Forecasting technology emergence: Scenario exploration and prediction accuracy

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Research Background
Technology forecasting is no easy task.
- Rapid technology advancement
Technology forecasting is increasingly important.
- Scarce resources
- Escalating global competitions
Yet, among the fast growing number of studies on technology forecasting approaches, evaluating prediction accuracy remain under-investigated due to the lack of golden criteria and the absence of comparison indicator, shadowing the true value of technology forecasting on wise decision making in R&D portfolio investment and innovation management.

Research Purpose
- To experiment different approaches of technology forecasting;
- To develop quantitative measures to compare their prediction performance;
- To examine prediction performance in both science space and technology/innovation space

Data & Methodology

Data sources
- Trial dataset: Web of Science publications (Y2007-Y2016), n1= 67,077
- Golden criteria datasets:
  - Web of Science publications (Y2017-Y2018), N1= 18,335
  - Derwent Innovation Index patents (Y2017-Y2018), N2= 317
- Complementary datasets:
  - JCR, Leiden Ranking; PubMed

Focus area: Synthetic biology

Prediction methods
- FREQ: frequencies of technical key words
- DEGREE: network indicator based on key words co-occurrence
- PAFIT: bayesian statistical indicator
- ES: emergence score algorithm

Prediction performance measurements
1. prediction precision
   Capture Rate = (#correctly predicted hotspots/# actual hotspots)*100%
2. prediction error: RMSE=√[Σ(d_i^2)/n]

Finding illustrations

Science advancement forecasting

Technological innovation forecasting

Preliminary Findings
- Keywords (Authors) itself seems work pretty good in projecting scientific evolution in field of synthetic biology.
- The weightings are not working well as we expect (marginal improvement).
- Yet, none of the four approaches perform well in predicting technological innovation.

Discussion

Limitations & future research directions
- Arbitrary/subjective selection (of research field; forecasting years; criteria dataset)

Policy implications
- (Only) correct technology forecasting can assist government decision makers and corporation managers to make wise decisions on R&D investment portfolio.