Combination of Contradictions Based approach and Logistic Curves models for Strategic Technological Forecasting

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Summary

In order to be reliable a forecast has to be reproducible and verifiable; the applied models have to be computable and based on patterns of system evolution. Nevertheless, application of merely quantitative models makes impossible to identify the pioneering technologies because new ones are uncountable. With logistic growth curves it is possible to predict time of growth of new technology, but it is questionable to recognize a technology precisely [1]. The expert opinions based approaches may provide the answer for the question ‘what’, but the results of intuitive approaches are doubtful. It is suggested a Researching Future methodology based on synergy of networks of contradictions and logistic curves models. It will be shown how the qualitative method allows interpreting the results of quantitative S-curve models and defining the features of the next technologies. The suggested methodology was applied, tested, and refined through several forecasting projects starting from 2003.

Keywords: network of contradictions, S-curve models, logistic curves models, OTSM-TRIZ

1. Motivation / State of the Art

After decades of research about future of technology changes, a lot of forecasting approaches were developed and tested in practice. Knowledge about future of technologies is particularly important for taking strategic decisions about investments into R&D and into educational systems. Reliable forecast of socio-technological changes is vital for running successfully micro- and macro-economic systems.

In context of engineering design, research and development of new technologies, and inventive problem solving a reliable forecast provides a lot of competitive advantages. For instance, how can one distinguish that a formulated problem is worth to be solved? Practical and research experiences of author within inventive problem solving proves that “we fail more often because we solve the wrong problem than because we get the wrong solution to the right problem[1].” More often than not, to identify right problems for solving is more essential for successful results than just to resolve a problem.

Literature survey demonstrates the growing interest in technological forecasting starting from the beginning of XX century [2-5]. The exponential growth of institutions, research groups and consultants involved in technological forecasting for last four decades produced a multitude of approaches and methodologies [2, 3, 6-11].

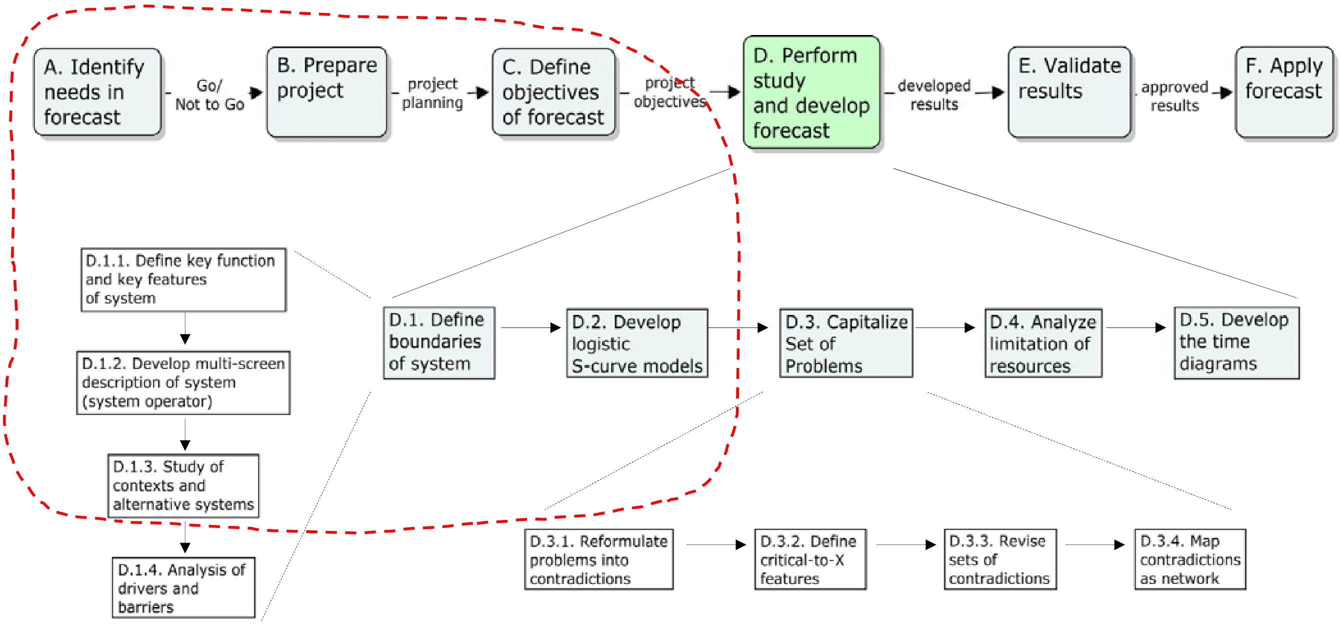
To overview the recent advancement about forecasting practice all methods can be classified into four groups:

(1) Causal models (e.g. analogy analysis, morphological analysis, laws and patterns of system evolution);
(2) Phenomenological models (e.g. extrapolations of time series data, regressions);
(3) Intuitive models (e.g. Delphi surveys, structured and unstructured interviews);
(4) Monitoring and mapping (e.g. scanning of literature and published sources, scenarios, mapping existing information).

The main drawback of qualitative methods (1, 3) is connected with low reproducibility of developed forecasts and high man-hours expenses. From this perspective, the quantitative methods (2) are always superior. Attempts to study future with massive examination of existing information (4) face with problems of trustworthiness of applied sources [12].

The following contradiction can be formulated: in order to be reliable and affordable the forecasting process has to apply quantitative methods and models from hard science, but in order to predict next technologies and pivotal socio-technological changes, the forecasting process has to be based on qualitative approaches using trustworthy sources of knowledge.

[1] Russell Lincoln Ackoff (1919-2009) – was a pioneer in the field of operations research, systems thinking and management science.



2. Experimental

The Researching Future methodology (RFM) has been developed as a kind of solution for supporting forecasting projects when it has been required to predict a distant future with high reliability. RFM is based on five components that help for integration of quantitative and qualitative approaches when using trustworthy sources of knowledge.

- Logistic Growth Curve models (quantitative approach from hard science adapted for socio-technological systems)
- Limit of Resources concept (verified models from economics; also applied in TRIZ as resource analysis)
- Wave & Cycles models (proved models from science and economics)
- Information and Knowledge Management models (techniques for effective management of team work)
- OTSM-TRIZ models (the contradiction model, the methodology to examine the network of contradictions, and several basic concepts from TRIZ).

Development of RFM was initiated in 2003 in border of research project for future distributed energy sources [13]. Every new version of RFM was tested through forecasting projects with practical outputs for strategic decision making. The suggested methodology is integrated into generic process[2] of technology forecast (TF) at the phase “Perform study and develop TF” [14]. The roadmap of future technological changes can be developed among other outcomes of the forecasting project.

3. Results and Discussion

The Researching Future methodology has been piloted in three large forecasting projects (Germany-France, Chile) and in two express-forecasts (France, Italy). The methodology has also been presented within two seminars organized for learning about RFM (Italy, Turkey). Some parts of methodology have been taught in border of Advanced Master of Innovative Design (INSA, Strasbourg) courses from 2009 to 2012. The interim versions of RFM were reported within engineering design conferences [13, 14, 15]. The results of performed projects demonstrate efficiency of methodology in the context of long-term technological forecasting and for engineering design.

[2] (1) identify needs in TF, (2) prepare project, (3) define objectives of TF, (4) perform study and develop TF, (5) evaluate results, and (5) apply TF

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