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

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Hans-Gert Gräbe, Rainer Thiel

Leipzig University, Germany

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GDR Inventor Schools – Facts and Organisation

- Over 300 inventor school courses in the 1980s (source: [RT1994]).
- Typical structure: 2 one-week courses in a guesthouse of the company.
- Participants bring their own problems.
- These are analysed and prepared in the first week according to the methodology. At the same time, the methodology is taught.
- This is followed by self-study at home (further analysis and preparation of the problem, patent analysis etc.).
- In the second week of the seminar, the results are discussed and the solution is developed further for application in production.

TRIZ Influence on the GDR Inventor Schools

- Michael Herrlich, WOIR and the 1960s
- Translation of three books of G.S. Altshuller
  - *Erfinden - (k)ein Problem?* (Invention – no problem?) Verlag Tribüne, Berlin 1973. Translation of *Алгоритм Изобретения* (1969) by Gerd Willimczyk.
  - *Flügel für Ikarus* (Wings for Icarus). Urania-Verlag, Leipzig 1983. Translation of *Крылья для Икара* (1980) by Thiel & Thiel.
  - *Erfinden. Wege zur Lösung technischer Probleme* (Inventing. Ways to solve technical problems). Verlag Technik, Berlin 1986. Translation of *Творчество как точная наука* (1979) by Thiel & Thiel.
- GDR-specific sources *Systematic Heuristics* (Johannes Müller) in the instruction of engineering students as well as less systematic innovation methodologies especially in the tradition of Karl Duncker.

Economic Situation in the GDR at the Beginning of the 1980s

The changed economic policy under Honecker in the 1970s neglected the development of the innovative power of the economy. In particular, after 1974, approaches to the development of cybernetics and control technology were scaled down, which in the early 1980s led to serious competitive disadvantages on the international market, especially for products from the mechanical engineering sector.

These problems could no longer be solved by a centrally planned economy alone, which increased the importance of strategic decisions at the enterprise level and thus the political weight of the directors of the combinats.

Economic Situation in the GDR at the Beginning of the 1980s

Thus, from the very beginning, the focus for ProHEAL was not only on technical problems, but on broader technical-economic problems at the level of operational management decisions of R&D and of further development of product portfolios under dynamically changing economic conditions.

Hence ProHEAl developed already at that times also elements of *Business TRIZ*.

ProHEAL – the Path Model Guiding through the Problem Field Levels

- **The Technical-Economic Problem Field Level**
  The consideration is person- and process-related and determined by the product-goods-purpose relations.
- **The Technical-Technological Problem Field Level**
  The consideration is object- and function-related and determined by the technical means-action-counteraction relations.
- **The Technical-Scientific Problem Field Level**
  The consideration is model- and event-related and determined by the field-factor-effect relations.

The Technical-Economic Problem Field Level

Goal: Develop a *basic variant* from the social needs as (potential) requirements *based on the technical state of the art* and the available production and management experience.

Analyse this basic variant carefully based on the (multidimensional) ABER(1) matrix and identify all major technical-economic contradictions (TEC) (e.g. between functional requirements – German: **A**nforderungen – and legal **R**estrictions).

The Technical-Economic Problem Field Level

Question: Can these TEC be solved by multidimensional optimisation and tayloring of the basic variant?

Yes: A solution strategy is **feasible**. Develop a corresponding **Draft Specification** (German: Pflichtenheft) for the realisation without inventive objective and implement that. $\rightarrow$ Done.

No: Identify the central (external) TEC and look for a technical-technological solution which transforms the basic variant and solves this TEC $\rightarrow$ Second level.

The Technical-Technological Problem Field Level

Delimit the *critical functional area* in the basic variant in which the central TEC manifests itself. Find the technical means, effects and counter-effects and their relationships in this critical functional area and develop a suitable technological model with the three components

- the *ideal technical system* that solves the TEC in the critical functional area,
- the *undesired side effects*,
- the *critical operational area* in the functional structure where the undesired effects conflict with the ideal solution.

The Technical-Technological Problem Field Level

Analyse this core variant carefully on the basis of a ABER(2) matrix and identify all significant technical-technological contradictions (TTC) (e.g. low controllability of a required operation (**A**nforderung) due to **R**estrictions on the counter-operator).

Question: Is the model justified by sufficiently secured hypotheses *or* technical-technological experience *or* technical-scientific knowledge?

No: Generate further hypotheses, which must then be analysed in more detail in a **separate sub-project**. Develop a corresponding **Draft Specification** with discovery-oriented questions and return with the results to this point.

Yes: Decide about further strategy (A) or (B).

The Technical-Technological Problem Field Level

(A) A solution strategy for the TTC is **conceivable**.

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. Return with the transformed core variant to level 1.

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.

The Technical-Technological Problem Field Level

(B) The solution at this problem field level is **not feasible and even not hypothetically conceivable**.

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 operating principle, at the third problem field level.

The Technical-Scientific Problem Field Level

For this purpose, the critical operational area must be analysed in more detail,

- designing an *ideal operational principle* that solves the TTC,
- identifying *harmful natural laws effects* that prohibit the technological implementation of the ideal operational principle and
- identifying *technical-constructive conditions* under which these harmful natural law effects are or can be suppressed.

Analyse this model carefully based on an ABER(3) matrix to identify all significant technical-scientific contradictions (TSC) (e.g. between known technical effects – German **E**rkenntnisse – and constructively required counter-effects as **R**estrictions).

The Technical-Scientific Problem Field Level

The solution goal is therefore no longer immediately oriented towards the (technical) invention, but primarily towards the acquisition of scientific knowledge, which opens up new space for inventive thinking.

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

For this purpose, a database 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 Ardenne's monograph on science-based technical effects was used in the inventor schools.

The Technical-Scientific Problem Field Level

Question: Is there a new functional principle according to the solution strategy and the operating principle?

Yes: A solution strategy for the TSC is **imaginable** (e.g. by adopting a known fundamentally different technological approach from another domain on the basis of sufficiently secure hypotheses). Draw up a **Draft Specification** with an **inventive approach for this fundamentally new solution**.

The Technical-Scientific Problem Field Level

Elaboration of the approach needs more time in order to test its suitability for production. If it is feasible, return to the second level with the transformed core variant.

If this can be solved an inventive high-tech solution is found, but it needs more and thorough preparation to be introduced into production (return with the transformed operational principle to the technical-technological problem field level to transform the basic variant).

The Technical-Scientific Problem Field Level

No: If no immediate solution is possible, then the entire system of the basic variant is fragile and requires a thorough scientific-technical analysis that cannot be dealt within an innovation project with well delimited resources.

Nevertheless, a **Draft Specification** for the research project to be carried out emerges from the analysis so far. With the results go back to the technical-scientific problem field level.

ProHEAL – the ABER Matrices

ABER(1)	Functio-nality	Profita-bility	Controll-ability	Useful-ness
A: Requirements				
B: Conditions				
C: Expectations				
D: Restrictions				

ABER(2)	Operand	Operation	Operator	Counter-operation	Counter-operator
A: Requirements					
B: Conditions					
C: Influence					
D: Restrictions					

ABER(3)	useful effects	side effects	counter-effects
A: Requirements			
B: Conditions			
C: Findings			
D: Restrictions			

ProHEAL – Main Distinctive Features as TRIZ Methodology

Due to the specific scope of application in socio-economic practices of large production units (combinates), ProHEAL differs significantly in some aspects 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. Value determinations are recorded under different aspects as evaluation figure at all problem field levels in the ABER matrices. Thus contradictions in the problem description are already identified during requirements elicitation.

ProHEAL – Special Features as TRIZ Methodology

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.

More Food for Thought:

1. Importance of domain-specific modelling.
2. Connections of the TRIZ Hill Scheme to other Business Process concepts.
3. Importance for Business TRIZ – Distinction between strategic and operational management.

ProHEAL – Recent Publications

- H.-G. Gräbe, R. Thiel. ProHEAL – Social Needs and Sustainability Aspects in the Methodology of the GDR Inventor Schools. LIFIS Online, 15.08.2021. `http://dx.doi.org/10.14625/graebe_20210815`
- H.-G. Gräbe, R. Thiel. ProHEAL Basics – Extended Version. August 2021. To appear in LIFIS Online.
- Rainer Thiel. Dialektik, TRIZ und ProHEAL (Dialectics, TRIZ and ProHEAL). Rohrbacher Manuskripte, Heft 21. LIFIS Berlin 2020. ISBN 978-3-7526-2015-3. (in German)
- H.-G. Gräbe. The Contribution to TRIZ by the Inventor Schools in the GDR. Proceedings of the TRIZFest 2019. ISBN 978-0-578-62617-8, pp. 346-352.
- `https://wumm-project.github.io/GIS`