Preprints of the 21st IFAC World Congress (Virtual)
Berlin, Germany, July 12-17, 2020

Responsible Innovation in Support of Society 5.0 - Aspects of Audit and Control

K. Nagy*, E. Hajrizi, L. Palkovics*****

**Budapest University for Technology and Economics-Szent István University-University for Business and Technology Joint Transformative Research Center, Budapest-Prihtina, Hungary-Kosovo(Cell: +36305350951, email: karoly.nagy@ubt-uni.net)*
***University for Business and Technology, Prishtina, Kosovo, (e-mail: ehajrizi@ubt-uni.net)*
**** Szent István University, Budapest, Hungary (e-mail:laszlo.palkovics@gmail.com)*

Abstract: We have developed an innovation model through which the benefits of the transformation of social needs into each other can be exploited. The model manages the planning and implementation processes of innovation in a unified system, approximately in parallel. Responsible innovation, as we have named our approach, minimizes the "development slack," increasing the effectiveness of financial support for innovation. Reviewing the concept of the Japanese Society 5.0 initiative, we came to the conclusion that our model would always have been tailored to the innovation needs of Society 5.0. At the same time, the Society 5.0 culture would be the most favorable medium for the completion and spread of our model. Responsible innovation is based on transformative research, and the "soul" of its implementation is modularization. This requires appropriate standards, audit and control support. Thanks to technological development and based on the opportunities inherent in responsible innovation, virtual economic zones, which provide a regulatory and organizational framework for mdular enterpris, have now become feasible and create. These can play an important role in making financial support for the recovery from the COVID-19 crisis effective.

Keywords: AI for business and economy, Human-centered systems engineering, University-industry cooperation for training control engineers, International Development, Knowledge networks, Knowledge Society, Security

1. INTRODUCTION - RENEVAL

"Renewal is never a search for and realization of something, that has not yet been, but a return to high beginnings. Renewal means acquiring something that a lost, but faint, image of man, still lives in it and that's why you're looking for." (Mawlay 1981))

In the wake of the COVID-19 Pandemic, now everyone is talking about restarting the economy. Our position is that we should not "fall back" into our previous lives, no matter how good or comfortable it was. The main lesson of Thomas Mann's Mario and the Magician is "not enough not to want something, but you want to want something else instead".

We, based on the results of our research work in this area, we claim that we know something else, something that has not happened before. This "something" is the achievement of the value of Japanese Society 5.0 program (Harayama 2020), that we consider to be the most important in European social relations, through the application and dissemination of the new model of responsible innovation we have developed. This value is that Society 5.0 directly aims to improve the lives of members of the society, individuals, unlike for example, to the German initiated 4.0 Industry Program, which would raise living standards through the transmission of industrial and economic development. The latter, and all similar "indirect" programs on the other hand, because it "does not touch" distributional conditions, inadvertently but obviously only exacerbates social inequalities.

If you thoroughly rethink the Society 5.0 program and begin the profound changes unfolding in Japanese society in connection with the program, you will realize that Society 5.0 is not a search for and realization of something that has not yet been, but a return to high beginnings. For something like the Essene Society according to Bordeux Székely (1981)

The new model of responsible innovation that we have developed ensures that the use of public money to support socio-economic development is truly progressive, with the greatest possible efficiency. This is one of the reasons we call our model "responsible innovation". Here, we note that the term "responsible" also appears in the designation of other types of innovation models. We are not claiming that our model is better or worse than these. All we are saying is that it is different.

We explored, developed the theoretical and methodological foundations of responsible innovation and set out to create the institutional and methodological conditions for implementation. We have already published several results of our research in prestigious international scientific forums, so we will not discuss them in detail, but will only refer to these publications (Nagy, Hajrizi 2018, Nagy Hajrizi 2019).

After a short presentation of our model, we will look at how responsible innovation will serve the achievement and

adaptation of Society 5.0 to European social relations. Finally, we point out the expectations for audit & control regarding the operating conditions of our model.

2. RESPONSIBLE INNOVATION

2.1 The main pillars

The theory of innovation boasts a library of literature. In Europe, the governments of the nation-states and the various institutions of the European Union support innovation with huge sums. The situation is similar in many other parts of the world. The highly professional support system of the US National Science Foundation (NSF) is an example to us. It was NSF that embraced and first began to support transformative research, which later became one of the pillars of our new innovation model. NSF Director Dr. Arden L. Bementa said, "Transformative Research: The Artistry and Alchemy of the 21st Century". Dr Bementa cites the following definition of transformative research in his paper:
"Transformative research is ... research driven by ideas that stand a reasonable chance of radically changing our understanding of an important existing scientific concept or leading to the creation of a new paradigm or field of science. Such research also is characterized by its challenge to current understanding or its pathway to new frontiers." (Bementa, 2007)

In essence, transformative research has made it possible for us to finally consciously and institutionally exploit an invaluable opportunity that has already lived with us. This possibility is based on the regularities of the transformation of social needs into each other, discovered by the Hungarian academic, Szabo (1985), and forms the so-called second pillar of responsible innovation. These are effective, latent and future, so to speak virtual needs. It should be noted that the concept of social need is not used in Maslow's interpretation (Maslow 2013). We will return to the conceptual interpretation of social needs later.

As for our topic, the point is that if we manage to recognize and satisfy certain virtual social needs already in the present, it eliminates certain unmet, unsatisfied contemporary needs. From then on, the daily struggle to meet social needs will be gradually replaced by interactive development. Social resources will be less and less diverted from real development for obsolete, often only fake needs kept alive by media marketing manipulation. All this will be achieved with the rise of responsible innovation. Transformative research has served the process by directing the recognition of virtual needs through its bold discoveries. How, how about this will be discussed in more detail below.

The third pillar of responsible innovation is modularization. The theory and methodology of modularization have a rich tradition. Practical applicability is important for responsible innovation. Advances in 5G, IoT (Internet of Things 2018) AI (Artificial Intelligence), sensor networks applications modularization of many things has become possible in practice. What is happening in our own development area is the development of the methodology and toolkit of modular enterprise development and "modular innovation", which is the practical branch of responsible innovation.

2.2 The institutional background of our R&D activity

As it was discussed above, the responsible innovation aims to meet future so-called virtual social needs. The hardest question what we were face was the recognition of the trends of the development of objective social needs, the recognition of virtual needs. To find a solution the University for Business and Technology (UBT) together with the Budapest University of Technology and Economics (BME) and Szent István University (SzIU) created the BME-SzIU-UBT Joint Transformative Research Centre. The transformative research is able to look at the horizon of "traditional" sciences. The "compass" of responsible innovation is transformative research. We believe that the shockingly new discoveries that become available through transformative research are made by "calling" or rather "sucking" virtual social needs. So all we have to do is "look around" our research findings and we will recognize these "life-giving" needs. All of this is not that simple, of course. Significant theoretical methodological developments were needed to make it work in practice.

2.3 *The two streamlines of responsible innovation*

The implementation of responsible innovation (RI) goes on two interconnected like a genetic spiral, streamlines:

->Transformative Research Driven Innovation
-> Modular Innovation

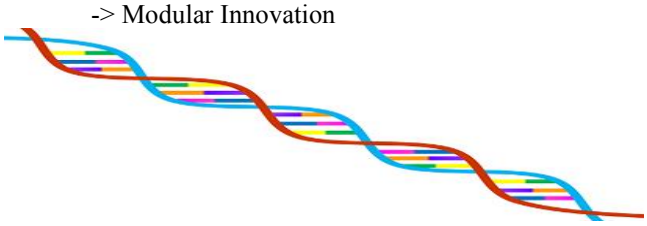

Figure1. The Genetic Spiral of RI
(Source: Nagy, Hajrizi 2019)

While modular innovation (MI) is the practical embodiment of RI, and the transformative research driven innovation (TRDI) is the strategic, ethical, political and planning side of responsible innovation. The TRDI is based on the usage of the results of transformative researches.

MI also has a dual nature. One means to improve the renewal of an element of a modularized organization, a system, in such a way that the connections of a particular module or module group and its interaction with other modules remain unchanged. On the other hand, MI means that all innovation projects and actions are tailored to a large-scale development path aimed at meeting the virtual social needs. All innovations can't be directed directly to the virtual social needs, but it must be ensured that, if they are indirectly aimed at satisfying them.

The audit and control essential for the realization of these two functions of the MI. Continuous monitoring of the relevant

status characteristics of the various types of modules, monitoring of deviations from the required normative and the necessary corrective measures should be taken.

The verification of our model, the first steps of its practical application brought new results in the field of basic concepts and thus in the further development of our model. These results are presented in the next section.

3. AN INTERACTIVE AND HOLISTIC APPROACH

3.1 The interactive nature of transformative research

The starting point for TR, as with all other scientific research, is transformative research idea generation. To facilitate this in the US, the National Science Foundation provides large sums of money to support the establishment and operation of Idea Labs and Idea Factories (Tilbury 2020). We have much more modest resources, so we chose a different path. In the intersection of science-spirituality and art, we try to generate a spiritual state in our researchers in which new ideas are more easily born. From this, the only thing that is important for the topic of the present study is that, in general, we consider strong intuition to be decisive for other areas of responsible innovation as well. This is why the results achieved by MIT (Massachusetts Institute of Technology) in the development of intuitive algorithms, for example, are so important to us (Hardesty 2017).

We intensively examined the methodological issues of transformative research. Based on our results so far, we have come to the conclusion that TR cannot be stuffed in to the Procrustean bed of any popular scientific methodology.

Our position is that TR can be implemented according to an interactive, unique methodology. The other important recognition is that TR is not some kind of antecedent of responsible innovation, but is realized as part of it. We can also understand that TR is the third streamline in addition to MI and TRDI. These three are realized simultaneously, in a synergistic interaction. This is why managing responsible innovation is so interesting and risky. As we have previously stated: leading your team in to unknown " (Nagy, Hajrizi, Gashi 2018).

In describing our original model, we have articulated that if we “look around” around TR results, there we discover the virtual social needs that “bring life” to those results. Well now the thing is, we're not looking around. However, we continue to believe that real scientific research results are born of “calling” virtual societal needs. However, if we look more closely at the basic nature of needs, it becomes clear that they cannot be specifically defined. The situation is that the recognition of virtual needs also takes place in the process of RI and is completed through the becoming effective of the needs, more precisely its realization in consumption.

3.2 Social needs

The concept of social need is one of the most difficult philosophical questions. There is also a serious socio-ethical issue: who has the right to declare that something is a social need, (Heller 1974).

We, without engaging in conceptual-terminological debates, proceeded from the following idea of the interpretation of the concept of social need: "It has always been true that nature, the living world as a whole, could sustain itself because all change could be within the natural balance. stay." (Tordai 1984) In our view, basic social needs are related to this staying within balance. There are, of course, countless conditions for this. In our opinion, in general, the maintenance and restoration of equilibrium states can be ensured by complying with Ashby's Law of Requisite Variety (Ashby 1956). The law asserts that in order to retain its ability to function and persist, each system and organism ‘is responsible for’ maintaining a constant equilibrium between its own internal variety and the variety of its environment.

At the beginning of historical times, man, hidden in caves, delimited himself with walls to reduce the effects of a natural environment of unmanageable complexity to be manageable. It has replaced the natural environment with an artificial environment with much less variety. Today, this artificial environment has become unmanageable. We devote most of our resources to learning, largely to keep up with this artificially generated variety. The rise of responsible innovation will reduce the unnecessary, harmful diversity kneaded by fake innovation.

There is another important implication of our interpretation of the term "equilibrium approach." Tordai writes that "when, as locally as he could no longer produce a "response change" of a magnitude that would have restored the original equilibrium, destruction became the equilibrium" (Tordai 1984).

This already refers directly to security needs. In the security model, with which we have been operating successfully for about 25 years (Nagy1996), the prevention of so-called synergistic system failures plays an excellent role.

The most difficult crisis situations to manage are those threatening with a synergetic or ‘third type’ system failure. Once the unfavorable constellation unfolds it is too late already: there is no way to halt the rip tide of irreversible status deteriorations. The only solution may be fleeing ahead. By this we mean that – in addition to intervention measures – we launch targeted developments with the application of a synergetic development method. This method is fairly easy to apply even under the conditions of restricted resources. In essence, by creating the appropriate constellation of several minor, well-harmonized developments and quality improvements, we generate a synergic interaction, which will cause the systems to be protected to ‘swing over’ to a new quality state. Very often, under the new quality conditions, problems that were unmanageable in the previous state simply cease to exist. Unfortunately there is no regular method to be learnt with respect to the creation of positive synergies either; again, we can only rely on experts with the adequate empirical knowledge and empathy, provided that they exist. We believe that responsible innovation, with its synergistic developments, can make a significant contribution to overcoming risk constellations threatening a third type of system collapse.

3.3 Modularization

Modularization plays a key role in meeting the "minimum variety required" requirements. “Modular design, or "modularity in design," is an approach that subdivides a system into smaller parts called modules (or skids), that can be independently created and then used in different systems.” (Ghandar 2019)

The economic role of modularization and modular innovation is really fulfilled in modular enterprises, in the Virtual Economic Zones (VEZs), that provide a regulatory and service framework for their operation. A business enterprise based on modules with IoT support is a specific form of new generation digital enterprises. This type of the new generation is the “modularized digital enterprise”, or “modular enterprise” (ME).

Operations in the VEZ’s shared-parameter, modularized world will entail a profound qualitative and quantitative change in terms of businesspersons’ interrelations as compared to previous deeply hierarchized business and organisational structures. In this world Trust will be of unprecedented significance. The modularization will open up new dimensions for logistics and personal logistics, in particular. The time spent on going to work and other costs can also be decreased (especially for intellectual staff) by bringing the locations where work is actually done closer to employees by flexibly adjusting the place of activity to the locations where the persons actually involved in the task in question are staying. Presumably, this process will be supported by the speedy spread of offices and other workplaces that can flexibly be rented and adapted to the infrastructural needs, which this type of modularization can be thanked for, actually.
Besides decreasing costs of “logistics” as brought about by face-to-face communication and co-operation, the number and variety of occasions will increase, as well. As a result, mutually self-authenticating human relationships will become stronger, trust will increase and the importance of VEZ’s virtual world will be reinforced. Earlier we discussed how „In cyberspace the basic precondition of the personal safety of participants and at the same time the realisation of the basic functions of virtual worlds is the evolution of direct, living and mutually self-authenticating human relationships between the participants. Communities of mutually authenticating participants must be formed, and networks filling up cyberspace can then be built on the mutual authentication of these communities” (Nagy, K. 1996)

4. SOCIETY5.0

Japan is rapidly moving toward “Society 5.0”, adding a fifth chapter to the four major stages of human development: hunter-gatherer, agrarian, industrial and information. In this new ultra-smart society, all things will be connected through IoT technology and all technologies will be integrated, dramatically improving the quality of life.

The Executive Member Council for Science, Technology and Innovation, Cabinet Office, Japan, Yuko Harayama said: “Digitalization is a means, but we humans must remain central actors. Traditionally, innovation driven by technology has been responsible for social development, but in the future, we will reverse our way of thinking, focusing on how to build a society that makes us happy and provides a sense of worth. That is why we focus on the word “society” as the foundation for human life.” (Harayama 2019)

To realize this new era, the Government of Japan is doing everything it can to encourage various players, including start-ups and “hidden gems” among small- and medium-sized enterprises, to come up with brand-new and innovative ideas, to provide the world with solutions.

The Society 5.0 program marks the beginning of a new era in Japanese history. At the political level, this beginning is marked by the inauguration of the new Japanese emperor.
Japan has revealed the name of its next imperial era to be "Reiwa," set to begin May 1 as Crown Prince Naruhito is expected to take the throne. Yoshihide Suga, Japan's chief cabinet secretary, announced the name at a press conference after thenext morning of the ceremony, unveiling a board with the two kanji characters written on it. While there was some deliberation over the exact meaning, the two characters that make up the new name, or the "gengo," translate roughly to "good fortune" and "peace" or "harmony," according to The Japan Times (The Japan Times 2019).

The adaptation of the Society 5.0 program to its global spread requires a cultural renewal. This is far from a purely technological, industrial and economic issue. As we have done before, every major social development program must be embedded in a culture program. In our case, this means that responsible innovation can be achieved as part of a new culture of innovation. The adaptation of Society 5.0 can be achieved through the spread of responsible innovation and the development of a new culture of innovation to serve it

5. STANDARDIZATION, AUDIT AND AUTOMATIC CONTROL SYSTEMS IN SUPPORT OF RESPONSIBLE INNOVATION AND MODULARIZATION

The International Federation of Auditors has already joined Society 5.0. There was the global accountancy profession’s call to action for G20 Leaders at the 2019 Osaka Summit: “High-quality, internationally-accepted standards are crucial to enhance confidence, growth and stability in the global economy and financial system. We urge G20 members to adopt and implement these standards in their countries and call for global adoption. We believe these policies are fundamental to achieving the G20’s aim of fair and sustainable development through an agenda that is people-centered, inclusive and forward looking. These are actionable steps toward realizing the United Nations Sustainable Development Goals (SDGs) and Japan’s global vision for “Society 5.0”.

As we fixed it above, control is essential for the realization of the two functions of the RI. Continuous monitoring of the relevant status characteristics of the various types of modules, monitoring of deviations from the required norms and the necessary corrective measures should be taken. An important part of the solution is the development of cost effective control systems to operate certain alignment mechanisms. The decisive part of these mechanisms should be automatic. The control is taken over by the AI.

Many of standard topics in automatic control including linear and nonlinear systems theory, identification. estimation and filtering. adaptive control. and stability theory are already available. Serious further development work is needed on both audit and control of AI applications. We are still in the early stages of standardization in these areas. The real impetus for modular innovation could be given by modular enterprises and the general spread of modularization.

6. CONCLUSIONS

The verification of the model and the initial steps of its practical application laid the foundations for important improvements. Transformative research has been integrated into our model as a third streamline and these three are managed in a holistic approach, in a unified system. The security significance and role of responsible innovation have been revealed. The basic goal of Society 5.0 is to focus directly on the good existence of individuals, members of society, and to require customized solutions. These are effectively designed by modularization. The accuracy of the customization depends on the depth of the modularization. The more detailed the modularization, the more variants can be produced. It is important to note that customization is the responsibility of users and consumers. Somehow it happens as it did at the time, in the heroic age of virtual reality, we "calibrated" the data glove to ourselves with a few hand gestures. To do this, of course, they need to be provided with the right tools, methodology and infrastructural conditions.

Responsible innovation is modular. This is the fundamental link between Society 5.0 and responsible innovation. Responsible innovation gives new impetus to the creation of modular businesses. Now, after COVID19, operating in the framework of virtual economic zones, they can cause even a quantum leap in economic development, rather than just a revival seeking to restore previous states. The direction of the quantum leap points in the direction of the Society 5.0 relationship.

Responsible innovation, accordingly, is an interactive, holistic process that takes place at the same time as research, in the sense described by Ackoff (1974). The fact that the process has indeed met virtual needs will emerge from the disappearance of obsolete, unsatisfied effective needs. In fact, the practical application of all real scientific results leads to the same result, even if it is not done consciously. Our model differs from widespread research commercialization in that it consciously and systematically supports and manages the "substitution of needs", the expedient transformation of needs into each other", and in a highly efficient way of modular innovation.

In summary the social advantages and basic features of our improved model and its application are the next:

A. Transformative research is no longer the antecedent of responsible innovation, but the third streamline of responsible innovation.

B. TR is implemented on the basis of a separate, interactively developed, unique methodology developed in each case.

C. RI intensively shapes and mobilizes the structure of social need, constantly renewing it. Meeting needs is part of social and economic upheaval, not some kind of aftermath. The opposition between the financing of effective needs to be met and the financing of innovation is eliminated, namely that one goes to the detriment of the other, depriving one of the resources of the other. The amounts spent on financing RI are realized directly in consumption. The results of the examination of the socio - political aspects of this are reported in separate publications.

D. The interactive, synergistic development generated by RI causes quantum leaps in socio - economic development and at the same time helps to continuously exceed the risk constellations threatening the disaster.

E. The modular nature of RI and the modularization generated by it, instead of the previous uniformization, opens up the possibility of a solution to a customized problem, a need adapted to the unique nature and needs of the members of society.

F. The RI radical reduces and eliminates the resource and development slacks.

In order to these benefits to take effect, the basic condition is to ensure the standardization of modularization and the conditions for audit and control. This also posed new challenges for the IFAC community. We propose to focus on the development of methods for the control, operation and monitoring of autonomous dynamical systems. Our special focal areas are the next: fusing learning and control, model predictive control, modularization, scalability & large scale systems, cyber physical systems, network controlled systems, identification and model validation methods. The partnership of specialists and experts is vital for us in these areas.

In all elements of our model developed above, it correlates with the innovation objectives of the Society 5.0 program and at the same time it can be fulfilled in the socio - economic conditions that Society 5.0 strives to create. From our point of view, as the inhabitants of European society, this means, on the one hand, that it is possible to develop innovation programs of a common nature, and, on the other hand, these programs will promote harmonization of values. All of this, given the EU's global weight and importance, paves the way for the current, even now-only, Japanese national program to become the beginning of a new social formation following the information society, as originally envisioned.

REFERENCES

Ackoff, L. (1974) Redesigning the Future. Wiley. New York, 1974.

Ashby, W.R. (1956) *An Introduction to Cybernetics.* Chapman & Hall. 1956.

Bementa, A. L. (2007) Transformative Research: The Artistry and Alchemy of the 21st Century

Bordeux Székely, E.(1981) From Enoch to the Dead Sea Scrolls. International Biogenetic Society, USA, 1981

Ghandar, A. (2020) Modular thinking - the future of audit? https://www.linkedin.com/pulse/modular-thinking-future-audit-amir-ghandar Accessed: 21.01.2020.

Granrath, L. (2017) Japan's Society 5.0: Going Beyond Industry 4.0. Japan Industry News https://www.japanindustrynews.com/2017/08/japans-society-5-0-going-beyond-industry-4-0/ Accessed: 31.03. 2019.

Hajrizi, E., Nagy, K. (2018). Transformative research driven innovation – the artistry of innovation management in the age of spiritual machines. GBRS2018 Conference, Roma, 13-15 June 2018

Harayama, Y. (2019) Society 5.0: Aiming for a New Human-centered Society. *Hitachi Review* Vol. 66, 2019. No. 6. pp.558–559.

Hardesty, L. Researchers add a splash of human intuition to planning algorithms. Massachusetts Institute of Technology (MIT), MIT News Office February 7, 2017. http://news.mit.edu/2017/human-intuition-planning-algorithms-0207 Downloaded: 13 01 2020

Heller, A. (1974). The Theory of Need in Marx. Allian and Busby 1974 London. ISBN 0 8503 174 8

Hosanagar, K. (2019). A human's guide to machine intelligence: how algorithms are shaping our lives and how we can stay in control New York : Viking, 2019. ISBN 9780525560883 (hardcover)

Japan Times (2019) REIWA. https://www.japantimes.co.jp/tag/reiwa/ Downloaded 19 01 2020

Maslow, A. H. (2013). A Theory of Human Motivation. Kindle edition. Dec 6, 2013

Mawlay al-Arabi ad Dargqawi (1981) The Darqawi Way. Letters from the Shaykh to the Fugara. Norwich:Diwan Press, 1981.

Nagy, K. (1996). Security of virtual worlds. Lecture at the conference on Internet Security (Budapest Congress Center, October 17, 1995). Published in *Tudományos és Műszaki Tájékoztatás* 1996 (4-5), pp. 148-154 ISSN 0041-3917

Nagy, K. (2013) A New Impetus to Globalization: Development of Virtual Economic Zones," Hong Kong December 2013. International Conference on the Modern development of Humanities and Social Science. Published in conference paper ISBN (on-line): 978-90786-77-90-1

Nagy, K. Hajrizi, E. Lakner Z. (2015)" Development of virtual economic zones in support of the mitigation of the migration pressure, Durres, Albania, November 2015. 4th International Conference for Business, Technology and Innovation (ICBTI 2015). Published in the conference paper.

Nagy, K., Hajrizi, E., Gashi, E. (2018).Management of Modular Enterprises. PICMET2018, Honolulu, 19-24 August,

Nagy, K., Hajrizi, E. (2018) Automatic Control in support of Modular Innovation. TECIS2018 Conference, Baku, 13-15 September 2018.

Nagy, K. Hajrizi, E. (2019). Building Pillars for Adapting Society 5.0 in Post-Conflict Countries. TECIS2019 Conference, Sozopol, 27. September 201)

Szabo, K. (1985) Arányossági elv és érték a modern Gazdaságban. Akadémiai Kiadó, 1985.

Tilbury, D. (2020) Industries of the Future, NSF Directorate For Engineering. April 7, 2020. https://www.nsf.gov/attachments/300069/public/ENG_AdCom_Industries_of_the_Future_2020_Spring-Downloaded: 13 04 2020

Tordai, Z. (1984) The Netwok of Action. Akadémiai Kiadó, 1984.