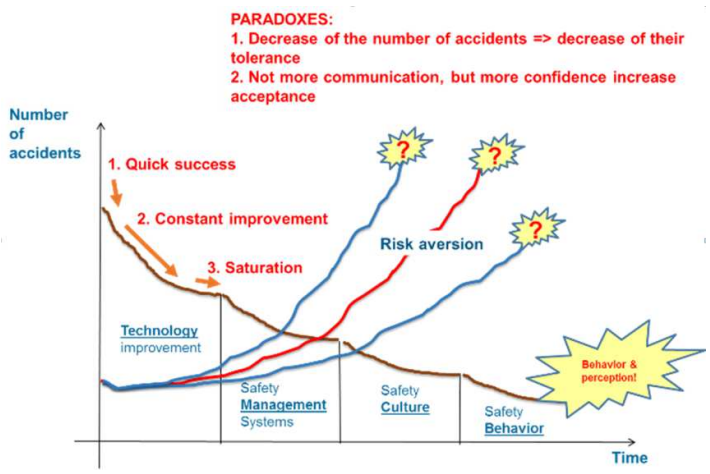

Figure 1. The risk perception paradox

6. RESILIENCE –THE ONLY WAY TO MANAGE THE "POORLY KNOWN THREATS"

The resilience concept is essentially understood as "the ability of a system to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions"[6].

A resilience management framework (Figure 1, Figure 2) includes risk analysis as a central component. Risk analysis depends on characterization of the threats, vulnerabilities and consequences of adverse events to determine the expected loss of critical functionality.

The risk is, thus, placed in the broader context of a system's ability to plan for, recover from and adapt to adverse events over time. In the system functionality profile, risk in a system is interpreted as the total reduction in critical functionality and the resilience of the system is related to the slope of the absorption curve and the shape of the recovery curve — indicating the temporal effect of the adverse event on the system.

The dashed line in Figure 2 suggests that highly resilient systems can adapt in such a way that the functionality of the system may improve with respect to the initial performance, enhancing the system's resilience to future adverse events.

For the area of innovation, the implication is clear: no matter the degree of "unknowns" the indicators must be established which would early enough signal not only possible risks, but also indicate the resilience of the (new) system, product, technology. Only that can be a "sustainable innovation". This "indication" is obviously based on the concept of the so-called resilience indicators, a concept still under development.

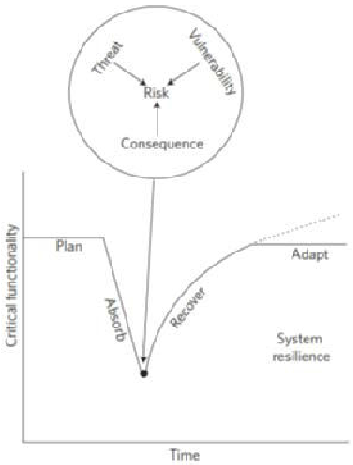

Figure 2. Risk and resilience [6]; Resilience of innovation - What we know about resilience, we know thanks to indicators

7. INNOVATION IN THE CONTEXT OF INDUSTRY 4.0 AND SHARED INNOVATION

In the concept of Industry 4.0 (see Figure 3 and details in [7]) the practical implementation of the Steinbeis concept, in the area of risk related technologies, very much looks at the issue of innovation in the "shared economy". In that sense the new franchising concept has been introduced, enabling also the geographically distant nodes of Steinbeis network to participate in the global innovation properly dealing with the challenges related to disruptiveness, inherent (un)safety of innovation and safety-related aspects of the share economy.

8. CONCLUSIONS

The "real innovation" is and should be disruptive (e.g., one cannot "order to disobey"). The "safe innovation" is often seen as something which can and should be embedded into the existing systems of institutions and regulation in charge of safety, which are, per definition, designed for and deal with known issues and apply agreed acceptance standards (e.g., the aviation safety regulation was not designed and built for the "Amazon delivery drones"). The "innovation on demand" (the share economy oriented innovation) is expected to go beyond the classical open innovation scheme sand lay an important role in the future economy. But, if the on-demand technology can work well for Uber, can the innovators, researchers, risk analysts and scientists perform equally well if reduced to the 19th century dockers crowded on the quayside waiting to be hired by the contractors? Hence, more than ever before,the success or failure of innovation will depend on successor failure of innovation risks management, but our current risks management approaches cannot fully cope with this requirement. We need new developments, possibly leading to a broadly accepted innovation risk governance framework, particularly those related to the management of time and context dependencies of innovation risks, abundances and uncertainty of the scenarios and cognitive science aspects governing the human risk perception and safety-relevant behavior in front of the "new technologies".

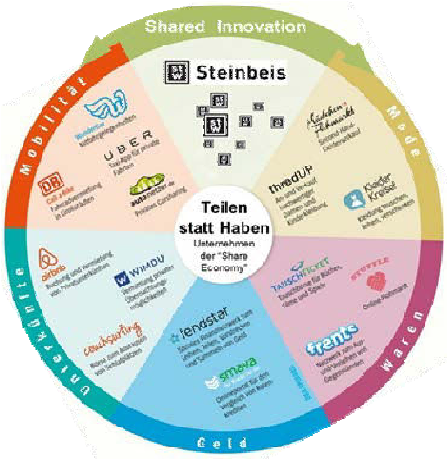

Figure 3. Shared economy innovation

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