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ProHEAL – Social Needs and Sustainability Aspects in the Methodology of the GDR Inventor Schools

Abstract

This paper presents the basic conceptual elements of ProHEAL, a version of TRIZ developed in the 1980s within the framework of the GDR inventor schools. It elaborated already at that time on the embedding of technical solutions in the organisation of production and identified the resulting technical-economic contradictions in a much more structured way than in the ARIZ-85C variant still used in the TRIZ mainstream. In addition to a presentation of the conceptual approach, the explanations are also relevant for a history of TRIZ ideas. The developments came to an abrupt end in 1990 after German unification and are widely unknown in the TRIZ community.

Keywords: ProHEAL, GDR inventor schools, TRIZ history of ideas.

1 The GDR Inventor Schools

The GDR inventor schools in the 1980s mark an important early independent TRIZ development outside the Russian-speaking community. The specific conditions in the GDR at the beginning of the 1980s were characterised by a greater economic autonomy of the big plants (combinats) at the one side and growing overall economic problems on the other, which had accumulated during 15 years of Honecker's "unity of economic and social policy" [7, 8]. Thus technical-economic aspects already played an important role in that TRIZ variation. Such aspects were taken up only 20 years later with "Business TRIZ" in the TRIZ mainstream.

Unfortunately, this heritage is largely unknown in the international TRIZ community, certainly also because relevant materials [14, 15] have so far only been available in German and have not been translated into one of the two leading TRIZ languages, Russian and English.

Within the WUMM project [17] we started to digitise historical materials from this development and make them publicly available, initially at least in scanned form [18]. The 90th birthday of Rainer Thiel in September 2020 was an occasion to reprint the KdT teaching material [14] from 1989 in an annotated version [16]. It systematises the experiences of that time in a detailed algorithmic variant ProHEAL (a German abbreviation for *Program for the elaboration of inventive tasks and solution approaches* – in short: the invention program), which is on par with ARIZ-85C in its level of detail.

Within the space restrictions of this publication, we present the central ProHEAL-specific concepts – the path model, the decision model and the versions of the ABER matrix on the three problem field levels. In an appendix we reproduce English translations of the ProHEAL thinking field structure, an uncommented verbal and graphical representation of the ProHEAL algorithm, and the ProHEAL decision tree.

The explanations in sections 3 and 4 follow [15, part 2, ch. 4], the detailed algorithmic presentation of the ProHEAL path model in the appendix is taken from [14] and [16]. [16, ch. 5] contains a detailed explanations of the 13 steps of the path model, which are also available in English translation with [9].

2 ProHEAL Basics – a Short Overview

The starting point of the TRIZ influence on ProHEAL were the German translation of three of Altshuller's publications [1, 2, 3]. These ideas fell on fertile ground, prepared on the one hand by the structure of *Honorable Inventors* existing since 1950 and on the other hand by the *Systematic Heuristics* of Johannes Müller [11, 12]. The latter experienced a short but intensive institutional boom in the early 1970s with lasting influence on a whole generation of engineers [10]. Details of the organisational unfolding of the inventor schools are presented in more detail in [7, 8] and [15].

Due to the specific scope of application in socio-economic practices of large production units (combinates), ProHEAL differs significantly in some approaches from TRIZ in Altshuller's variant available at that time.

This refers **firstly** to the more detailed elaboration of *technical-economic contradictions* between social needs and technological possibilities. Although Altshuller is also aware of administrative contradictions, they are not seriously addressed in his work.

Secondly, ProHEAL early abandoned a monofunctional orientation, which still plays a central role in the TRIZ system concept as MPV (for example [13]). In ProHEAL, value determinations are recorded under different aspects as evaluation figure[1] at all levels of detail in the ABER matrices. Thus contradictions in the problem description are already

[1] In German "Zielgröße" but here the notion "evaluation figure" is used to emphasise its multidimensional structure.

identified during requirements elicitation. Such concepts of *generalised contradictions*, that are formed from a larger number of action and evaluation parameters, nowadays is elaborated in the IDM approach [6] in more detail.

Thirdly, in addition to solving a contradictory problem situation, the transfer of the solution into production also plays an important role in ProHEAL. Thus, even the solutions of contradictions on levels 2 and 3 are being returned to level 1 in node E2 to decide about the transfer to production, see the figure in the appendix.

As in TRIZ, the *ProHEAL Path Model* distinguishes three levels of contradiction. On the first level, a *basic variant* of the system as required is developed from the technical-economic requirements, and the (external) *technical-economic contradiction* (TEC) is identified. This contradiction can either already be solved at this level or a *critical functional area* of the basic variant is identified in which the problems caused by the TEC are concentrated. On the second level, the ideal technical subsystem for the *core variant* and the harmful technical effects are detailed. They meet in this area in the (internal) *technical-technological contradiction* (TTC). This too can either already be solved or the *critical operational area* of the core variant is identified. There a deeper *technical-scientific contradiction* (TSC) does manifest itself. Finally, on the third level, the ideal natural process of the core variant and its harmful effects are opposed to each other in the critical operational area.

Solutions on the second level often lead to unexpected low-tech inventions that are easy to implement in production – *surprisingly simple solutions* (SSS) or a *surprising impact* (SI). Solutions on the third level often lead to high-tech inventions. They have to be verified more comprehensively before transferring them to production. If no solution is found on the third level either, serious scientific research is required that goes beyond the possibilities of a company innovation project. The agenda to be worked on (C6-C9 in the appendix) lies outside of ProHEAL.

3 The Problem Field Levels in the ProHEAL Path Model

3.1 The Technical-Economic Problem Field Level

At this first level, all problem-determining facts come into consideration that relate the social need as potential need for a solution and the status of technology as a system of available technical products and processes as potential solution.

The consideration is person- and process-related and determined by the product-goods-purpose relationship[2]. Results at this problem field level are

[2] German: Produkt-Ware-Zweck-Relation

- the *technical-economic objectives* of an innovation project,
- the *basic variant* of a process or product innovation that is tailored to the technological requirements,
- the *critical functional area* in the multi-dimensional optimisation behavior of this basic variant,
- the *TEC* that prevents an optimal design and tailoring of the basic variant.

If the basic variant cannot be optimised in terms of the technical-economic objectives, we are faced with an inventive problem that has to be analysed at the next level on which the solution of the TEC is the goal of the invention.

3.2 The Technical-Technological Problem Field Level

At this next level, all the facts are considered that affect the technical system of the basic variant, its structure, function, its behavior and its immediate technological environment.

The consideration is object- and function-related and determined by the technical means-action-counteraction relations[3] . Results at this problem field level are

- the *ideal technical subsystem* as an ideal solution of the TEC in the critical functional area of the basic variant,
- the *undesired effects* as not intended, technically disadvantageous influence of the ideal subsystem on the functional behavior of the basic variant,
- the *critical operational area* in the functional structure where the causal interdependence of the ideal subsystem and the undesired effects are located,
- the *TTC*, that prevents to eliminate or suppress the undesired effect by varying the parameters of the functional principle of the ideal subsystem.

If a technical subsystem with an *alternative* functional principle in the critical functional area of the basic variant can be found without causing significant undesired side effects, then we obtained an invention as a solution to the TEC. Due to the heuristic approach, this often turns out to be located in the low-tech area, as a *surprisingly simple solution.* In the best case it only requires a technical trial run before productive roll-out.

If the solution at this problem field level is not achieved, the problem situation has to be formulated as inventive task that contains the TTC as well as a solution strategy tailored to this contradiction. The goal is to determine the harmful natural law effects in the critical operational area of the functional structure and to replace them with an alternative, known operating principle, at the third problem field level.

[3] German: Technische Mittel-Wirkung-Gegenwirkung-Relation

3.3 The Technical-Scientific Problem Field Level

At this third level, all facts come into consideration that concern the operating principle of the basic variant, the requirements for its technical use as well as its theoretical and experimental basics.

The consideration is model- and event-related and determined by the field-factor-effect relationships[4] . Results at this problem field level are

- the *ideal operating principle* that solves the TTC in the critical operational area of the functional structure,
- the *harmful natural law effects* which prevent the technical deployment of the ideal operating principle,
- *new technical-constructive boundary conditions* in the critical operational area, which suppress the harmful natural law effects,
- the *TSC*, which prevents the deployment of the ideal operating principle by varying the technical-constructive boundary conditions in the critical operational area.

If the new operating principle can be technically unfolded in the necessary dimensions to ensure the fulfillment of the function in the critical range, we are faced with an invention as a solution to the TTC. Since this enters new technical-scientific territory, the solution is usually in the high-tech area. It requires further application-oriented fundamental research for its verification.

If a solution to the problem cannot be found in this way, we are faced with a *system-immanent TSC*, that questions the development and viability of the system as a whole. The solution strategy then requires to search for a suitable, so far unknown operating principle or a fundamental process innovation. Both problem solving strategies usually go beyond the scope of a timely and financially definable innovation project. They were therefore not subject to further methodological considerations in ProHEAL, since they could not be based on corrections of the existing process and a corresponding new solution for the basic variant.

4 The ABER Matrices as a Strategic Tool in the Invention Methodology

The ProHEAL invention methodology proposes a set of methodological instruments, which includes three categories of tools and techniques:

- *Strategic tools* for goal and path planning, for working out the problem-determining contradiction at each level and to find solution strategies to overcome such a contradiction.

[4] German: Feld-Faktor-Effekt-Relationen

- *Tactical tools* for the procurement and processing of information, for the generation of solution variants and their evaluation according to given solution strategies.
- *Creativity techniques* to activate and strengthen intuition, imagination, fluency in thinking and the ability to abstract, associate and for lateral thinking.

The strategic tools differ at the three problem field levels and have inventive method specifics. The tactical tools and creativity techniques do not have inventive methodical specifics and can be used at all three problem field levels in a similar way. The choice is determined solely by the heuristic specifics of the respective working situation and the activities related to the situation.

4.1 The Evaluation Matrix (ABER(1) Matrix) at Problem Field Level 1

It is used to systematically record the goal-determining

- *Requirements* (**A**nforderungen),
- *Conditions* (**B**edingungen),
- *Expectations* (**E**rwartungen) and
- *Restrictions* (**R**estriktionen)

related to

- *Functionality*,
- *Profitability*,
- *Controllability* and
- *Usefulness*

of the investigated technical system.

The need for innovation is explicitly or implicitly expressed in a *technical-economic problem situation*. It results, for example, from increased requirements, changed conditions, new expectations and tightened restrictions with regard to production, distribution, use, abrasion or removal of the technical system.

	Functionality	Profitability	Controllability	Usefulness
A: Requirements				
B: Conditions				
C: Expectations				
D: Restrictions				

A template of the ABER(1) matrix.

The ABER(1) matrix has 16 entries and contains at least as many evaluation parameters as elements. It is used to systematically explore the actual need for action, the action goals, the project idea on which the innovation project is based. It converts this information into technical-economic system properties of the technical product or service with direct reference to the corresponding evaluation parameters.

Extensive parameter variations are used to elaborate negative feedback in the ABER matrices at different levels. E.g. an improvement in functional requirements may cause increased costs and thus have negative impact on profitability. In this way, TEC are extracted from the variation of parameters in the ABER(1) matrix.

Working with the ABER(1) matrix also requires a *process analysis* beyond the scope of the actual action goals. As result of this analysis the technical system with its overall function is *delimited* as black box model and its interfaces are sufficiently defined within the overall process. It is important that no process is skipped to capture also hidden facts, that not immediately trigger need for action and therefore are not mentioned in the goals, but may cause additional problems.

This already may result in a more precise definition of the action goals and in a modification of the project idea, which can be decisive for the later invention. The intention of the ABER(1) matrix is to anticipate all conceivable "yes, but" ("ja, aber" in German), which are expected to be opposed against an invention when it comes to introduce it into production and to the market.

The heuristic goal of further work with the ABER(1) matrix is first to find out the main technical-economic parameter that serves as *guiding parameter* for the action goals if it is varied as independent variable, and the variation behavior of the system of parameters of the evaluation figure as a whole. In the further analysis of the evaluation figure it is important to define the systemic, technical-economic problem situation that results from it. The technical-economic problem situation results from the fact that improving the guiding parameter deteriorates other, high-ranking evaluation parameters to an inadmissible degree or they go beyond given limit values.

ProHEAL assumes that the discussion of the technical-economic problem situation starts with an already contoured specific technical system. This can be an existing technical system in terms of the required overall function (*reference variant*) or one composed of components of the known and commercially available state of the art (*basic variant*). For a reference variant optimisation algorithms as well as manufacturing and operational experience are available. The potential for error is therefore relatively small. But the potential for contradiction is high as the system as a whole may be out of date. It is the other way in the case with a basic variant. A decision goes usually for a basic variant with a balanced ratio of potential for error and contradiction.

4.2 The Critical Function Matrix (ABER(2) Matrix) at Problem Field Level 2

It serves to systematically delimit the *critical functional area* and to define the technical-technological innovation objective in the form of the *ideal subsystem of the basic variant* by defining

- the functional requirements (A),
- the design and manufacturing conditions (B),
- the technological influences (E = **E**influss) as well as
- natural law restrictions and their fulfillment (R)

in relation to the elementary components of the subsystem:

- *Operand* (object that is acted on),
- *Operation* (way of acting)
- *Operator* (means to act),
- *Counter-operation* (way of counter-action in the sense of creating an equilibrium which realises the function) and
- *Counter-operator* (means to stabilise the function).

As result the technical-scientific solution needs are determined in terms of new functional requirements, other design and manufacturing conditions, changed technological influences or other types of natural law restrictions in the functional realisation. Further such solution needs are to be considered for which neither suitable means-effect relationships nor function-fulfilling technical arrangements are known in the system-related state of the art.

The work with the ABER(2) matrix is based on a *function-related structural analysis* of the system considered as a whole. It aims at delimiting the critical functional area and defining the interface conditions for the ideal subsystem in both structural and functional direction. This makes the interrelations transparent and manipulable, which cause the undesired effect in the functional behavior of the ideal subsystem.

The ABER(2) matrix has 20 entries and at least as many functional or structural parameters as elements for the ideal subsystem. When it is created, the *need for innovation* and the *technical-technological innovation goal* are explored. At the same time the inventive innovation idea is shaped as the new functional principle of the ideal subsystem. The considerations are to be extended beyond the ideal subsystem also to its interrelationships with the technical system as a whole. This is fixed in the definition of the design conditions and the technological influences in the ABER(2) matrix.

The work with the ABER(2) matrix is not only directed towards a contradiction-free inventive solution idea for the ideal subsystem. The result also may be the formulation of a *TTC* that prevents such a solution based on known operating principles. In this case, the contradicting structural and functional parameters in the critical operational area of the ideal subsystem have been found and based on this, a solution strategy can be generated that is oriented on a new operating principle.

4.3 The Operational Field Matrix (ABER(3) Matrix) at Problem Field Level 3

It is based on a scientific-mathematical model and a working hypothesis based on that model concerning the processes in the *critical operational area* of the ideal subsystem. It serves to systematically record

- Requirements (A),
- Conditions (B),
- Findings (E = **E**rkenntnisse),
- Restrictions (R)

in relation to

- technically usable effects,
- technologically to be controlled side effects and accompanying effects,
- constructively required counter-effects and guiding effects in the functional structure of the ideal subsystem

as well as the elaboration of the causal relationships between those operational parameters.

The demand on application-oriented scientific research results from previously unrealised effectiveness and efficiency requirements, completely new usage conditions, not yet available scientific knowledge or ethical or ecological restrictions.

The operational field matrix has 12 entries and at least as many operational parameters as elements to transform the problem and the solution goal from the technical to the level of scientific observation and representation.

Now the solution goal is a new functional principle according to the solution strategy and the operating principle. The solution goal is therefore no longer immediately oriented towards the invention, but primarily towards the acquisition of scientific knowledge, which opens up new space for inventive thinking.

The operational field matrix also serves to critically question inventive innovation ideas and needs for technical-scientific solutions from a point of view of natural science restrictions. This can lead to a new view on the problem and a new inventive innovation idea, which no longer implies an undesired effect and therefore is free of contradictions in the technical-technological meaning.

For the critical, solution-oriented exploration of the inventive innovation idea from this scientific point of view, substance-field analysis can be applied. Within ProHEAL substance-field analysis was developed further from a more phenomenological to an analytical tool to create effect-related solution modules.

For this purpose, a system of scientific effects in different forms was developed as a knowledge store on electronic media, that could be used to search for suitable solution variants starting with a problem- and contradiction-oriented menu. Also Manfred Ardenne's monograph [5] was used in the inventor schools.

5 Conclusion

To understand the specific experiences of the GDR inventor schools and the algorithmic TRIZ variant ProHEAL presented here it is indispensable to take into account the larger picture of the specific economic development conditions in the GDR of the 1980s. Altshuller's *Theory of the Development of Creative Personalities* and his term *heresy* used in this context [4] refer to special experiences and observations of the founder of TRIZ as such a personality. At the same time, they point to a special position and mechanisms of social exclusion of such "troublemakers" when they are not needed to solve mature problems that resist "normal" problem-solving approaches. Bundles of such problems in times of crisis – and this is what the GDR economy of the 1980s was all about – opens up scope for the application of contradiction-oriented problem-solving methodologies in a wider range.

There was a *practical* fertile ground and roots already prepared in the 1970s which could now grow more intensively in a number of GDR combinates. At a first level, this required broadening the personnel base of appropriately trained experts. The practical organisational and methodological approaches of this movement of trainings are described in more detail in [15]. Even driven by strong traits of self-organisation, it would not have reached the dimensions that were ultimately achieved without the provision of time and material resources by a number of combinates. The dissolution of this economic-structural basis after 1990 led to the rapid collapse of these training structures.

Even the few efforts of far-sighted representatives of a West German culture of innovation don't change this general picture – what value can be generated in a capitalist market economy from experiences gained in a socialist planned economy? Such a judgement shows ideological blindness, as witnesses the experience of the introduction of TRIZ methods in South Korea, which was also essentially triggered by the open-mindedness of strategic management and the provision of resources by large economic units as SAMSUNG.

Germany was faced with a second TRIZ wave at the beginning of the 2000s, which was triggered by Russian-speaking TRIZ experts emigrating to Germany. This wave was already unable to pick up these older developments, neither in terms of personnel nor organisation, and the TRIZ expertise of representatives of this first generation – such as Michael Herrlich, Hansjürgen Linde, Hans-Joachim Rindfleisch, Rainer Thiel, Dietmar Zobel – is still perceived as marginal even in the inner German discourse.

It should be all the more interesting to compare those developments, which date back more than 30 years, with current trends – above all with *Business TRIZ* – to identify moments of the uncompensated and let them become effective. This paper aims to contribute to such a process.

6 Postscript

The paper was accepted by the reviewers for presentation at the *TRIZ Future Conference 2021*, but it does not meet the "novelty" criteria for a paper to be included in the Conference Proceedings, as 61% of the material presented here[5] can also be found on the pages of the WUMM project and hence „is not new“. Such rules massively hinder the further development of scientific ideas and call into question the discursive character of scientific work. *LIFIS-Online* is a scientific journal that stands on clearly different positions. Hence this survey is published in this journal.

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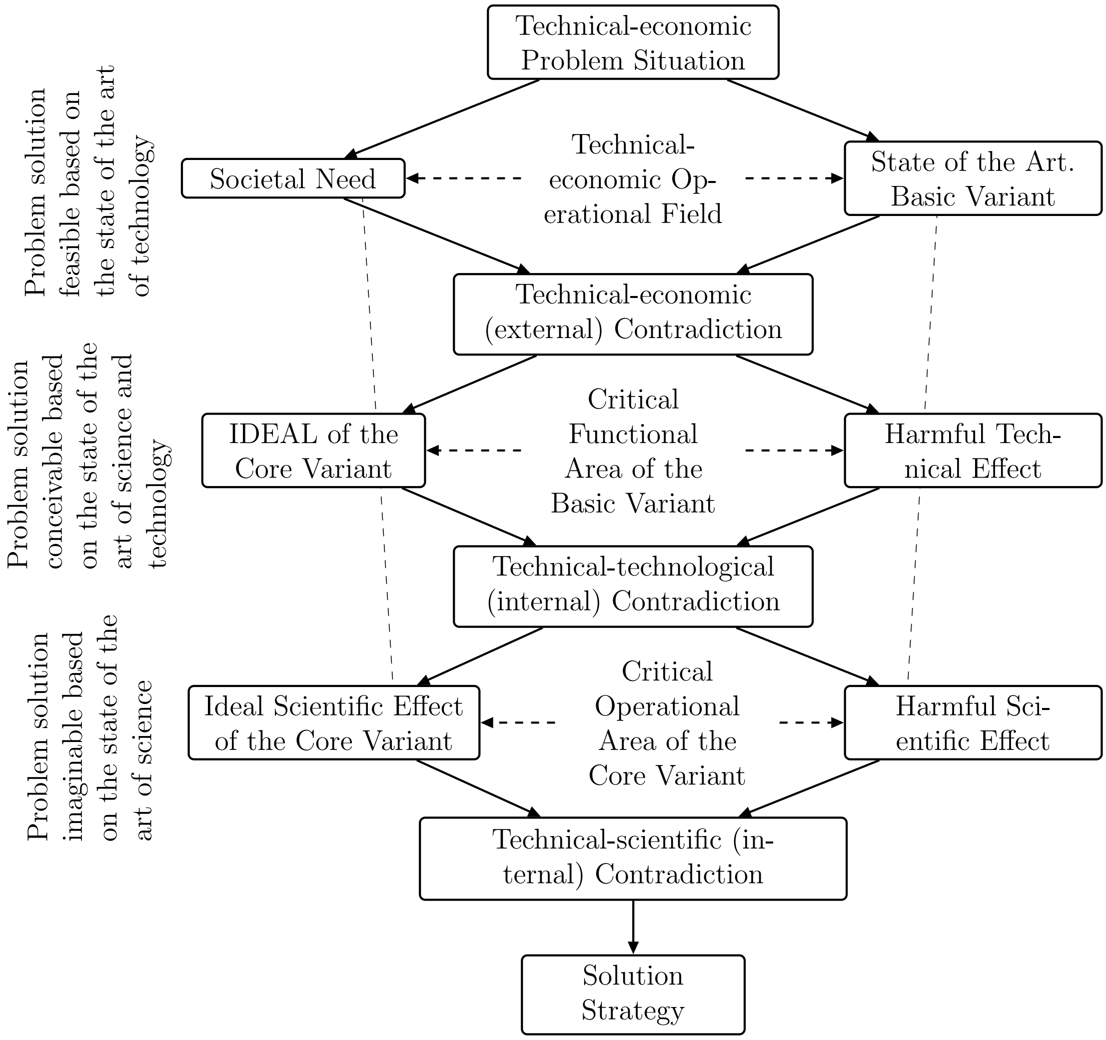
Appendix. The ProHEAL Building Blocks

In the following, we reproduce an English translation of the main blocks of the ProHEAL approach, the *Thinking Field Structure*, the *Path Model* and the *Decision Model* as published (in German) in [14, Appendix] and republished in [16, Appendix]. They give the TRIZ expert a good overview of similarities and differences of the ProHEAL approach to other TRIZ versions.

Appendix 1. The ProHEAL Thinking Field Structure



Appendix 2. ProHEAL – The Algorithm

The following presentation follows [14, Appendix], in which the algorithm is presented in short form as a programme flow chart. The numbers in brackets refer to the detailed version of the algorithm in [16, ch. 3] (30 printed pages). Since the presentation of the details would go far beyond the scope of this paper, we refer the interested reader to this (German) publication. See also the diagrammatic presentation of the path model in part D of this appendix.

A. The Technical-Economic Part of the Program

Objective: Critique of the state of the art from a technical-economic point of view. Determine the relevant evaluation and reference variables.

- (A1) Specify the societal need (SN) according to operational tasks of the enterprise
  - (A1a) Determine the overall SN (1.3), (1.6)
  - (A1b) Determine the special SN (1.1), (1.2), (1.4)
- (A2) Find the ABER (1.4), (1.6), (1.7)
- (A3) Determine the required usage properties (1.4), (1.5)
- (A4) Define the components in the evaluation figure (1.8), (1.9), (1.10)
- (A5) Choose the technical-technological principle (2.1)
- (A6) Determine the basic variant of the technical system starting from the state of the art (2.2), (2.3), (2.4)
- (A7) Formulate the technical-economic objective (2.5), (4.3b)
- (A8) Black box analysis of the technical system (2.6), (2.7), (2.8), (2.9), (2.10), (2.11), (2.14), (2.15), (3.4)
- (A9) Delimit the technical-economic field of operation (2.12), (2.13), (3.1), (3.2), (3.3)
- (A10) Determine the guiding parameter (2.5f), (4.1)
- (E1) **Decide:** Is the technical system appropriately delimited? (4.2), (3.4)
  - **Yes:** Go to (E2)
  - **No:** Back to (A8)
- (E2) **Decide:** Is an optimisation solution possible? (2.9), (2.14), (2.15)
  - **Yes:** Work out the optimisation solution → STOP
  - **No:** Go to (A11)
- (A11) Find and formulate the TEC that determines the problem (4.2), (4.3), (4.4)
- (E3) **Decide:** Is there a case of "business blindness"?
  - **Yes:** Back to (E2)
  - **No:** Proceed with part B
  - **Unknown:** Back to (A5)

B. The Technical-technological Part of the Program

Objective: Critique of the state of the art from a technical-technological point of view. Determine the decisive functional parameters.

(B1) Find and formulate the undesired effect (2.10), (2.11), (2.15c), (2.15e), (5.1), (5.4)
(B2) Delimit the critical functional area in the structure of the technical system (2.8), (2.15c), (2.15d) (3.4), (5.2), (5.3)
(B3) Draft the ideal subsystem for the core variant (in the critical functional area of the technical system) – IDEAL – (6.1)
(B4) Develop ideas about the necessary technical requirements (ABER) for the usefulness of the IDEAL (ideal conceptions) (6.2)
(B5) Conceptual modification of the technical system with regard to required functional properties outside the critical functional area according to the IDEAL on the ABER (6.3), (6.4)
(E4) **Decide:** Does a harmful technical effect reappear? (6.5)

- **Yes:** Back to (B2)
- **No:** Go to (E5)

(E5) Decide: Are the ABER sufficiently determined? (6.2a)

- **Yes:** Go to (B6)
- **No:** Back to (B4)

(B6) Extract the ideal final result (6.4)
(E6) **Decide:** Is the ideal vision in the ABER technically feasible? (6.2a), (9.5)

- **Yes:** An unexpected approach to a surprisingly simple solution (SSS) is found (6.5). Back to (E2).
- **No:** Go to (B7)

(B7) Find and formulate the TTC (6.2d), (7)
(E7) **Decide:** Is it a prejudice of the professional world? (6.2a), (9.5)

- **Yes:** Transition to the elimination of the TTC with surprising impact (6.2a), (9.5). Back to (E2).
- **No:** Go to part C
- **Unknown:** Back to (B1)

C. The Technical-scientific Part of the Program

Objective: Critique of the state of the art from a technical-scientific point of view. Determination of the decisive operational parameter.

(C1) Derive the technical-scientific cause of the harmful technical effect from the ABER (8.1a)
(C2) Find the critical operational area in the technical system (2.8)
(C3) Model the critical operational area.
(C4) Formulate a search query to the database of scientific effects to realise the ABER according to the ideal vision (ideal scientific effect) (8.3)
(E8) **Decide:** Is there an appropriate scientific effect?

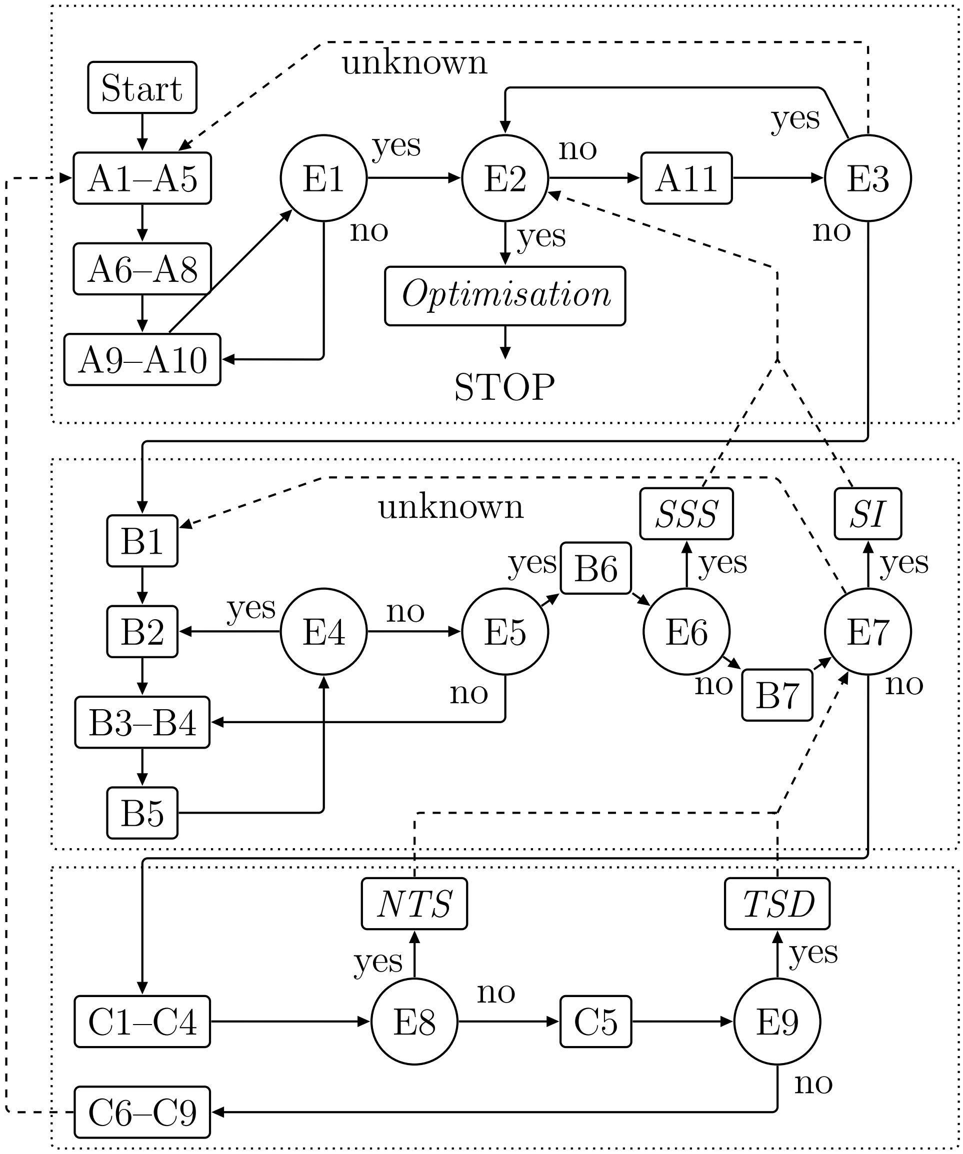
- **Yes:** Consider it as basis for a new technical approaches. Back to (E6).
- **No:** Go to (C5)

(C5) Formulate the technical-scientific contradiction (8.1b), (10.1)
(E9) **Decide:** Is it a matter of blindness in the professional world? (8.2), (10.1)

- **Yes:** Consider technical approaches from a foreign domain. Back to (E2).
- **No:** Go to (C6)
- **Unknown:** Back to (C1)

(C6) Find suitable solution strategies in the technical system to overcome the TSC (8.2), (9.1), (9.2), (9.4a), (10.2)
(C7) Formulate the invention task with the goal of a radical renewal of the structure of the technical system (9.4b)
(C8) Find suitable solution principles to solve the problem of the invention task (9.3), (9.4a)
(C9) Find fundamentally new approaches to solutions (creation of a new generation of the technical system) (10.2) → Back to (A5)

D. Diagrammatic Presentation of the Algorithmic Structure of ProHEAL



Legend

SSS	Surprisingly Simple Solution
SI	Surprising Impact
NTS	Novel Technical Solution
TSD	Technical Solution from another Domain

Appendix 3. The ProHEAL Decision Tree

In [14, Appendix] the decision tree is also presented as a diagram and announced as *Renewal Passport, Part I – Elaboration of Inventive Tasks and Solution Approaches within the Nomenclature Framework of the achievements and work stages of the Plan Science and Technology.* This formulates a normative claim as to how ProHEAL fits into more general planning documents, which play an important role not only in a socialist planned economy. Whether this normative claim was realised in practice is another matter.

(P1) Can the **technical-economic contradiction** be solved by multidimensional optimisation based on the state of the art?

- Yes. Derive a **Draft Specification**[6] of the realisation without inventive objective.
- No. Continue with (P2).

(P2) Can the *harmful technical effect* be determined and explained using sufficiently secured hypotheses or models based on the state of the technical-technological experience and the technical-scientific knowledge?

- Yes. Continue with (P4).
- No. Continue with (P3).

(P3) Hypothesis generation. Derivation of the target question for hypothesis testing. Derive a **Draft Specification** for the required research with a discovery-oriented question.
Return to (P2) with the results.

(P4) Does the *ideal final result* appear realisable as a complete elimination of the *harmful technical effect* without substantial change of the technical system as a whole?

- Yes, under certain conditions. Derive a **Draft Specifiction** of the realisation with inventive objective.
- Not realisable, even taking into account all feasible options. Continue with (P5).

(P5) Does the **technical-technological contradiction** appear to be solvable based on the state of the art in technology or at least a solution is hypothetically conceivable?

- Yes. Continue with (P7).
- No, and even hypothetically not conceivable. Continue with (P6).

(P6) Solve the **technical-scientific contradiction** by finding hypotheses, building models and deriving the search question for effective operational principles. Derive a **Draft Specification** of the research project with inventive objective.
Return to (P5) with the results.

[6] German: "Pflichtenheft".

(P7) Is a **solution strategy for the technical-technological contradiction** feasible?

- Yes, possibly in more distant analogy areas and/or on the basis of on the basis of sufficiently secured hypotheses. Continue with (P9).
- No. Continue with (P8).

(P8) The search question has to be formulated on the basis of insufficiently secured hypotheses concerning the technical applicability of operational and working principles. Derive a **Draft Specification** of research with an inventive objective.
Return to (P7) with the results.

(P9) Derive a **Draft specification** for realisation from the principal solution approaches with an inventive objective.