

Bringing back a source – TRIZ in Social Science

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Abstract:

Dialectic played an important role in the transformation of TRIZ as a problem and as a methodological aim. It is argued that this source can be fruitful for the field of social sciences. As a systematic and theoretical topic, TRIZ offers new impulses for further research and for the development of teaching. We will demonstrate that TRIZ in social science can not only serve purposes of social science, but also help to create a different understanding of the role of the social scientist. This new role offers new perspectives for further development in science, but also for project work of a digitally enhanced market economy. The development of AI requires a systematic design and a methodical survey of the requirements of its respective target group. Bringing back a source of TRIZ means remembering the possibilities of dialectic in theory and practice.

Keywords: Dialectic, Infradisciplinarity, Human-Machine-Interaction, Methodological Pluralism, User-centered Design

1. Introduction

In view of the complex development processes, systematic innovation approaches are becoming indispensable. The role of AI as a key technology in this area is undisputed. It is often overlooked that very different types of artificial intelligence are used depending on the task. And they all differ in their architecture, in their adaptation to their environment and its requirements. For example, chatbots, facial recognition systems, search engines and driving assistants are used.

Accordingly, not only ethical issues are of interest to developers, but also the understanding and design of human-machine interaction, which focuses on the user both as consumer and producer [1,15]. To include such a prosumer as much as possible, understanding and implementation processes are therefore systematically interwoven

and require the identification of risks and the subsequent management of practical adaptation.

Interdisciplinarity becomes both a theoretical prerequisite for context setting and a practical basis for project development. Both theories and methods of the social sciences and humanities increasingly play a role, as tools and as new methodological perspectives on the processes themselves.

Model development and adaptation is no longer important only for scientists, but the developer and programmer are also dependent on such representations and simulations. The complex design of the knowledge base as well as the sociologically based construction of the user-centered designs are crucial.

Methods are used and are the basic prerequisite to make the connections visible. The sociological framework is both the site of emergence and the arena of systematic innovation. Humanities and more over social science are interesting for methods and procedures. However, this new role in contemporary social science has gone rather unnoticed or even still trapped in its self-imposed methodological restrictions.

In this paper, we will first address the phenomenon of socio-technological complexity in section 2, which is fundamental for the methodological approach and the development of new applications. This leads to the main problems that will be discussed in section 3.

Complex systematic contexts are usually themselves subjected to argumentative analysis, and in the process the contradictions that are so crucial to the contexts are ignored as method. Yet such strategies have not been unknown in the past. The connection between contextual model development and comprehensive contradiction analysis can already be found in Altshullers work and has been tested and applied as TRIZ in many fields as we will show in section 4. The aim of this study is to make TRIZ fruitful for the field of social sciences by having social scientists themselves reflect on their own methodological foundations. Therefore, we are looking closely on the historical development of dialectic as contradiction method, which is not linear in the sense of argumentation. Social science for that reason is the focus of this paper which does not mean that humanities cannot benefit from these experiences.

Furthermore, the social scientists themselves should participate in the development process to not only analyze, but to actively shape the development process with the help of the complex methodology and in anticipation of various user requirements.

As we will demonstrate in section 5, there are various fields of application for this complex methodology. For example, in teaching, in research and in the formation of a sustainable reflexive awareness of the context of one's own methodological approach.

In these areas, the various insights of TRIZ into dialectics are shaped differently according to the respective objects and circumstances, yet they are united by non-linearity with comprehensive contextualization of contradictions. Following this insight, in Section 6 we will look ahead to what is feasible in the exploitation of these approaches beyond academia and outline opportunities that can be crucial for today's digitization and the responsible development of smart AI applications.

Dialectic consequently serves as a motor, method and foundation. While our consideration remains a speculative discussion of the possibilities, it nevertheless demonstrates both the existing conditions and the different facets to make contradictions

methodologically fruitful in a comprehensive contextualization. Remembering TRIZ's own theoretical basis of development is thus not solely a topic for the social sciences, but itself a comprehensive utilization of social science procedures, insights and ultimately an attitude in a social development that impresses both by its complexity and its speed.

2. Socio-technological Complexity

Technological developments are embedded in a socio-technological framework. Accordingly, the interdisciplinary composition of development teams is a natural prerequisite.

This also means that the observer and actor perspectives are mixed. The complexity of the environment and the actors lead on the one hand to an interweaving of theories as well as perspectives. On the other hand, linkages are also a personal concern of the actors, because their theoretical description as well as representation of the subject matter is itself part of the process in which the actors cooperatively participate. Today's development of technology and its socio-economic conjunctions point to a more complex context: the socio-technological frame is the basic condition and place of the changes that keep the world in suspense.

Against this background, the legitimate question of who can meet these challenges becomes complex itself and refers to the complexity of socio-technological development.

Even today, technical applications are by no means the simple implementation of a black-box solution but require comprehensive project management as well as the intensive elaboration of user demands. Project managers are already dependent on participant observation and a mixed-method approach to combine customer wishes and applicability into a satisfactory application. Social scientists play an increasingly important role in such a collaboration both with respect to their profound professional training and their methodological knowledge, which is of interest for practice recognition as well as design. The prosumer, as consumer and producer, will not be found alone in the intended target group; rather, developers in today's interdisciplinary teams are relied upon to contribute their methodological experience and to be involved as a potential target group. Thus, the analysis of ongoing development as process is a theoretical and practical problem that poses new challenges, especially for the social sciences.

Accordingly, the focus of the present paper is twofold. On the one hand, TRIZ is of interest as an extension and inspiration for social science methodology and reasoning itself. TRIZ presents a long lasting and methodical possibility to meet these complex demands of socio-technological development in the social sciences themselves. On the other hand, it is of interest how such a trained social scientist can work in heterogeneous development teams and make the complexity of the socio-technical development manageable there. Her knowledge of methods, her involvement as an actress in development, and her view of the contexts and conditions of possibility of such processes make the social scientist, as well as her methods themselves, the object of

interest in being able to responsibly design sustainable human-machine interaction. The methods themselves thus become the central object for the skilled person.

3. Problem: Argumentation and Contradictions

Analysis of basic conditions and requirements has become an elementary task of project design in the field of modern applications of the socio-technological framework. Analyses themselves are accordingly both the basis and representing determinations of the needs of the architecture and the possible customer of an application. Nowadays it appears as normality that customer requirements, but also technical possibilities are more and more aligned during the concretization of a project. Remarkably, social science standards and considerations are exported and made fruitful, but unfortunately mostly without a reflection on the conditions of the social science perspective itself.

The analysis of the social sciences is itself a problem that is almost blind to the challenges and possible applications of the complexity of its objects. One does indeed develop a critical attitude and sensitivity towards the problems of the use of terms and the transition from adaptation to practical action. But the problem of argumentative leadership itself is rarely considered.

Social science methods, for all their critical awareness of the problems of definitions, axioms and basic concepts, are basically built up argumentatively linear. This leads, on the one hand, to the typical sequence of stages as a representation of development in the social sciences and, on the other hand, to the content-poor trap of brainstorming in the context of the practical application of methods in the field of direct project work. [15]

Analytical reasoning as a linear explanation and representation thus falls short in the social sciences, but also in its practical application to product development.[16] Contexts are addressed as a background assumption rather than being used seriously in theory. Contexts, in turn, are the condition and object of consideration as well as practical guideposts for the modification of social science methods. Linear argumentation and the non-interwoven adaptation of context form the core of the application of social science methods both in science and the market economy.

There is an internal contradiction: the context itself should come into play as a modeled representation and as a field of application but cannot be captured because of the linearity of the argumentation; the black box does not become a white box. The context as field of application and as modeled representation are not interwoven but are demanded to interact. Linearity keeps them separate and prevents the view of complexity. Real contradictions that would become visible in the interaction of need, environment and circumstances remain invisible in this representation. Internal contradictions are thus not identified and certainly do not become the theoretical building block or even fulcrum for getting a sustainable theory adaptation for iterative evaluation and development. Internal contradictions, however, are the driving forces for the development of the theory as well as a user-friendly application. Accordingly, the central problem is the underestimation of contradictions both in the methods of social

science and in the application of these methods in practical projects outside the scientific enterprise. [13,14]

The possibility to make contradictions useful as a method and as a frame of reference in problem solving is thus a requirement for the systematic evaluation of conditions as well as for the fruitfulness of sustainable as well as innovative solutions. The social scientist both as theorist and developer is challenged.

TRIZ provides both theoretical and practical experience of mediating sociological analysis of contradiction and innovative practice design as well as a theory-immanent basis on the problem of contradiction itself. The basis of the decades-long differentiation of the most diverse TRIZ tools, applications and utilizations in many fields is itself the problem of dialectics.

Bringing back a source of TRIZ now also means remembering a source of social science work itself: Dialectic is both contradiction analysis and the grasping of the laws of the genesis of contradictions, and thus itself a method as well as a frame of reference. Dialectic implies non-linear contextualization and iterative influence on the conditions of one's own course of development.

This developmental movement, which is more than an argumentative sequence of steps, deals with the most general laws of movement and at the same time participates in them by taking the internal contradictions seriously. [2]

Dialectic is a controversial topic in the social sciences and humanities because, on the one hand, it is limited to an understanding of method as the linear negativity of thesis and, on the other hand, it is supposed to be a political point of view. The humanities may have lost access to this methodological possibility, but experiences can be gained from areas beyond academic discourse.

From the very beginning, TRIZ moves beyond formal-logical conceptualizations and linear-argumentative descriptions. The agent is part of the contextual contradictions and their historical formation.

4. Dialectic in Research and Teaching: The Experience of the Theoretical Foundation of TRIZ

Bringing back the source of TRIZ; namely its dialectical foundation leads back to the historical genesis of this undertaking due to the contextual intertwining in the theoretical, but also institutional sense. Dialectic itself was and is a term that, because of its historical use, provokes categories that complicate its scientific use. One may say without hesitation that the term itself mutated into a means of struggle as well as an arena of confrontation and thus always accompanied the historical genesis of TRIZ.

Dialectic thus has a contradictory history and development itself. In Plato it was still a form of dialogical argument, [3] it shifts to the syllogistic trope utilization in the Middle Ages [4] and culminates at the beginning of modern times to the interplay of invention and judgment. [5] In all this time, dialectic as a method is context independent. The context is integrated at the latest by Hegel, in whom dialectic appears as a method and consideration of the movement of the concept itself. [6]

The situation changes again in the 19th century and dialectic is transfigured on the one hand to the linear sequence of thesis-antithesis and synthesis [7] and on the other hand declared to be the expression of the most general laws of motion of nature. [8]

The connection of method and context makes this enterprise increasingly a political undertaking and culminates at the latest with Stalin's work in a naturalized conception of a general conception of laws of motion. This should purely naturally, without any historical prescription, linearly open the view to the future. [9] Just this deterministic narrowness of a possible connection of method and context became after the Stalinist times a methodological and theoretical problem for the scientists of the Eastern Bloc and the basis for the development of TRIZ. Agents reminded themselves of the sociological source of their own doing.

- a. Already in the discussions of the Moscow Methodological Circle in the 1950s, the narrowness of formal logic and its linear argumentation became the basis of the argument. [10] It is recognized that dialectic must integrate the context and at the same time act on it, to have a dialectic that is not subject to the Stalinist traps. Dialectic is liberated from deterministic limitations as a method and contextualization of opposites, of negations, and of the transformation of quantity into quality. It is understood that innovation and systemic consideration of contexts interact dialectically and escape any linearity.
- b. Altshuller will dock here and develop TRIZ as a dialectical work and methodological program. His insights follow the discussions in Moscow. One of the practical influences of these philosophical concepts was the declaration that invention itself can be an exact science that can meet the methodological requirements of natural science. In a dialectical and thus systematic way, methodology and the frame of reference are linked and contradictions themselves become the decisive factor. These appear as objects, target object and motor for the process. [11] Through contextualization by comprehensive patent evaluation, innovative research is, as it were, placed on the real ground of development and drawn into a systematic as well as dialectical connection of consideration and participation. [ibid. p. 30-35] The minimal machine is a tool, a target and an engine. The social scientist as inventor is both methodological worker and contextualized innovator.
- c. This approach received a completely new dimension through its institutional version in the GDR and the attempt to create inventor schools which combine construction and TRIZ directly. Altshuller's approach of a systematic-dialectical linking of method and context by emphasizing the role of contradictions found here a further theoretical development as well as a practical application to innovation processes. On the one hand, one tried to understand the fundamental problems of dialectic better and more comprehensively; contradictions themselves become the expression and the realization of the most general laws of the movement in an understandable as well as

provable context. [13] On the other hand, one makes these scientific considerations immediately applicable to practice, thus changing the theoretical content at the same time. Innovations of the contradiction methodology are directly linked to real problems by institutionalization in inventor schools and thus transformed. [14] One recognizes that the social scientist is both an inventor in methodological, academic terms but also an innovator in practical terms through the comprehensive connection to the socio-technological environment. Innovation for science and for society go hand in hand here through the systematic use of contradictions as laws, trends and strategies.

Thus, for all three directions of TRIZ development, firstly, the emphasis on dialectic as source beyond argumentative linear constraints is crucial. Method and context as the ingredients of a comprehensive analysis of contradictions form the methodological core for the social scientist. And secondly, the social scientist as inventor of sustainable strategies in practice himself becomes the object of study of this systematic form of innovation. She herself becomes a developer as part of an interdisciplinary team. Accordingly, here she is always moving beyond a strict separation of natural sciences and social sciences, of theory and practice, of hard facts and soft presentation of analysis.[12]

TRIZ has always cultivated this heritage and produced applications and adaptations of the concerns in decades of experience for many fields.[13] Nevertheless, the emphasis on application and the concentration on the practical work of developers, engineers and programmers led to a forgetting of the actual sources, so to speak.

TRIZ has neglected the moment of further development of its own dialectical source in the social sciences and thus of the development of the social scientist as developer. Bringing back this source does not only mean to become clear about the role of dialectic in the historical genesis or to rethink the methodological basis, but to make TRIZ fruitful again for the social sciences in this complex sense.

5. Teaching, Research and Self-awareness

The identification and implementation of laws, trends and strategies are a contextual as well as contradictory matter, which poses new challenges to the social scientist both within academia and in the market economy. The experience of TRIZ thus leads to two different fields and, accordingly, to two different tasks. TRIZ in the social sciences means, on the one hand, the transformation of teaching and research in social sciences. On the other hand, it means to understand the self-perception as well as the activity of the social scientist differently.

In teaching and research these two fields are crucial, where dialectical methodology as well as contextualized analysis are intertwined. The social scientist must deal with requirements of the method as well as its fields of application.

In teaching social sciences, therefore, four possibilities arise for implementing the experience of TRIZ:

- a. Simple rational argumentation is a limitation, which can be improved by reference to contextual entanglements. Besides philosophy of science and logic, an awareness of the genesis of dialectic and its methodological content can broaden the perspective. It requires us to return to this scientific source beyond ideological overload.
- b. Systems theories and systemic contextualization are now part of the curriculum in the social sciences. However, the same linearity errors as in the step sequences of argumentation are repeated too often. Here, the genesis of systems theory and its contradictory content links can produce another view. TRIZ as experience and toolbox opens the view on applications as a regulator for theory building.
- c. Interdisciplinarity is indispensable for both the foundations of social science teaching, science-theoretical training, and application-oriented model building. Nevertheless, here it does not simply mean the union of different disciplines, but the common conceptual work on the subject matter. Infradisciplinarity is a skill that brings together different disciplinary perspectives through the cooperative work of the concept on the problem. Methods, contexts and contradictions become the new cornerstone of social science education through cooperative interaction.
- d. Modeling and simulation are both tools and research subjects for all three fields of science education. The future of social science will have to include more and more the possibilities of visualization, narration as well as the projection of strategies in education. Here, TRIZ is a model and a resource for experience.

Overall, teaching in the social sciences needs a stronger focus on the connection between method and context, which could be accomplished through the problem of contradiction and its attempts at commissioning through TRIZ. For research, on the other hand, two new possibilities arise, namely in the design of the research itself and in the popularization of this enterprise. Research can be focused on two areas and so taking the new requirements seriously:

- a. Connecting innovations and strategies requires more spaces in which the individual disciplines can exchange ideas with each other. To achieve this, it is not enough to redesign teaching; institutional integration into the disciplines is needed.
- b. Accordingly, research collaborations are the next logical step and the future field of scientific cooperation. But here, simple interdisciplinarity is not very conducive, because the same problems of conceptual work of teaching take effect here, too. What is needed is living infradisciplinarity, i.e., joint work on the objects and the concepts used, even across disciplinary boundaries;

application-specific conceptual work becomes a factor for the future of science.

However, these new opportunities for research are only one part of the shaping of this activity. At the same time, popularization is increasingly taking place, also in two areas:

- a. With the changes in teaching and research also the presentation of the results becomes crucial. This is by no means limited to a target group, but we must also consider these recipients as the social context. Against the background of today's inconsistencies in the socio-technological framework, it becomes even more important when presenting facts and results to put them into a critical appraisal at the same time.
The identification of laws, trends and strategies and their implementation in practical application must consider the contradictions of science itself as well as the objections against it.
- b. Policy advice and policy processing thus become a mutual requirement that the scientist must consider in teaching and research. Neither a simple projection of possible development stages nor a simple simulation of possible trends can suffice. Contradictions accordingly become the political concern of one's own scientific strategy.

All in all, against this background, research and teaching must be understood as an iterative coordination process of social reality and must have a lasting effect on the self-image of science. TRIZ in the social sciences becomes an activation of potential in civil society.

In addition, the role of the social scientist itself is tangentially affected and changed. The application of innovative methodologies in social sciences is not simply the change of teaching and research, but the opening of the role of the social scientist to be understood in a new way also outside of science.

The real work of projective as well as digital development in the socio-technological framework already clearly indicates this new connection. Every innovative application in the market economy today already needs the involvement of the user as well as the extraction of her needs in the creation of the architecture as well as the design. Increasingly, methods are being used that come from the social sciences.

The application of TRIZ experience in the social sciences improves teaching, research and the popularization of the social scientist, while developing a new profession for the market economy.

The social scientist can work in the development triangle of project work by firstly understanding and coordinating the cooperation of development team and end-user. Secondly, by methodically mediating between end-users and hardware as well as software development by identifying their conflicting requirements. And third, by bringing the development team and the product together in an enlightening way in design as well as in sales.

TRIZ thus becomes a guide for model building but also a model for the sustainable development of innovative approaches. The dialectical contradiction method becomes the subject, methodology and guidance of the social scientist as a skilled worker.

6. Projects and Projections

To study systematic innovation and to use these studies are thus of great interest for science, for the scientist but also for the market economy in a complex world as outlined in section 2 and 3. The search for a source, such as dialectics in TRIZ, as we demonstrated in Section 4, is at the same time a search for design possibilities in academia, the changing economy and an increasingly demanding society. Projections of science and projects of business are not of a contradictory nature, rather they share the same contradictory intertwining of real processes, as we showed in section 5.

Dialectic as a contradiction methodology and analysis is accordingly for teaching and research a possibility of sustainable participation as well as for the market economy to establish a new training strand. Systematic innovation today needs the ethicist and social scientist not only for the development of new smart products, but also for the scientific organization as well as for professional and content-related training. Beyond classical moral requirements, the scientist will be able to refer to the analysis and exploitation of contradictions for the challenges of the changes in the socio-technological framework and especially for the socially formative development of artificial intelligence.

Dialectical analysis is not the argumentative recommendation of step-like moral taxonomies, but the identification and possible pointing out of solutions that have long existed in real practice. Bringing back this dialectical source is thus recalling the linkages that accompany our social life and enable the design of new forms of coexistence. Innovation through artificial intelligence can be elevated to a new sustainable and responsible level through innovation in the social sciences and the humanities.

Bringing back the source of TRIZ is bringing back the social complexity for science and development.

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