TECHNOLOGY CYCLES AND THEIR DIFFERENTIATION BASED ON TEXT MINING APPROACHES

Patricia Helmich, Peter Neuhäusler, Rainer Frietsch
Fraunhofer ISI, Karlsruhe
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Structure of the Presentation

1. Introduction
2. Method
3. Application and evaluation
4. Conclusion

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Introduction

- In general, the development of technologies follows a two-cycle pattern: a first phase of rather fundamental research and a second phase of more application-oriented research (Meyer-Krahmer and Dreher (2004), Schmoch (2007)).

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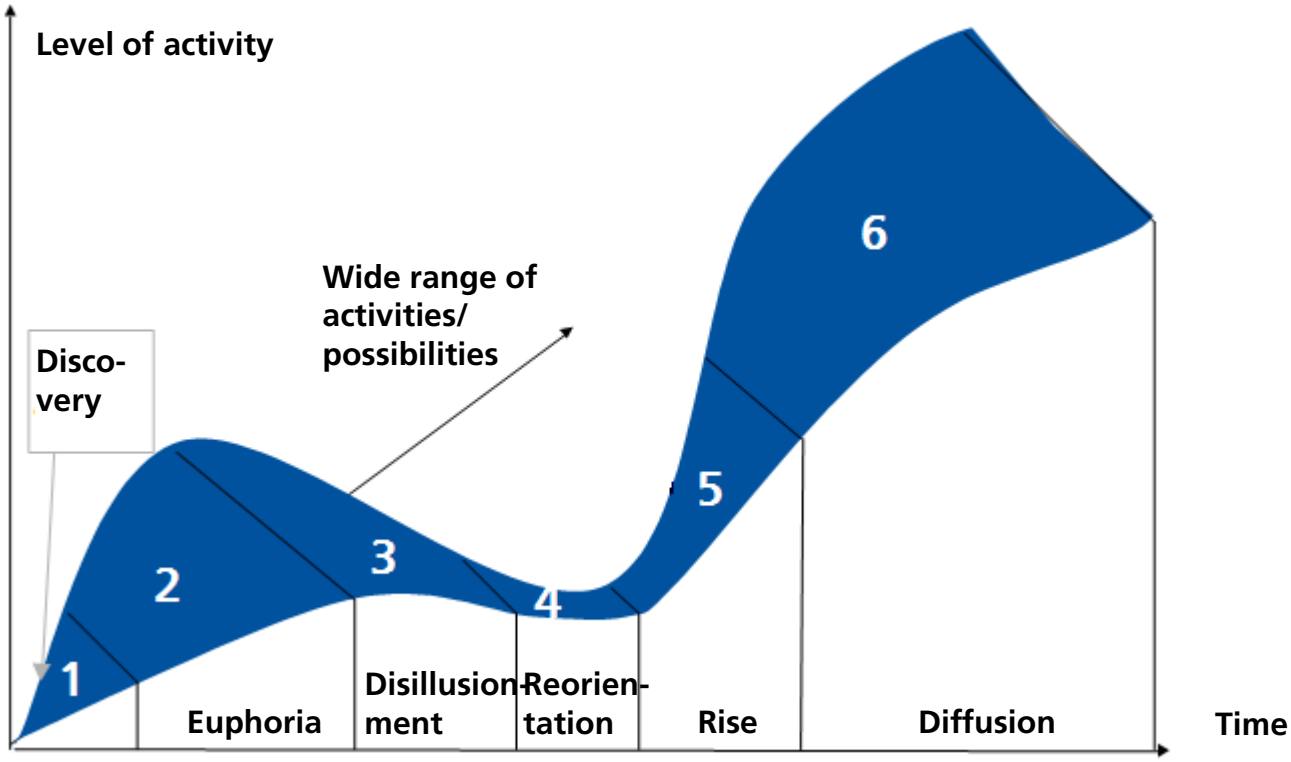
Technology cycles: 6 Phases



Source: Dreher et al. (2005); Meyer-Krahmer und Dreher (2004); Frietsch et al. (2010)

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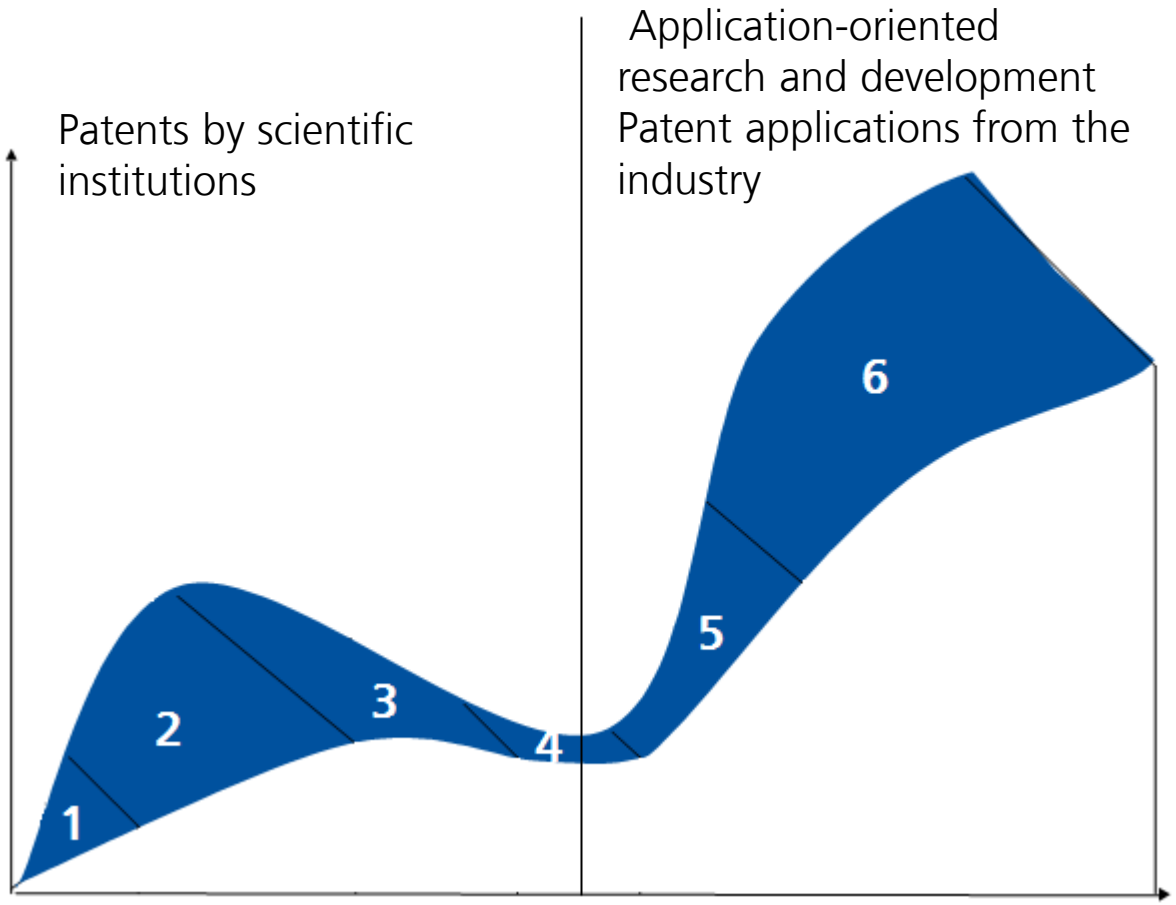
Technology cycles: Double boom curve



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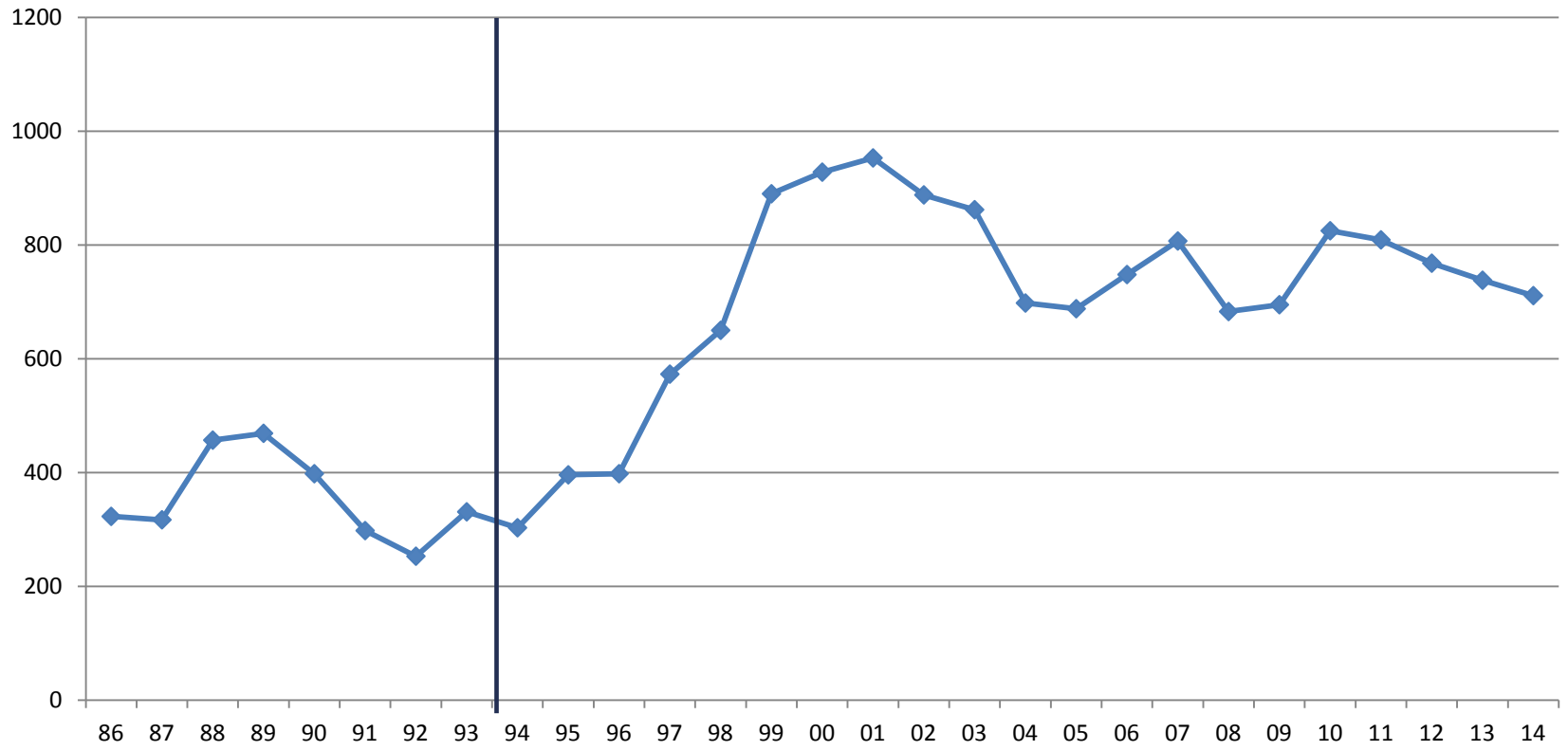
Technology Cycles - Example

Combustion engine



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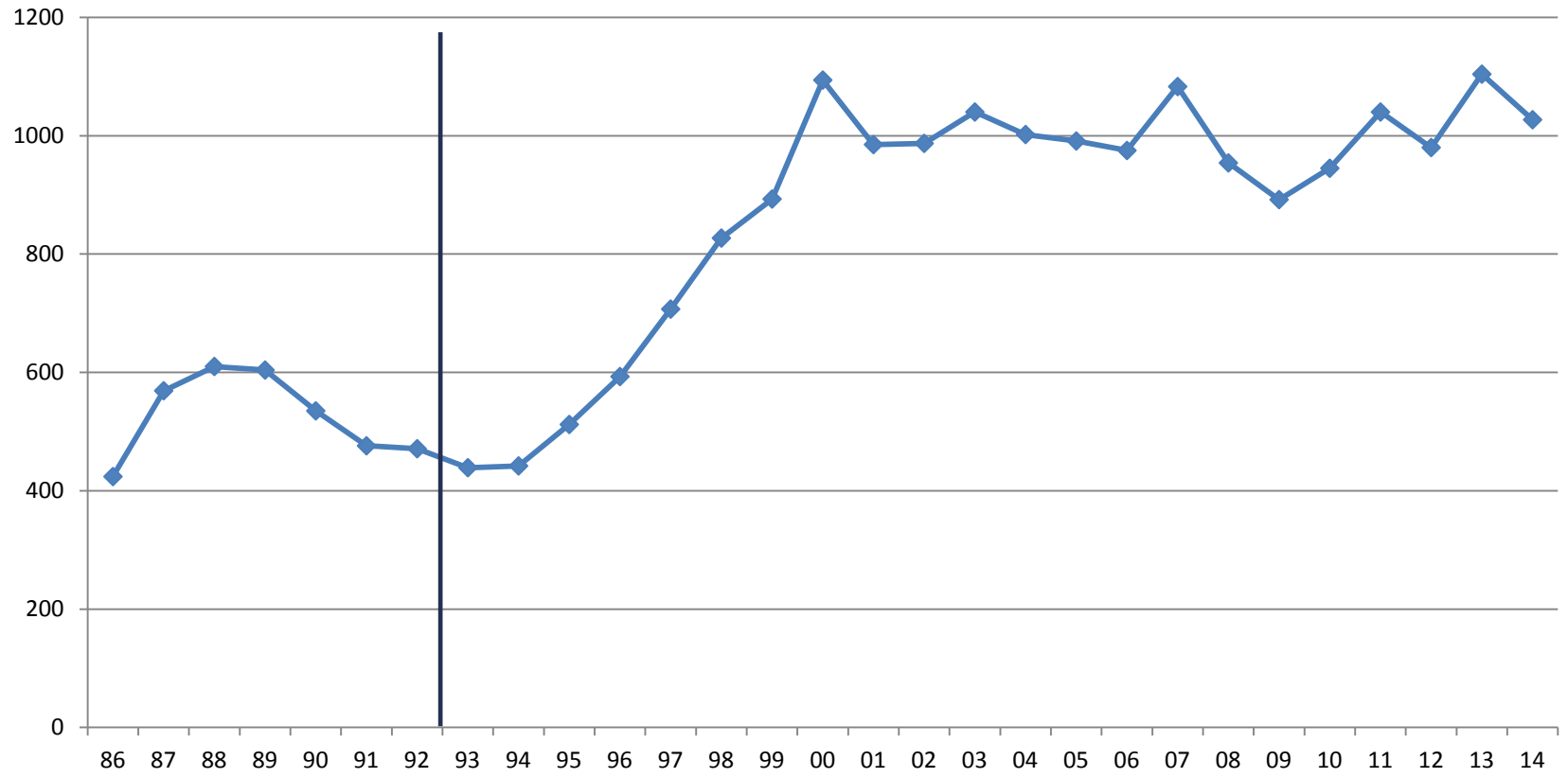
Technology Cycles – Example

Optical technologies



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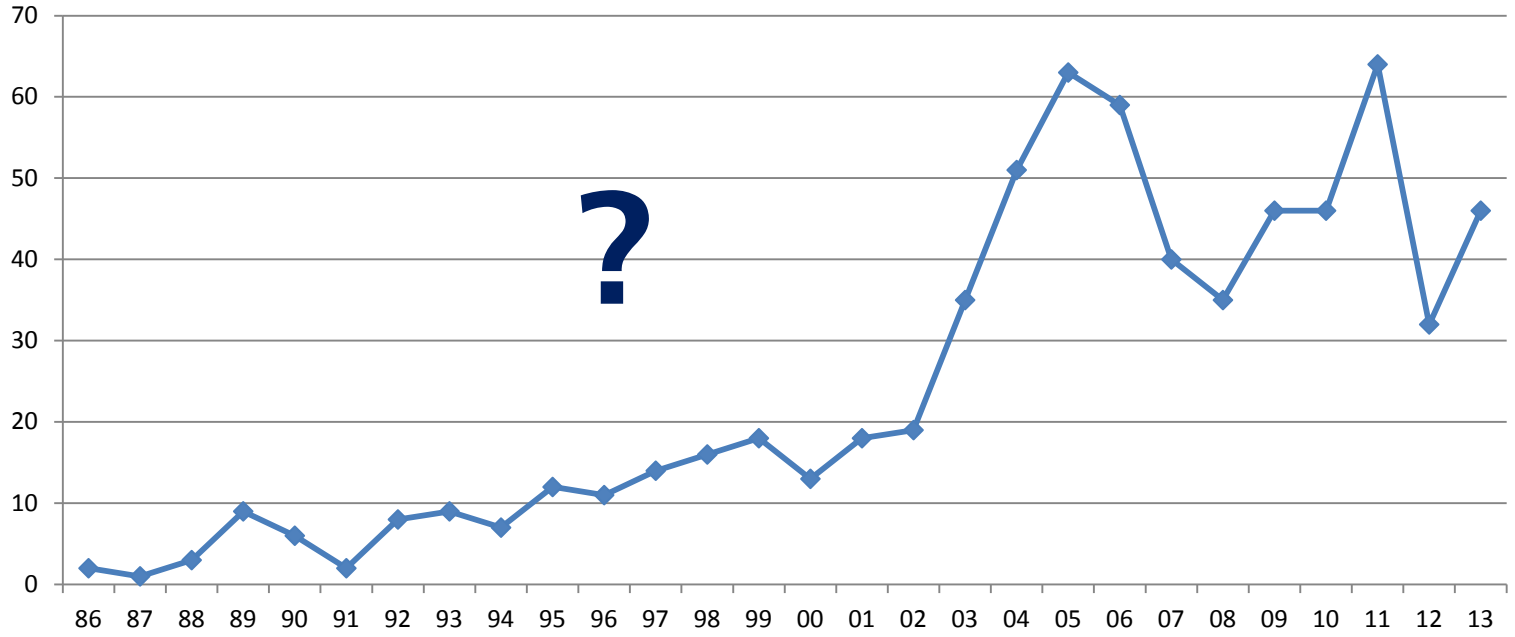
Technology Cycles – Problems

- No clear distinction of the two phases
- Two phases not yet finished

- e.g. RFID



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Introduction

- In general, the development of technologies follows a two-cycle pattern: a first phase of rather fundamental research and a second phase of more application-oriented research (Meyer-Krahmer and Dreher (2004), Schmoch (2007)).
- We propose a text-based method that provides evidence for the difference of the two phases and may be applied for the identification of the two different phases.

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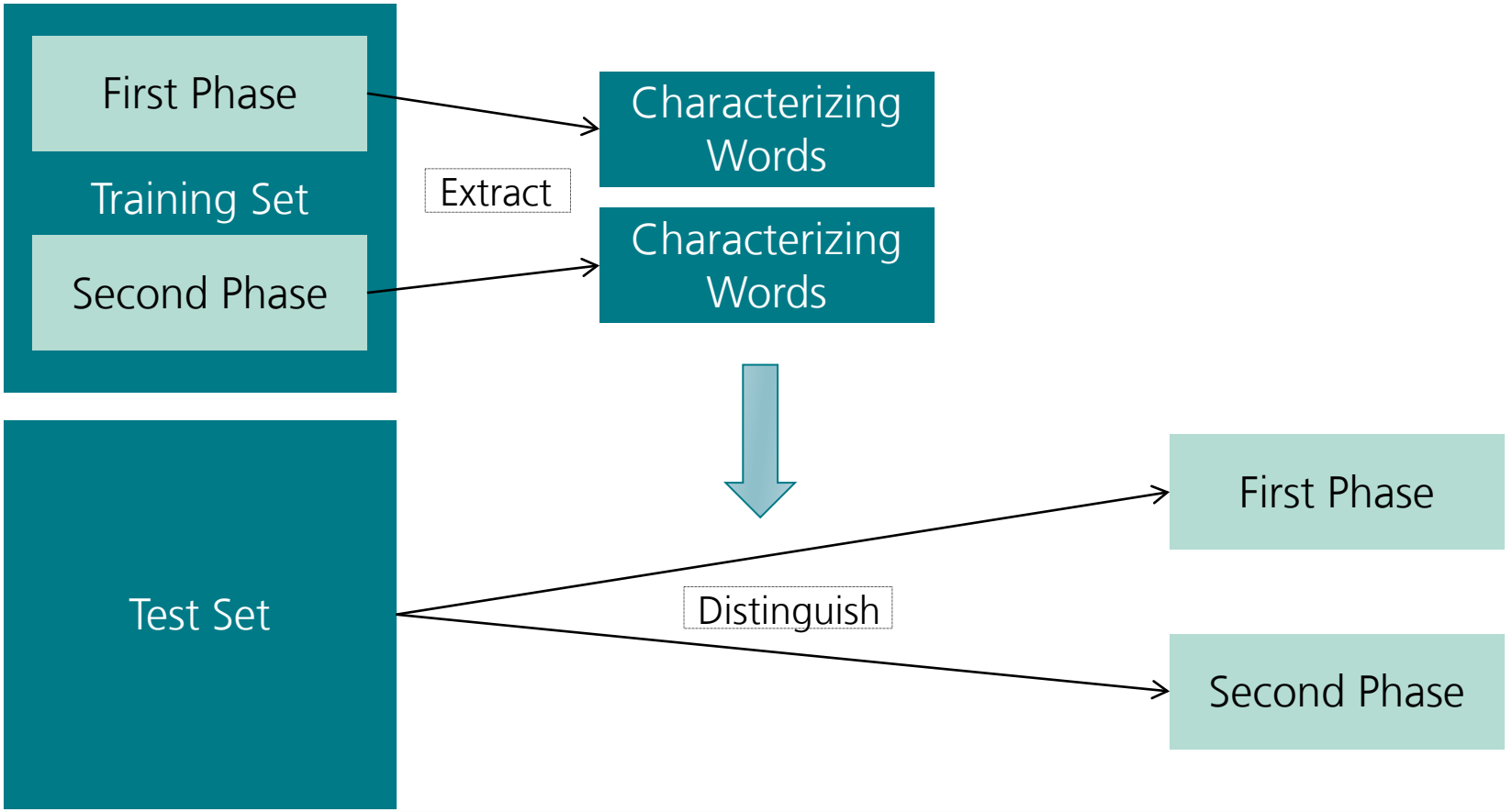
Method – Overview

Phase characterization based on keywords



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Training Set

- Nanotechnology for materials or surface science, e.g. nanocomposites
- Photovoltaics
- Solar thermal energy
- Wind power
- Lasers
- Combustion engine

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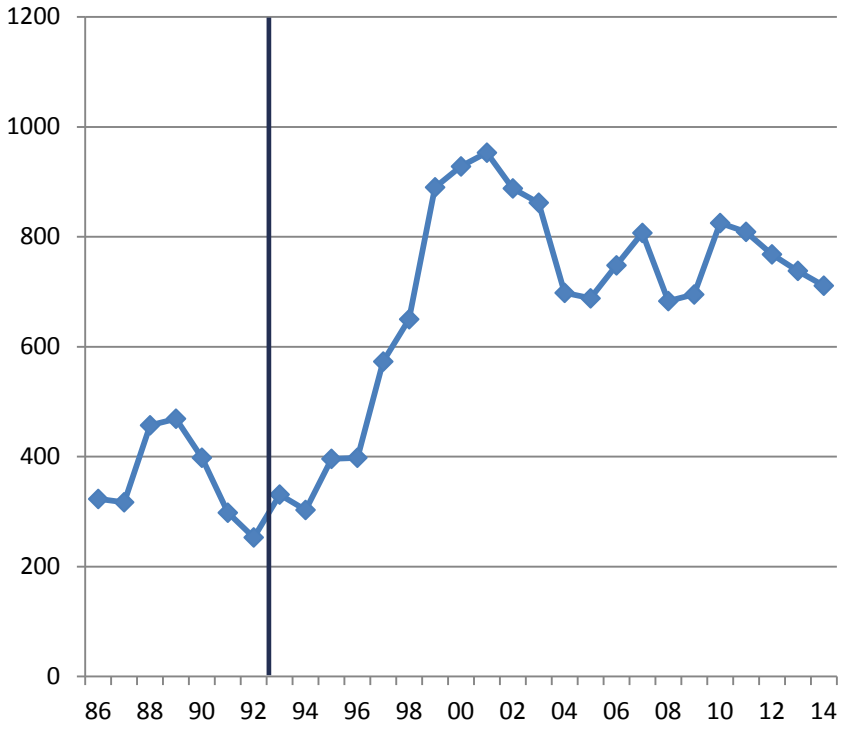
Training Set

- **Combustion** engine: 2nd phase since **1993**



First Phase

Training Set

Second Phase

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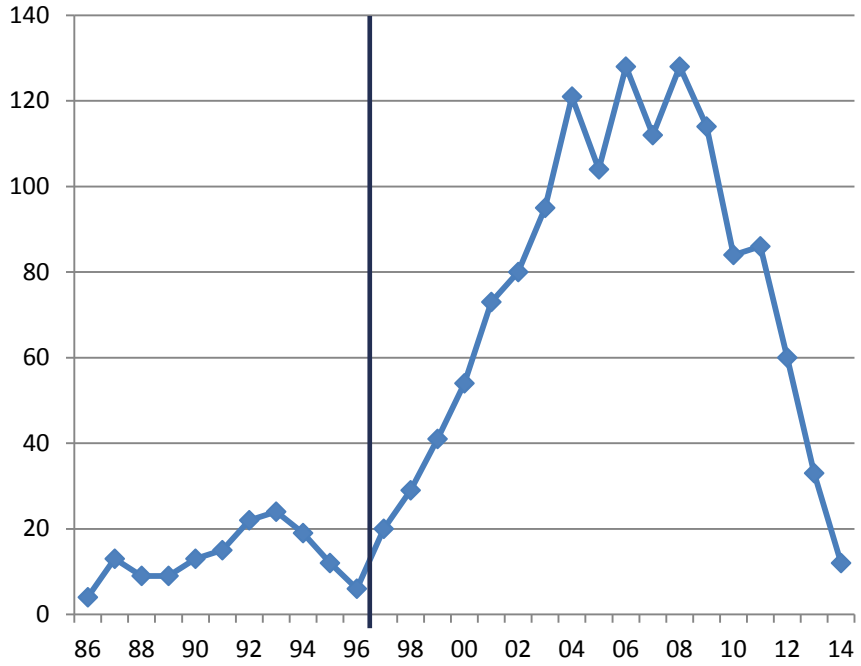
Training Set

- **Nanotechnology** for materials or surface science, e.g. nanocomposites: 2nd phase since **1997**



First Phase

Training Set

Second Phase

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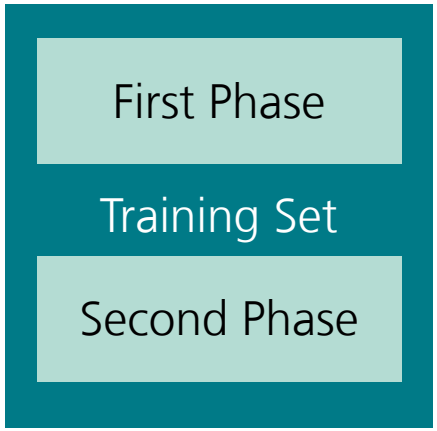
Training Set

- **Combustion** engine: : 2nd phase since **1993**
- **Nanotechnology** for materials or surface science, e.g. nanocomposites: 2nd phase since **1997**
- **Photovoltaics**: 2nd phase since **2005**
- **Solar** thermal energy: 2nd phase since **2003**
- **Wind** power: 2nd phase since **2006**
- **Lasers**: 2nd phase since **1994**



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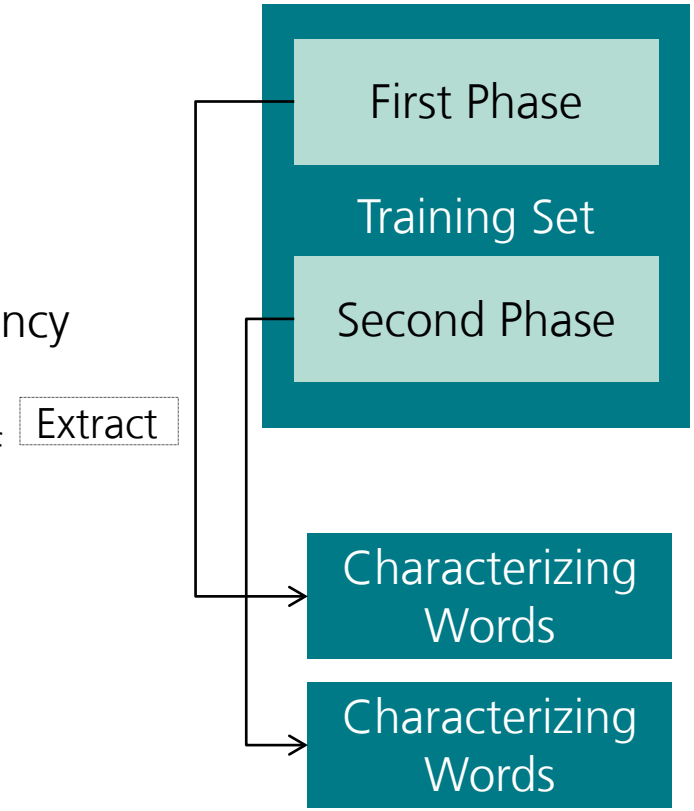
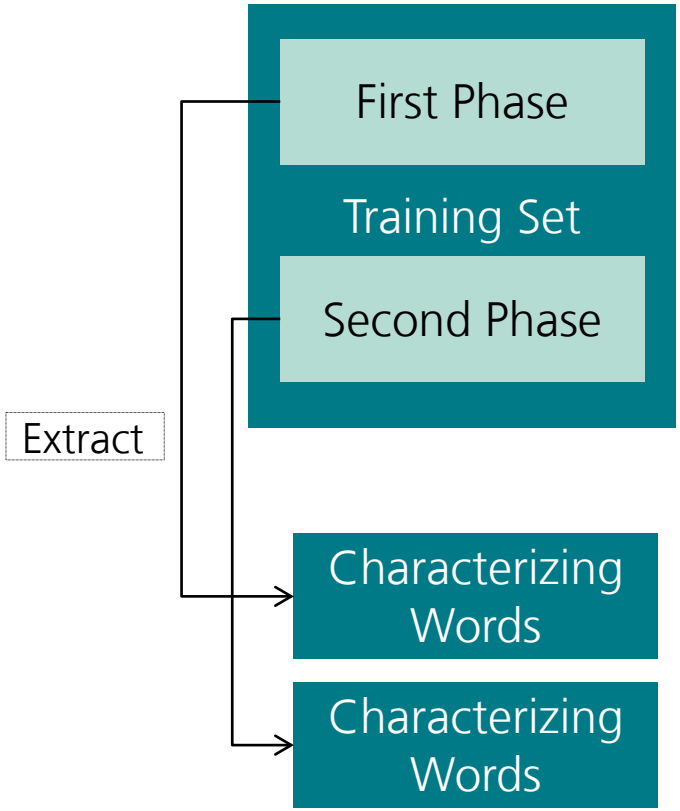
Training – Extraction of characterizing terms

- Determine characterizing words for first and second phase, respectively
- Method:
  - Filter out stopwords of the training texts
  - Extract terms with normalized term frequency (ntf) of each phase
  - Compute difference between ntf scores of first and second phase for each term
  - Terms that show the highest positive difference for a phase are identified as characterizing terms



Training – Extraction of characterizing terms

- Characterizing words can be classified into two categories:
  - Field specific terms
  - General terms
- Field specific terms:
  - Give additional evidence for the correct phrase identification based on patent counts
  - Not generally applicable, maybe on thematically related fields
- General terms:
  - Applicable on different fields
  - May be used for identification of unknown phases in new fields



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Training – Overview

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- Photovoltaics
- Solar thermal energy
- Wind power
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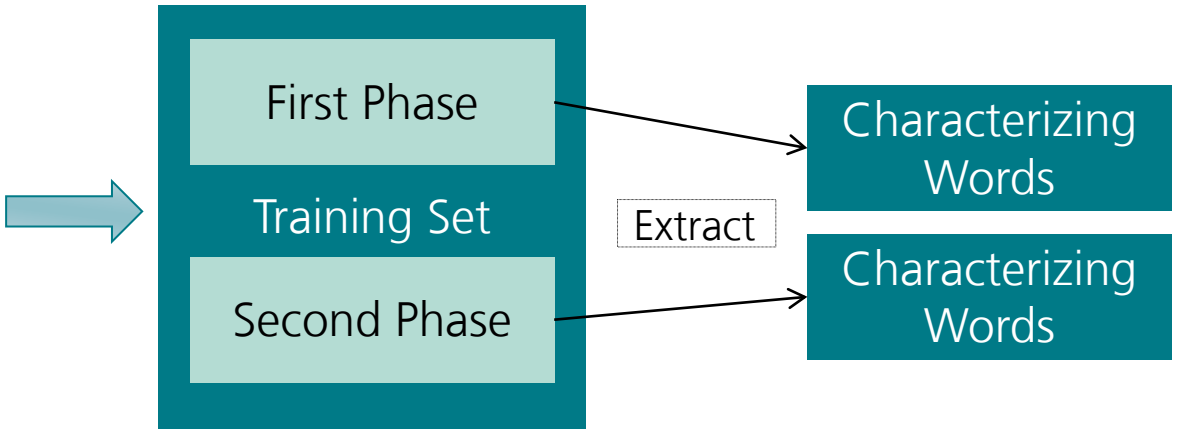

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Training – Overview

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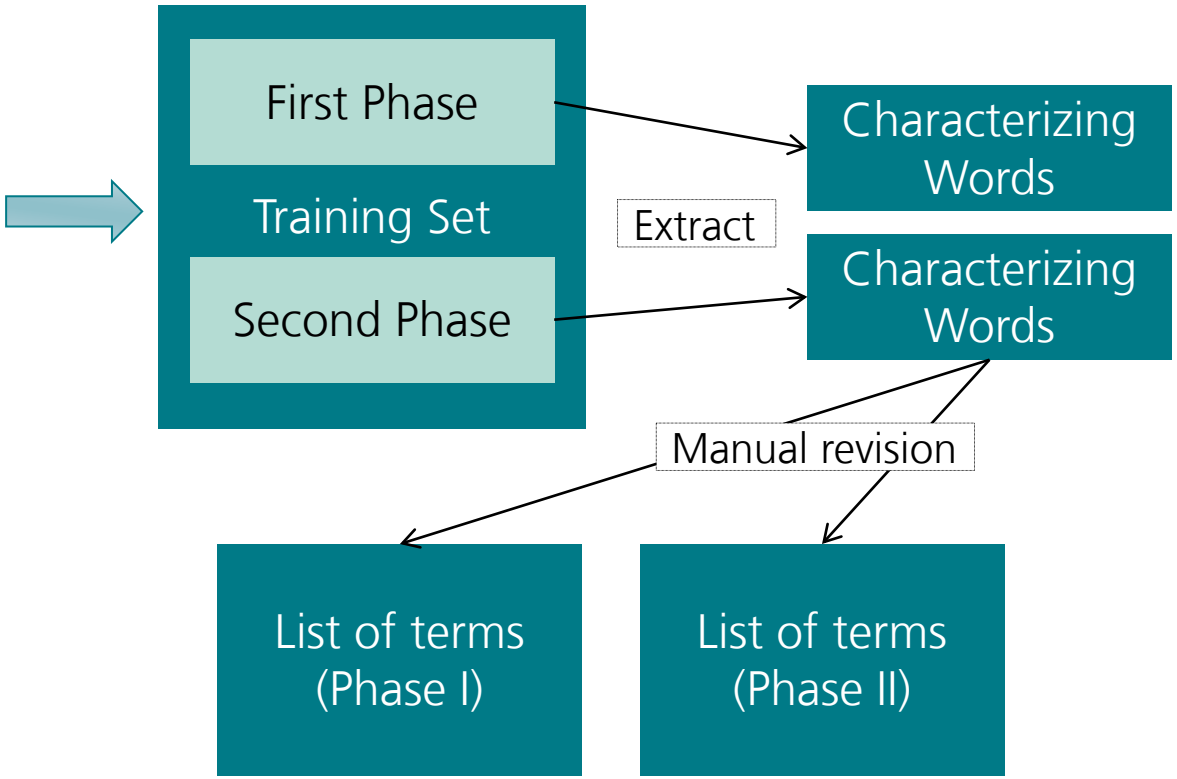

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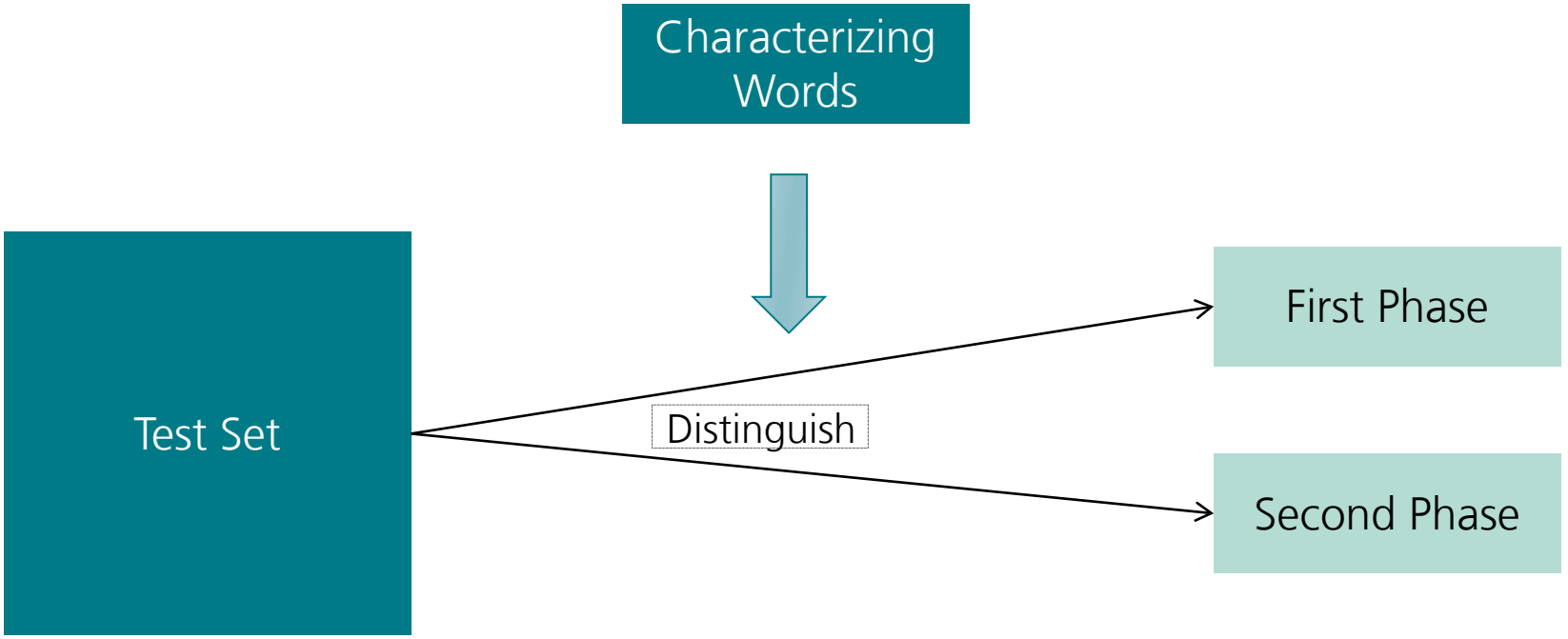
Application and Evaluation – Overview



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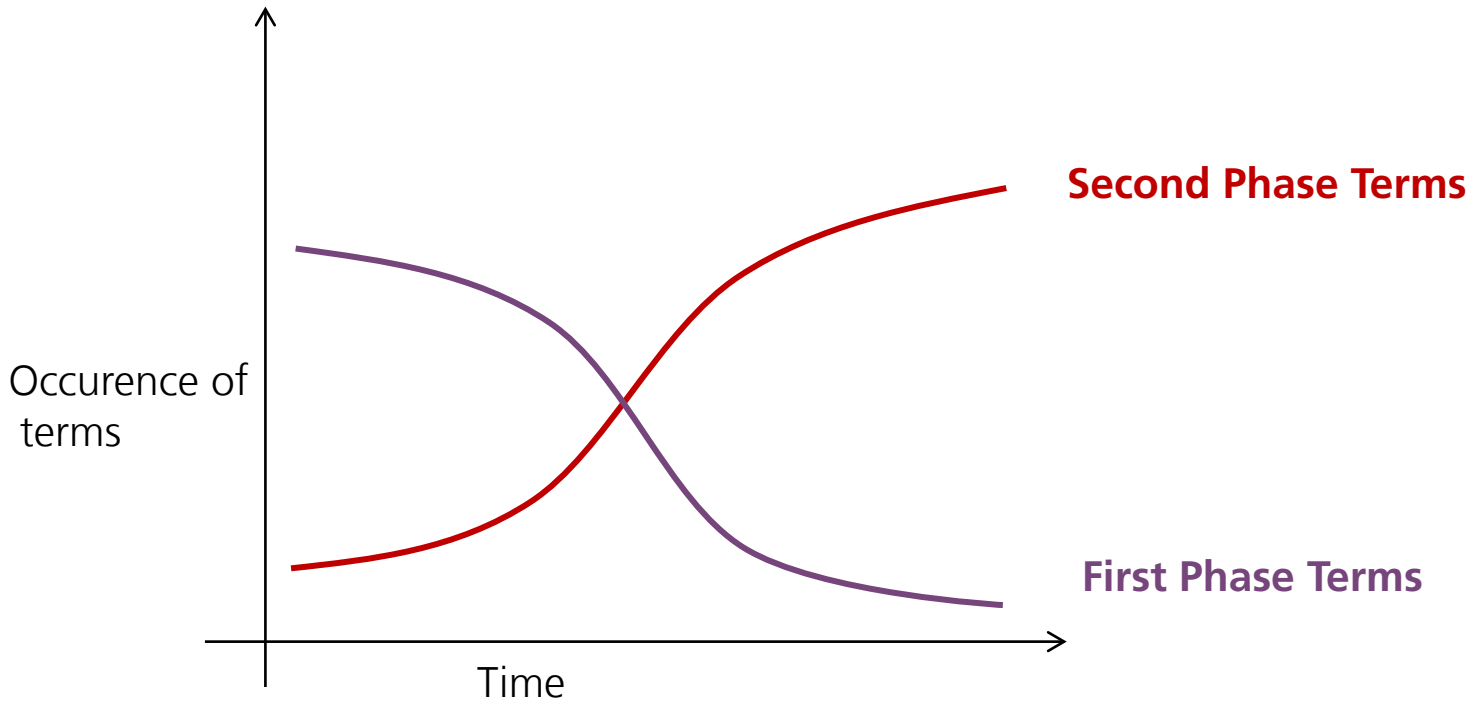
Application of the method



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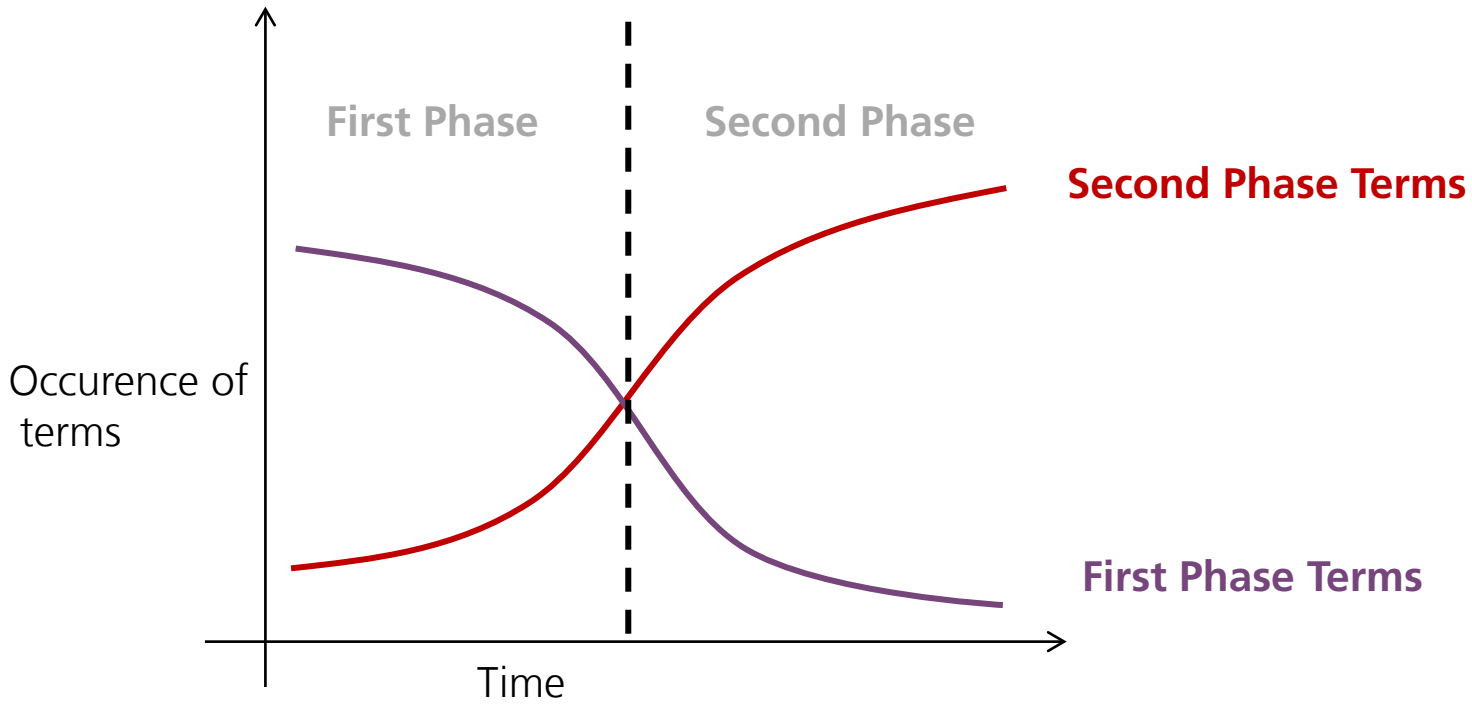

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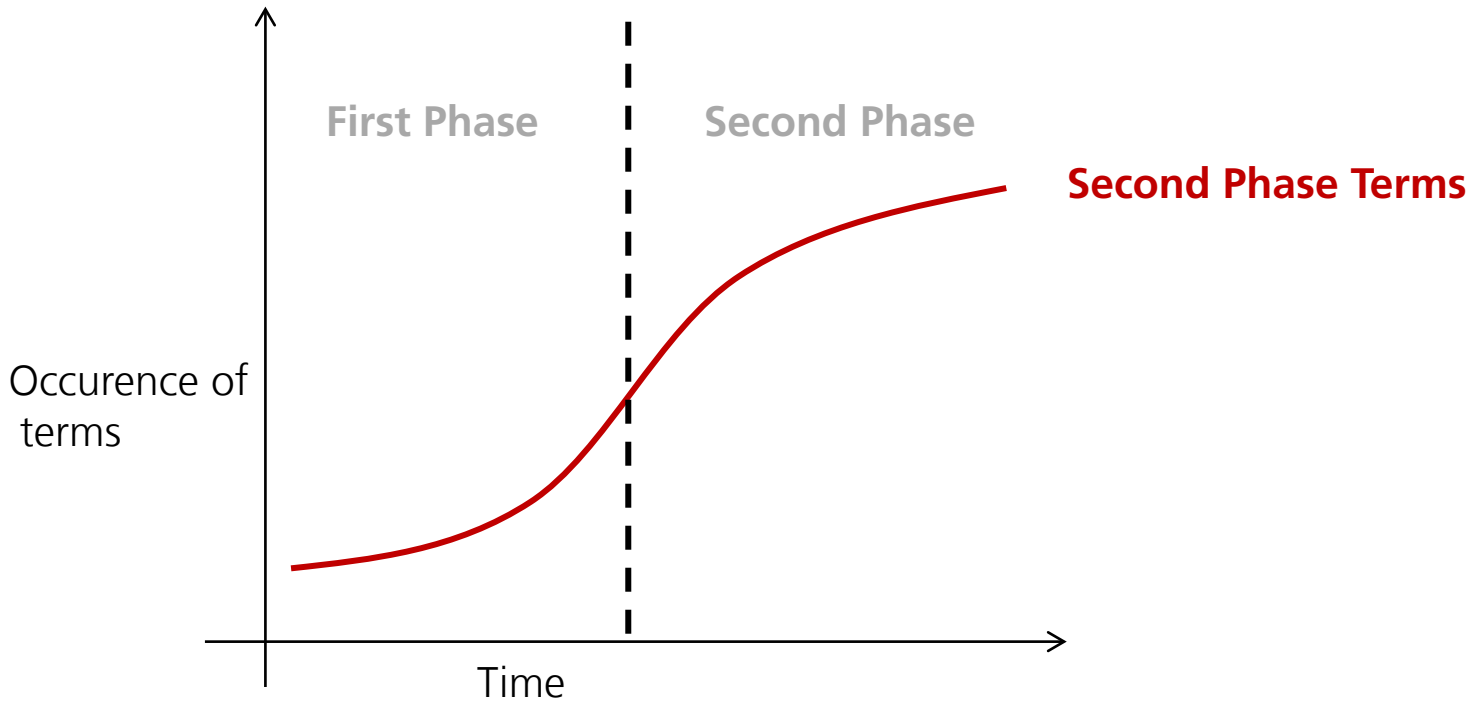

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Extracted characterizing terms – Examples

- Examples of terms (Phase II):
  - Method
  - System
  - Module
  - Assembly
  - Process
  - Produce
  - Workpiece
  - Manufacture
  - Apply
  - Apparatus

List of terms (Phase II)

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Test Set

- **Mesaurement and testing technology:** 2nd phase since **1993**
- **Optical technologies:** 2nd phase since **1992**
- **Audio and video compression**: 2nd phase since **1992**

Test Set

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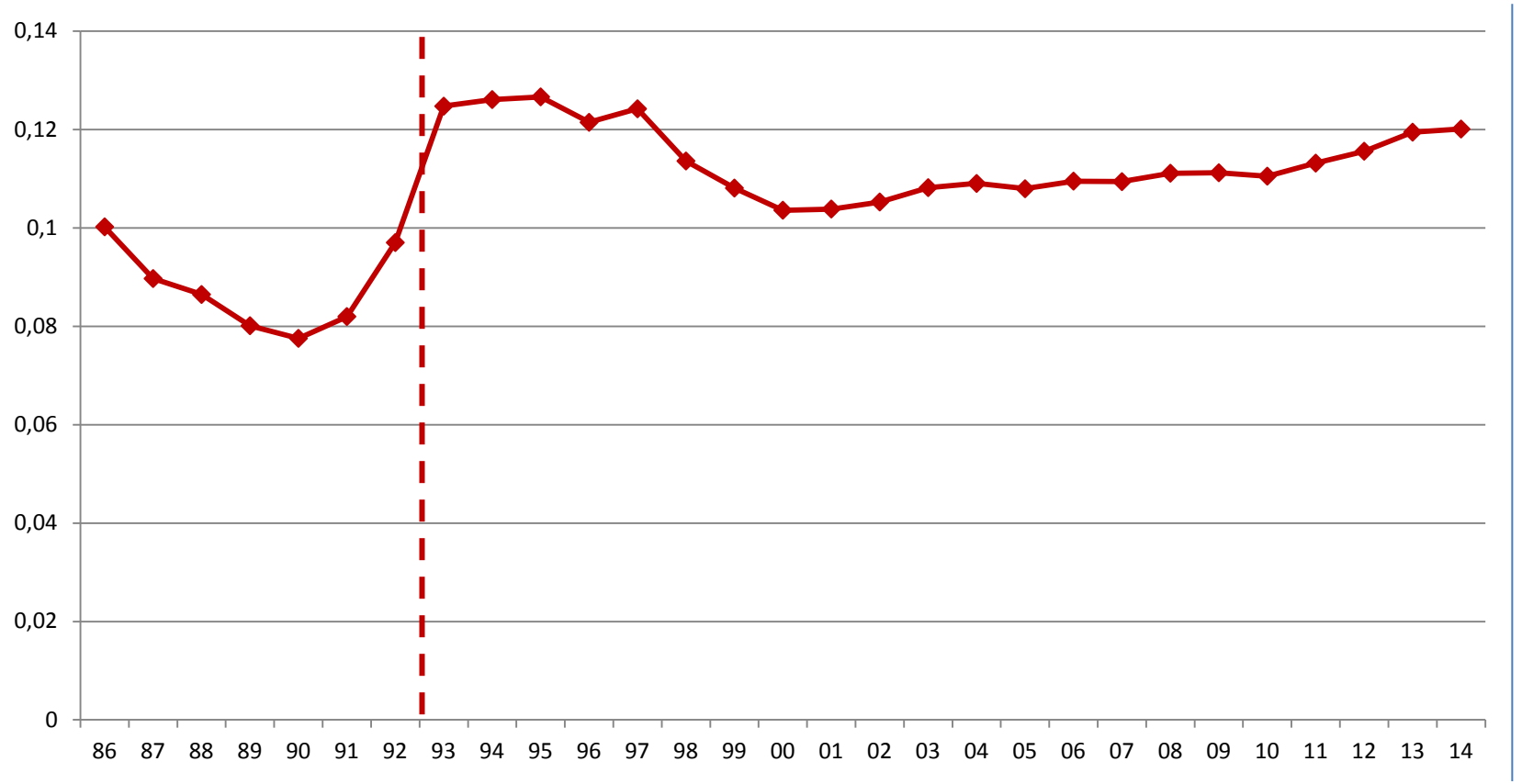
Evaluation: Measurement and testing technology



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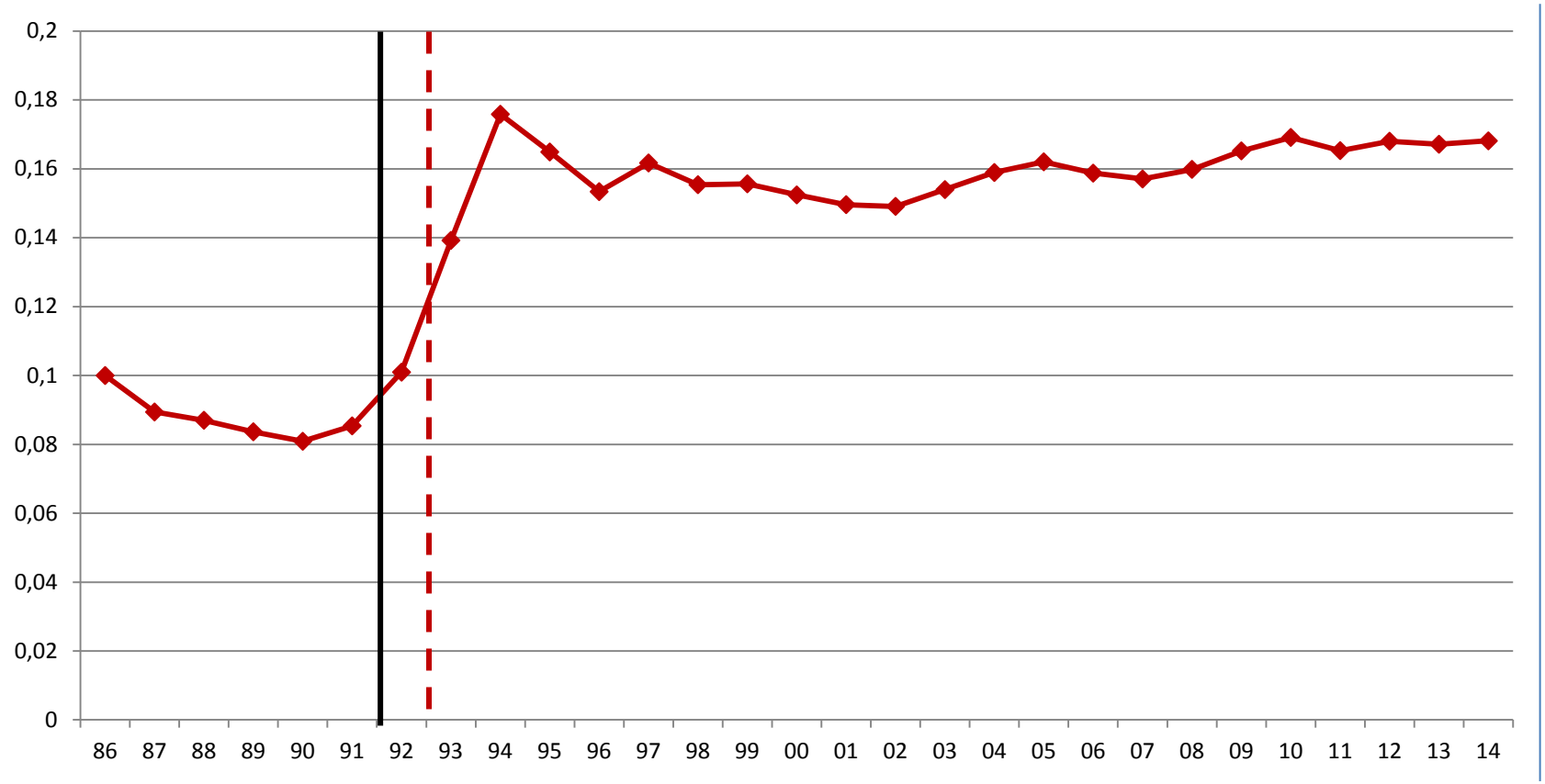
Evaluation: Optical Technologies



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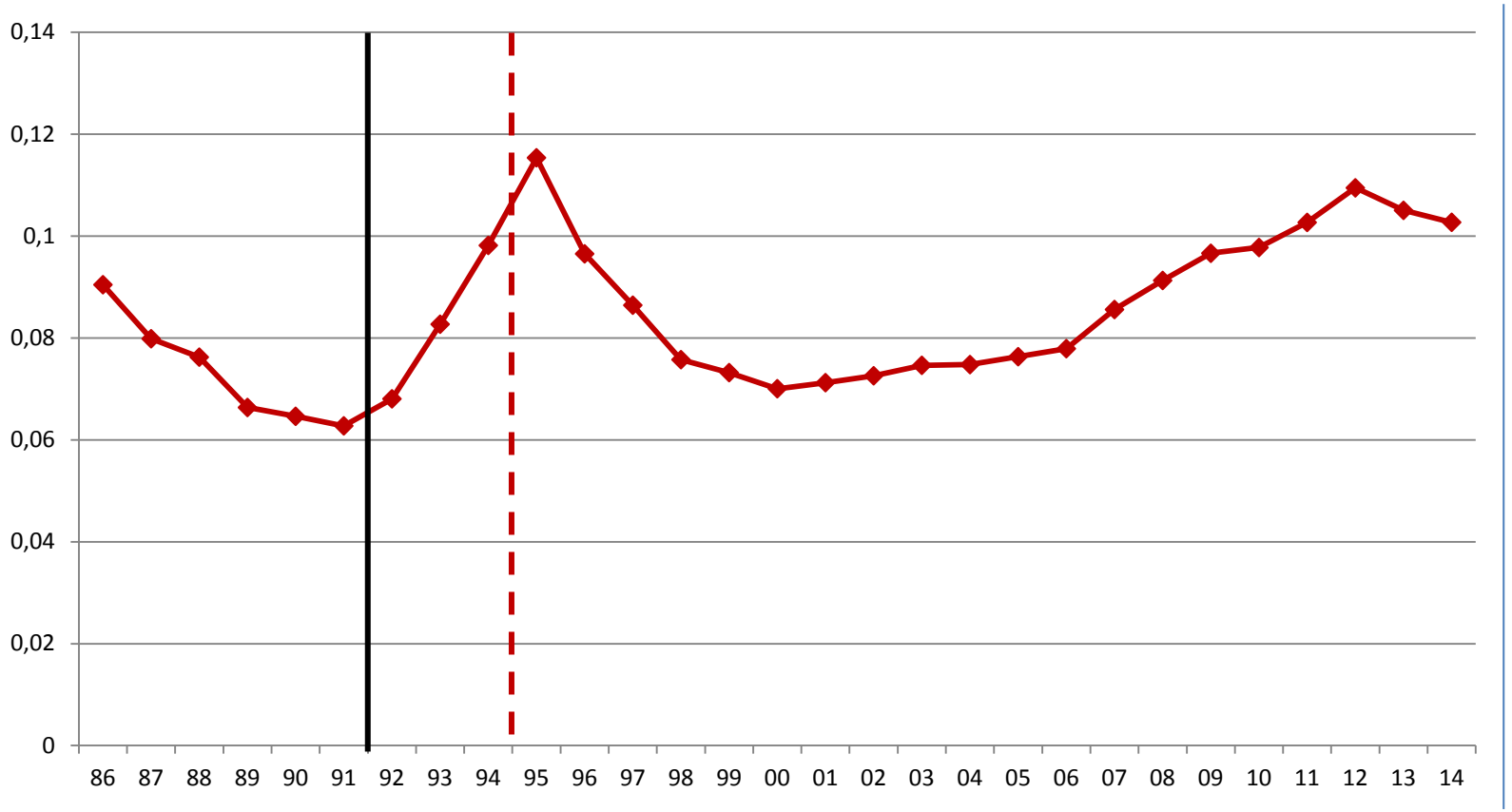
Evaluation: Audio and video compression



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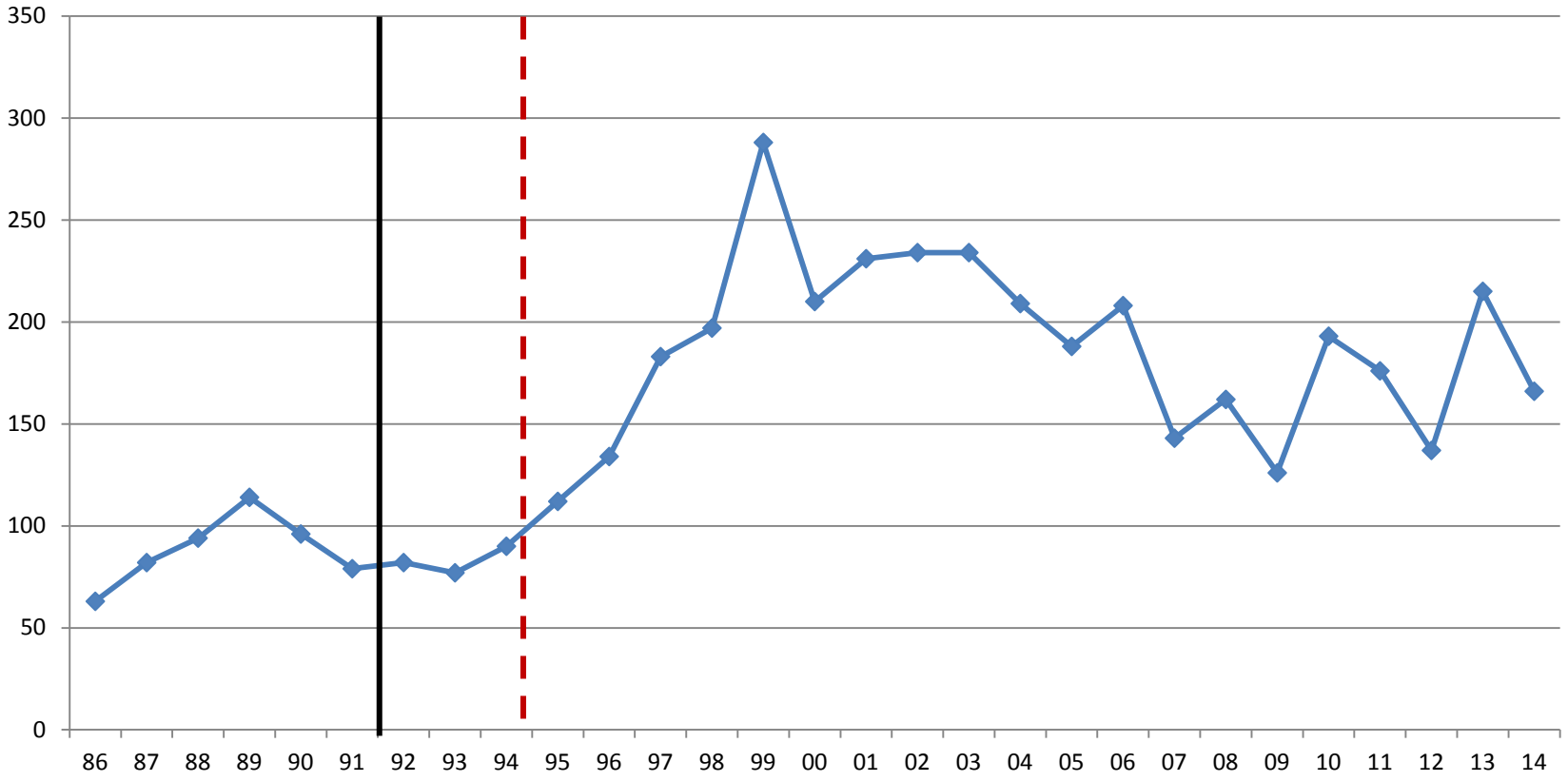

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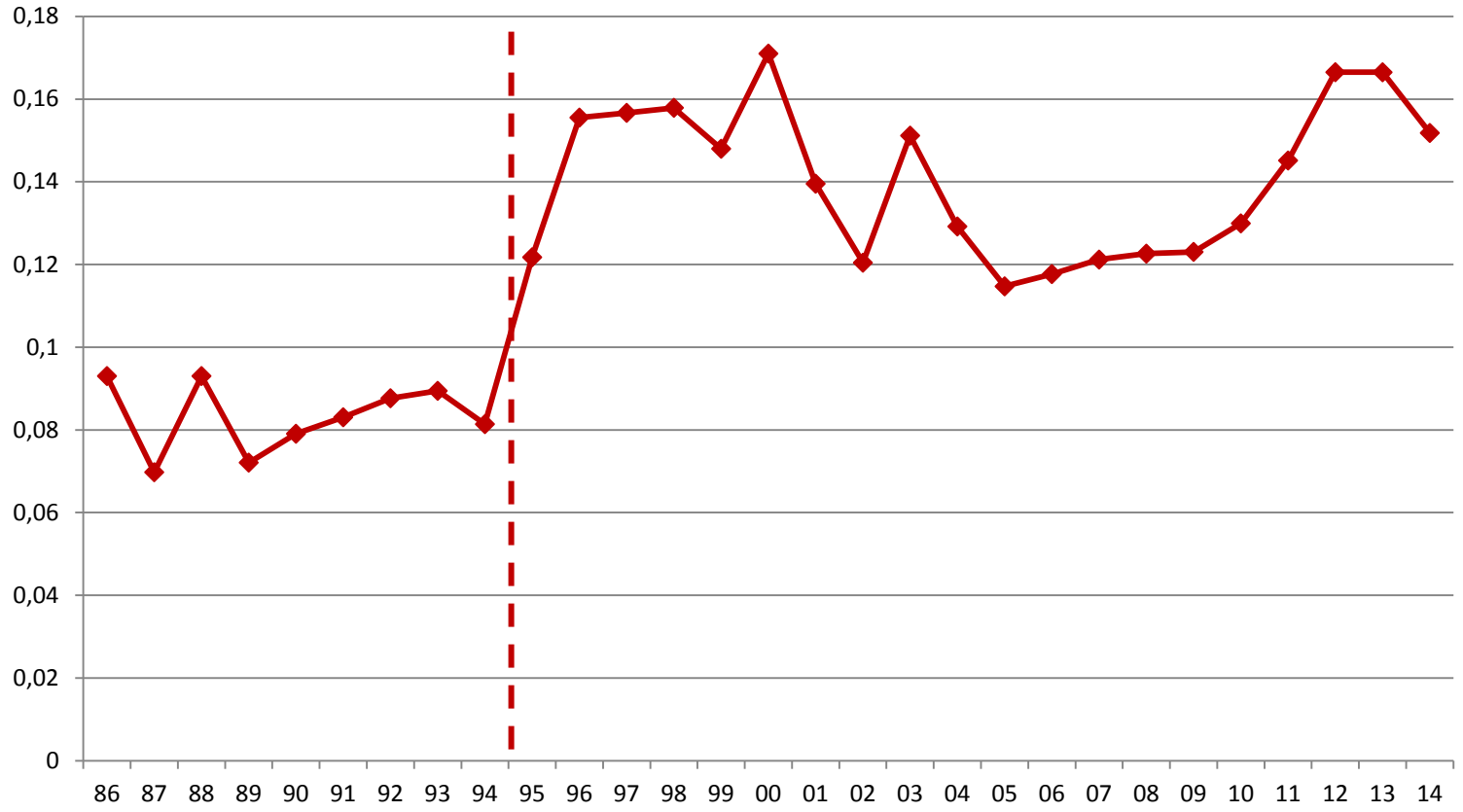
Application: RFID



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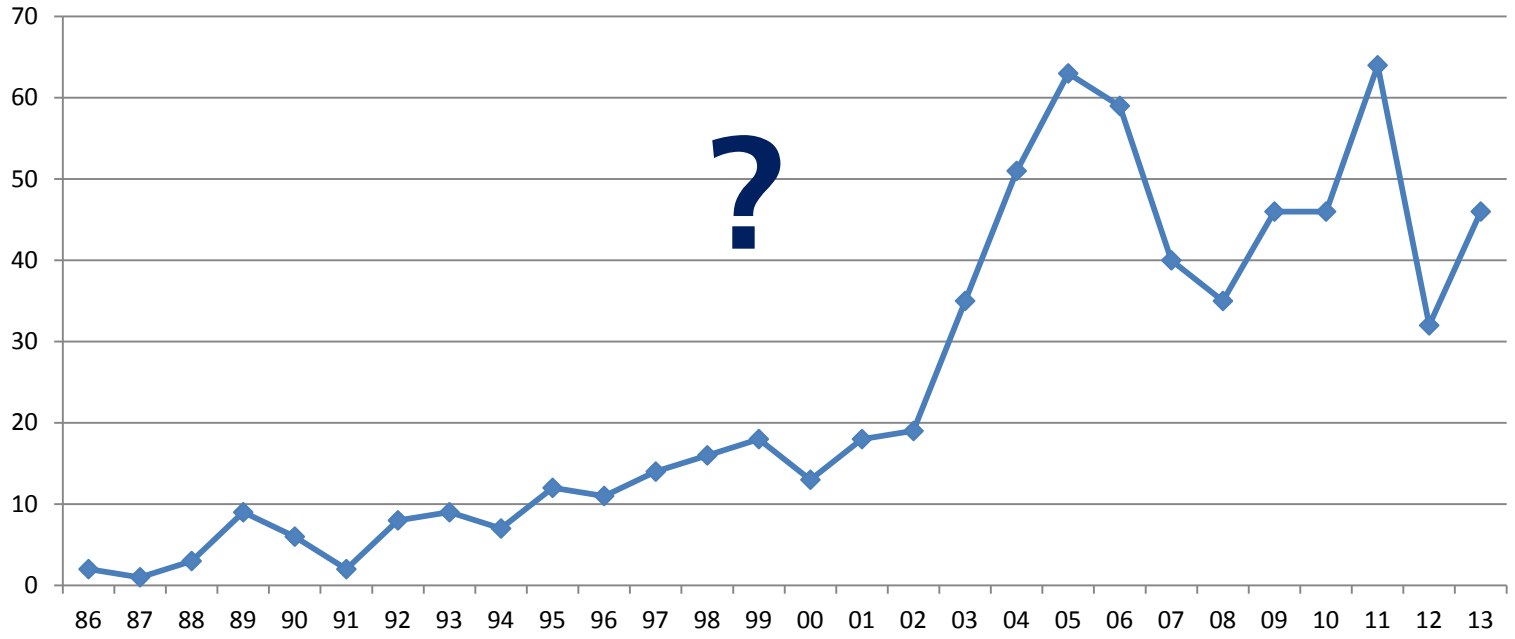
Application: RFID

- No clear distinction of the two phases based on patent counts
- e.g. RFID



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Application: RFID

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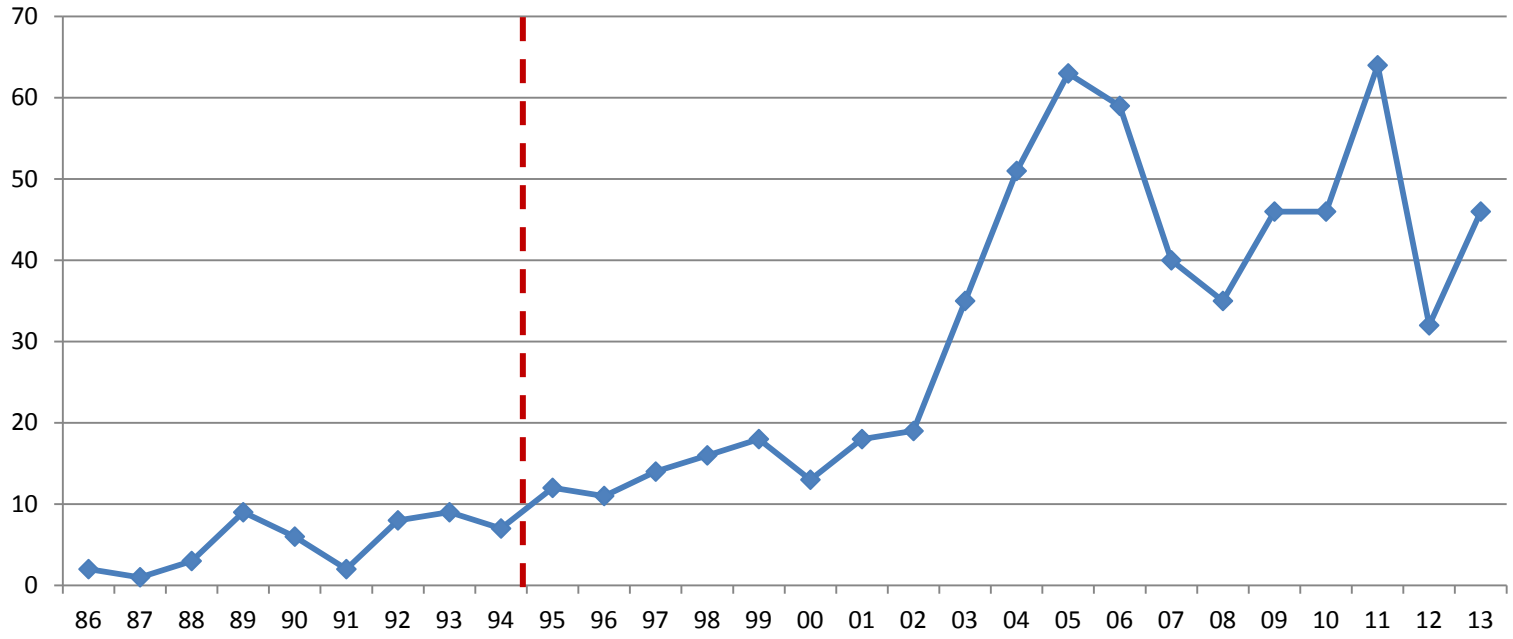

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Conclusion

- Based on our generally applicable method, we are able to identify phases in different fields
- The text-based indicator may be used as an additional indicator to the original method based on patent counts or in cases where the original method does not give clear results

- Future work:
  - Extend/Optimize the training set
  - Extend the method to include terms that consist of two ore more single terms
  - Include terms characterizing the first phase
  - Include publication data into the analysis
  - Further automate the process

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