KB Open Research Seminar

Conceptualizing disruptive innovation paths, patent zero, and patent-data-based operationalization

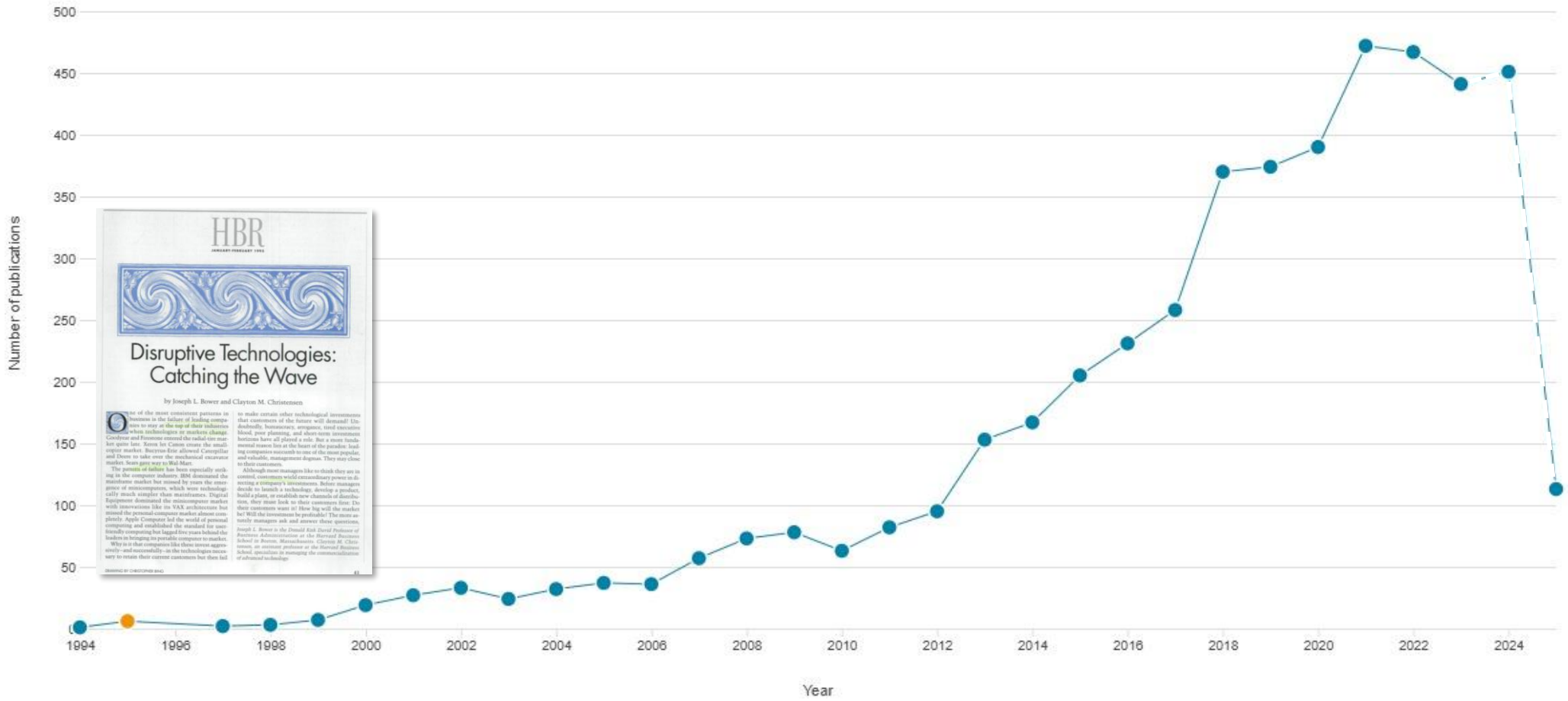
Melanie Martini

11.06.2025

The Theory

Source: FhGenie

That the topic is widely discussed can also be seen in KATI



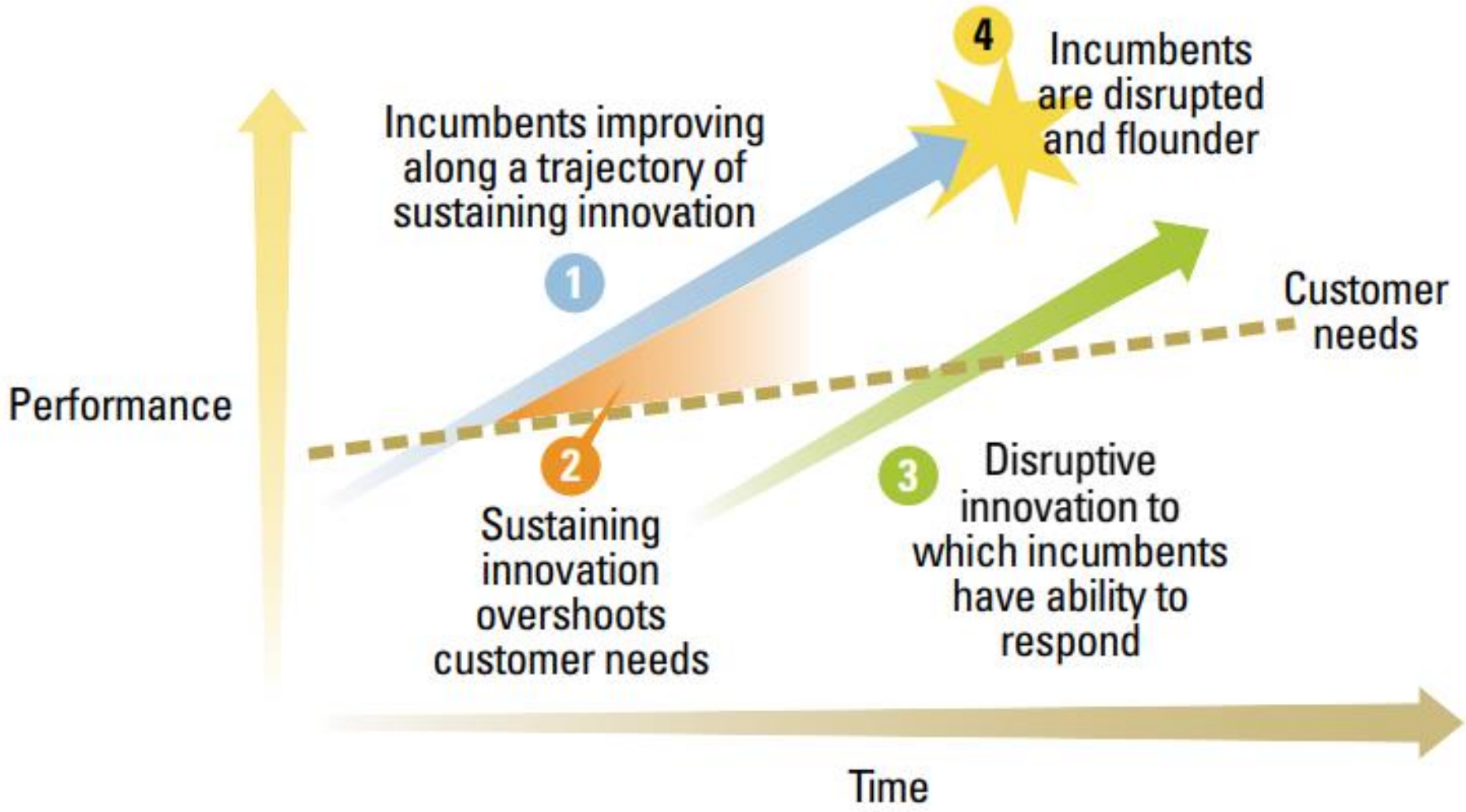
Document Set: Disruptive innovation
Date: May 22, 2025
Source: KATI developed by Fraunhofer INT

»

Disruptive Innovation describes a process by which a product or service takes root in simple applications at the bottom of the market—typically by being less expensive and more accessible—and then relentlessly moves upmarket, eventually displacing established competitors.«

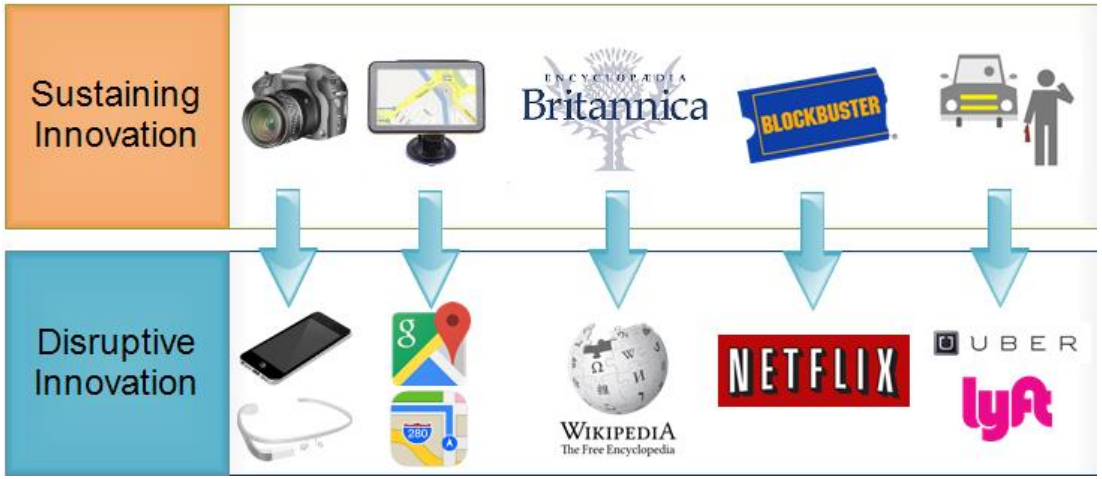
Clayton Christensen,
https://www.christenseninstitute.org/theory/disruptive-innovation/

The four elements of disruptive innovations

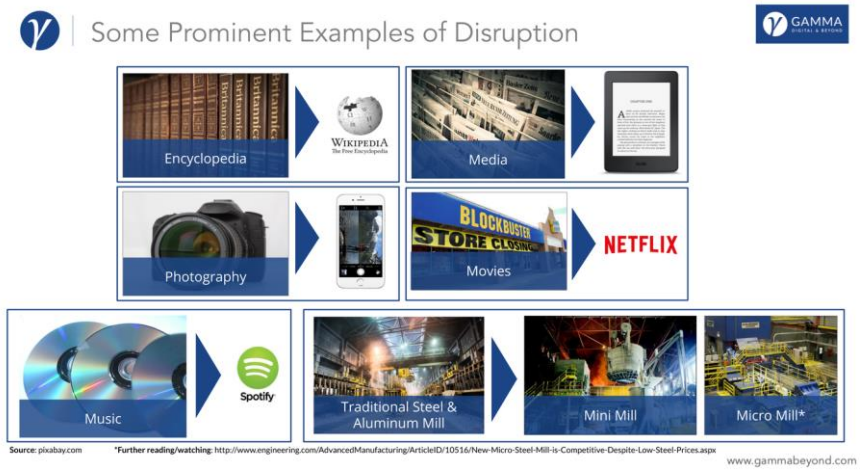


Grafik von King, Andrew A., and Baljir Baatartogtokh. "How useful is the theory of disruptive innovation?." MIT Sloan management review 57.1 (2015): 77.

There are many examples of disruptive innovations



Industry	Incumbent	Entrant	Type of innovation *(Sustaining vs. Disruptive)*
Online Education in a University	HARVARD BUSINESS SCHOOL	Harvard Business School Online	Sustaining Innovation
Personal vs. Xerox High-Quality Copiers			New-Market **Disruptive** Innovation
On-demand Video Streaming	BLOCKBUSTER	NETFLIX	Combination of Low-End and New Market **Disruptive** Innovation
Smartphone vs. Pcs			New Market **Disruptive** innovation
PCs vs. Mainframe Computers			Combination of Low-End and New Market **Disruptive** Innovation
Airbnb vs. Hotels	Marriott MARRIOTT	airbnb	Combination of Low-End and New Market **Disruptive** Innovation
Digital vs. Film Cameras	Kodak	Canon	Combination of Low-End and New Market **Disruptive** Innovation
Cellphone Camera vs. Photography Industry	photography market as a whole		Combination of Low-End and New Market **Disruptive** Innovation



There are many examples of disruptive innovations

Including a list from Christensen

SAMPLE OF 77 DISRUPTIVE INNOVATIONS

This sample of disruptive innovations corresponds to the 75 cases listed in *The Innovator's Solution* and two cases discussed at length in *The Innovator's Dilemma*.

- 802.11 (Wi-Fi)
- Amazon.com
- Barnes & Noble
- Beef processing
- Bell Telephone
- Black & Decker
- Blended plastics
- Bloomberg
- Boxed beef
- Canon photocopiers
- Catalog retailing
- Charles Schwab
- Circuit City, Best Buy
- Cisco
- Community colleges
- Concord School of Law
- Credit scoring
- Dell
- Department stores
- Digital animation
- Digital printing
- Discount department stores
- Disk drives
- eBay
- ECNs
- Email
- Embraer and Canadair regional jets
- Endoscopic surgery
- Fidelity Management
- Flat panel displays (Sharp and others)
- Ford
- Galanz
- GE Capital
- Google
- Honda motorcycles
- Hydraulic excavators
- Inkjet printers
- Intel microprocessor
- Intuit's QuickBooks
- Intuit's TurboTax
- Japanese steelmakers
- JetBlue
- Kodak
- Kodak Fun Saver
- Korean auto manufacturers
- Linux
- MBNA
- McDonald's
- MCI, Sprint
- Merrill Lynch
- Microsoft DOS
- Minicomputers
- Online stockbrokers
- Online travel agencies
- Oracle
- Palm Pilot, RIM BlackBerry
- Personal computers
- Plastics
- Portable blood glucose meters
- Salesforce.com
- Seiko watches
- SonoSite
- Sony
- Southwest Airlines
- SQL database software
- Staples
- Steel mini-mills
- Sun Microsystems
- Toyota
- Toys-R-Us
- Ultrasound
- University of Phoenix
- Unmanned aircraft
- Vanguard
- Veritas and Network Appliance
- Wireless telephony
- Xerox

Grafiken von King, Andrew A., and Baljir Baatartogtokh. "How useful is the theory of disruptive innovation?." MIT Sloan management review 57.1 (2015): 77.

There are many examples of disruptive innovations

But the assessment of disruptive innovations is very subjective and difficult to measure

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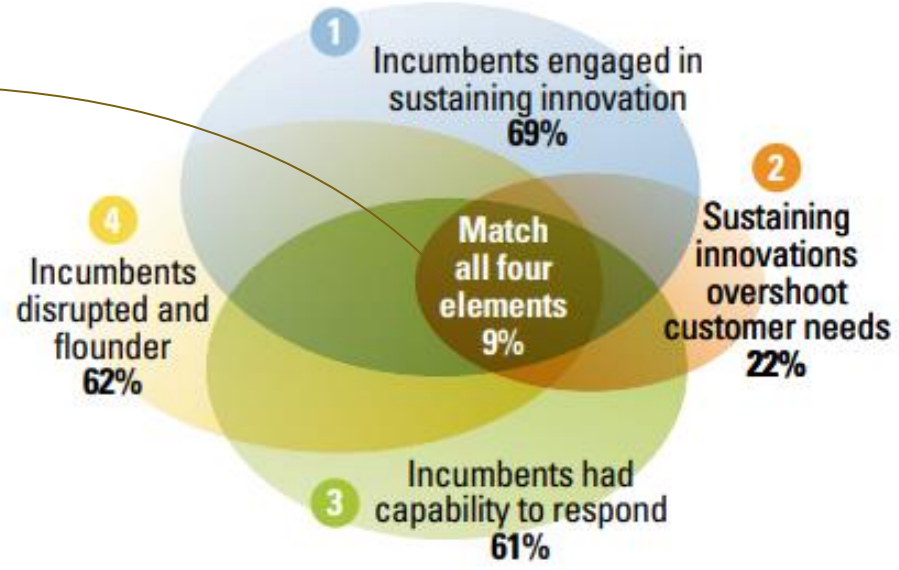
HOW WELL DO THE CASES MATCH THE THEORY?

This Venn diagram maps the 77 examples listed in *The Innovator's Dilemma* and *The Innovator's Solution* and shows the extent to which, in the opinion of industry experts, they exhibit each of four key elements of the theory. Using the industry experts' assessments, only seven of the cases (9%) exhibited all four elements of the theory.



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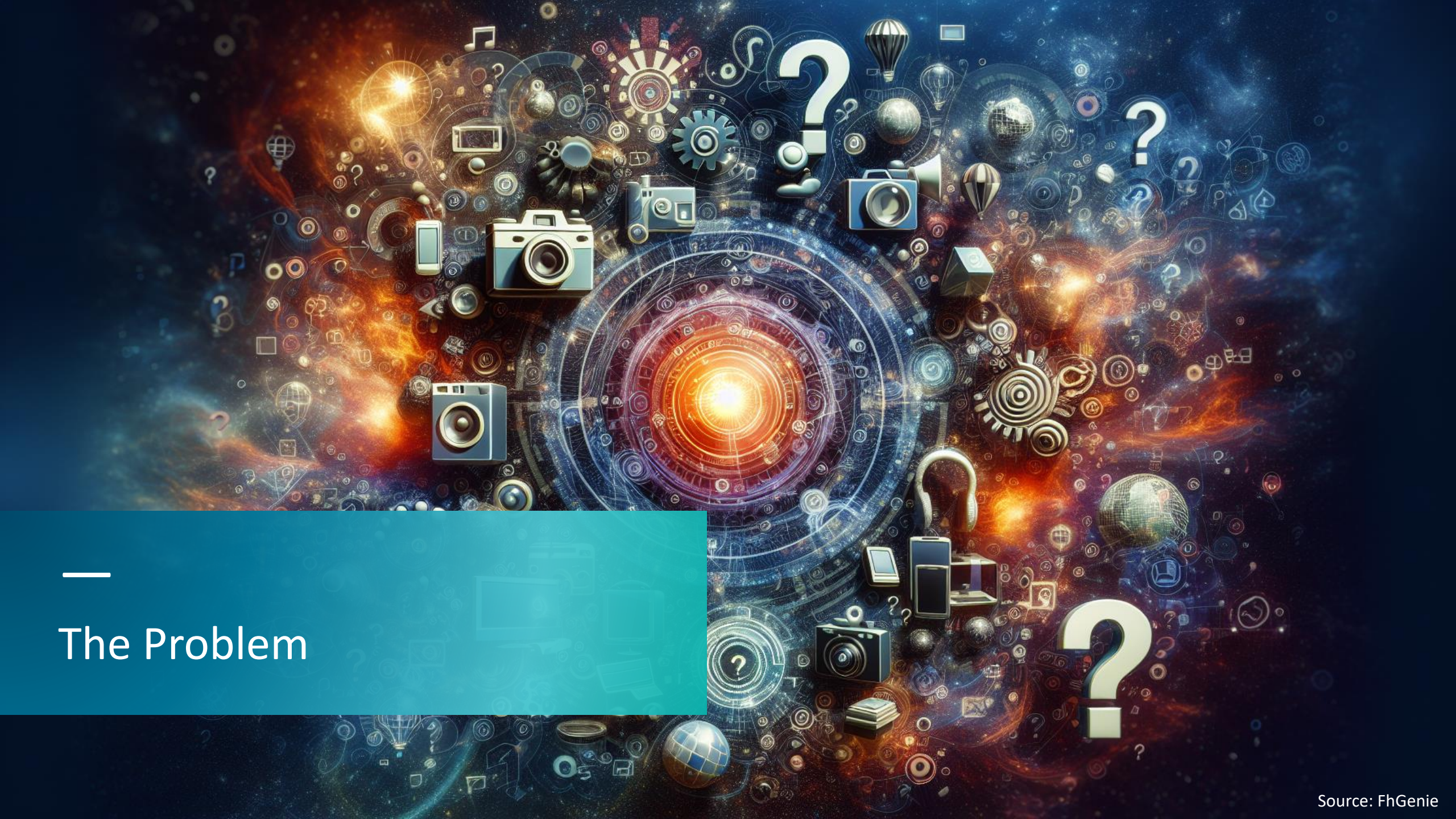

The Problem

Source: FhGenie

How can disruptive innovations be identified (quantitatively)?

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- Wireless telephony
- Xerox

So far there are two approaches

Questionnaires

- Are answered by experts in the respective field
- Primarily serve to classify an already known technology or technological field
- Examples:
  - Keller and Hüsig (2009)
  - Guo et al. (2019)

→ Have a strong theoretical reference but fail to address the challenge of first identifying the relevant innovations. Subjective consideration.

Data analysis

- Uses various data, such as patent data, to automatically recognize patterns
- Serves both to classify an already known technology and to identify new technologies
- Beispiele:
  - Aristodemou and Tietze (2018)
  - Bhatt et al. (2023)
  - Park et al. (2023)

→ Often overemphasize individual indicators and frequently lack a comprehensive reference to the underlying theories.

A solution?

Source: FhGenie

Our idea

1. Identification of the paths of disruptive innovations
2. Tracking the paths through patent analysis
3. Construction of a framework for the early identification of *potentially* disruptive innovations using patent data

Conceptualizing disruptive innovation paths, patent zero and patent-data based operationalization

https://doi.org/10.17863/CAM.111428

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This paper has been accepted and presented at the 2024 ISPIM conference.

The paper is also available via Fraunhofer Publica: https://doi.org/10.24406/publica-3571

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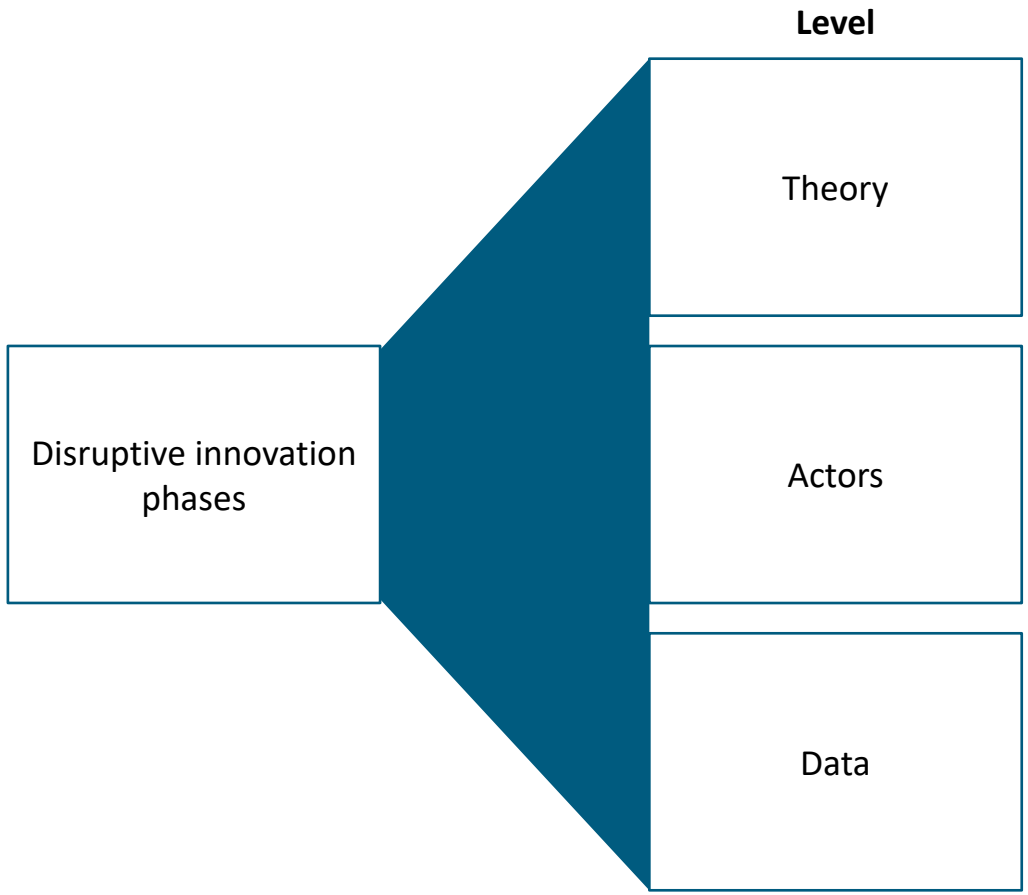
IfM Centre for Technology Management

  Public

Martini, M., Tietze, F., John, M., Aristodemou, L., Schönmann, A., & Schimpf, S. (2024). Conceptualizing disruptive innovation paths, patent zero and patent-data based operationalization. CTM Working Papers (5/24), University of Cambridge. https://doi.org/10.17863/CAM.111428

Our approach combines theory and practice



Questions

- How do we expect incumbents and disruptors to behave at each stage?
- How can the behavior of incumbents and disruptors be represented in patenting patterns?
- What indicators can be used to describe the behavior in each phase?

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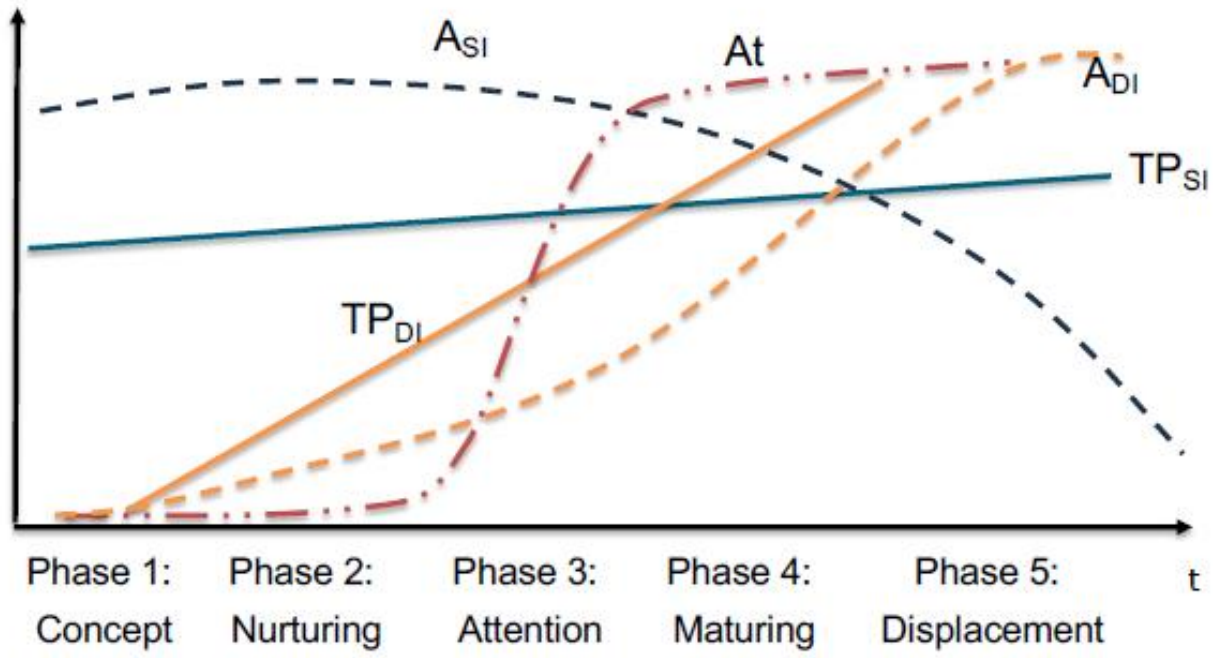
Level 1: theory

The 5-phase system



Legend

TP = Technology performance

A = Adoption

At = Attention

DI = Disruptive innovation

SI = Sustaining innovation

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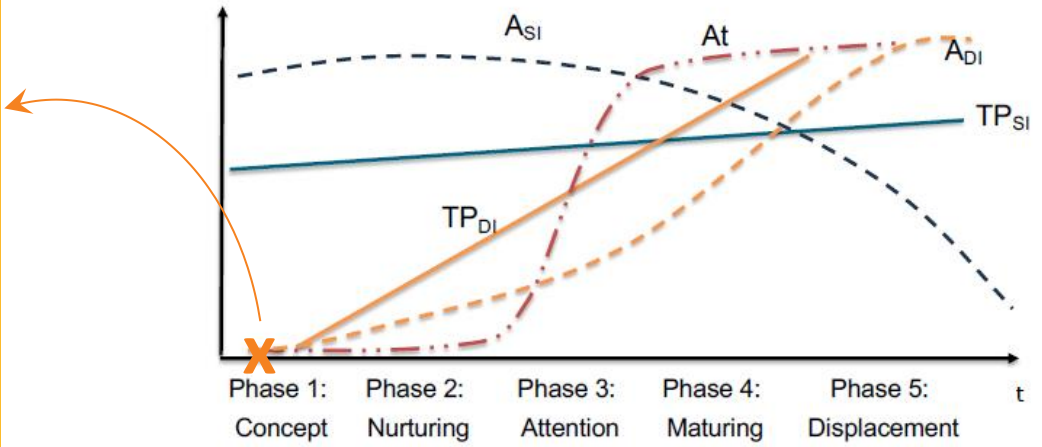
Level 2: actors

The definition of **patent zero**

» A disruptor's **first patent** clearly related to their respective disruptive innovation, **initiating** a new patenting **trajectory**. It serves as a focal point for **tracing the origins** and spread of the disruptive innovation, facilitating understanding of its diffusion dynamics.

A patent zero is likely to have **little prior art**, a **high inventive step** with **broad claim** and a **large patent family**.«



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Level 2: actors

Who reacts in which phase?

	Concept phase	Nurturing phase	Attention phase	Maturing phase	Displacement phase
Incumbents	▪ Low patenting frequency ▪ Patent focus on incremental improvements of their established technology, i.e. narrow scope with low inventive step ▪ Or focus on process-innovations		▪ Defend their technology, leading to more, but still narrow patents	▪ Patent oppositions to the disruptors' patents ▪ First citations of patent zero by the incumbents	▪ Switching to adopt disruptive innovation, resulting in more citations of the disruptors' patents
Disruptor	▪ Patent Zero emerges with large family, broad scope/ claims, high inventive step, little prior art	▪ Applies for follow-up patents that cite patent Zero ▪ Follow up patents have gradually decreasing inventive step ▪ Increasingly narrower patent claims		▪ Patent zero gets attacked, but survives ▪ Opposing incumbents' patents refering to disruptive inn.	▪ Defends its position by sueing incumbents and following disruptors for infringement or filing oppositions aimed at invalidating their patents
Disruptor follower	▪ Do not exist yet		▪ First following disruptors emerge ▪ If filing patents, presumably narrower (more specialized), with lower inventive step citing disruptors' patents		

Tietze, F. (2024). CONCEPTUALIZING DISRUPTIVE INNOVATION PATHS, PATENT ZERO AND PATENT-DATA BASED OPERATIONALIZATION. Presented at the THE 21ST SHANGHAI INTERNATIONAL INTELLECTUAL PROPERTY FORUM-SICIP SUB FORUM INNOVATION RESEARCH POWERED BY INTELLECTUAL PROPERTY DATA, Shanghai International College of Intellectual Property, Tongji University.

Level 3: data

The identification of patent zero proves difficult!

Base year	industry	disruptive_innov	As described by Christensen	example	Can the innovation be found in patents?
2000s	customer relationship management software development	salesforce.com	Salesforce.com	Salesforce.com	possible first patent: US2005065925 AA; 2003; "QUERY OPTIMIZATION IN A MULTI-TENANT DATABASE SYSTEM"
recent past	plastics production	polyolefin plastics	Blended Plastics	Himont composite materials	**possible first patent: US5286564A; 1990; "Elastoplastic Polyolefin Compositions"; Replacing: Polycarbonate; problem: whole class of plastics; Solution: look for Production methods**
1990s	book retailing	online book sales	Amazon.com	Amazon.com	first patent unclear, combination of multiple patents? (recommendation system US6029141A, 1-click buy US5960411A)
1960s	beef butchering	boxed beef	boxed beef	Iowa Beef Packers' boxed beef	hard to find – can't be found?
1990s	accounting software production and sales	personal finance software	Intuit's QuickBooks accounting software	Intuit's QuickBooks accounting software	possible first patent: US6411938 BA; 1999; "CLIENT-SERVER ONLINE PAYROLL PROCESSING"
1990s	commercial passenger aircraft production	smaller (regional) jets	Embraer & Canadair regional jets	Embraer & Canadair regional jets	**first patent unclear, combination of multiple patents (parts of aircrafts: Turbofan engines and Large cabin for business jets)**
2000s	stock exchange services (e.g. the NY Stock Exchange)	electronic clearing networks	ECNs	Direct Edge	hard to find, possible first patent: US2003004853AA; 2001; "Graphical Front End System For Real Time Security Trading"
2000s	**database software development**	**SQL database software**	**SQL database software**	**Microsoft's SQL**	**possible first patent: US5495604A; 1993; "Method And Apparatus For The Modeling And Query Of Database Structures Using Natural Language-Like Constructs"**
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1960s	food services	fast-food companies	McDonald's	McDonald's	hard to find - can't be found?
1990s	legal education	on-line law schools	Concord School of Law	Concord Law School of Kaplan University	hard to find - can't be found?

Level 3: data

Analysis of a patent zero with the example of SQL

Office

European Patent Office

Application Number

94927247

Application Date

24.08.1994

Publication Number

0715739

Publication Date

12.06.1996

Publication Kind

B1

IPC

G06F 12/00 | G06F 17/30

CPC

G06F 16/2423 | G06F 16/24526 | G06F 16/243 | G06F 16/2428 | Y10S 707/99943 | Y10S 707/968

View more classifications

Applicants

MICROSOFT CORP

Inventors

HARDING JAMES ALLAN
MCCORMACK JONATHAN IAN

Designated States

Title

[DE] VERFAHREN UND GERÄT ZUR MODELLIERUNG UND ABFRAGE VON DATENBANKENSTRUKTUREN MIT NATÜRLICHEN SPRACHARTIGEN KONSTRUKTIONEN
[EN] METHOD AND APPARATUS FOR THE MODELING AND QUERY OF DATABASE STRUCTURES USING NATURAL LANGUAGE-LIKE CONSTRUCTS
[FR] PROCEDE ET APPAREIL POUR LA MODELISATION ET L'INTERROGATION DE STRUCTURES DE BASE DE DONNEES A L'AIDE DE CONSTRUCTIONS SEMBLABLES AU LANGAGE NATUREL

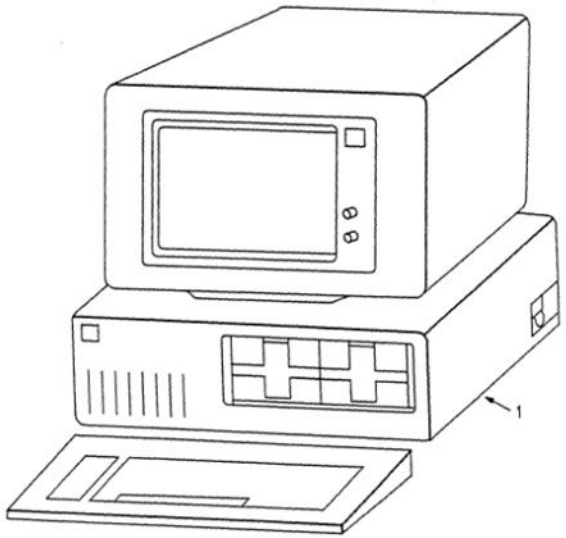


FIG. 1

Abstract

[EN] Computerized tools for modeling database designs and specifying queries of the data contained therein. Once it is determined that an information system needs to be created, the Fact Compiler of the present invention is invoked to create it. After creating the information system, the user creates a fact-tree as a prelude to generating queries to the system. After creating the fact-tree, the user verifies that it is correct using the Tree Interpreter of the present invention. Once the fact tree has been verified, the Query Mapper of the present invention is used to generate information system queries.

Level 3: data

Analysis of a patent zero with the example of SQL

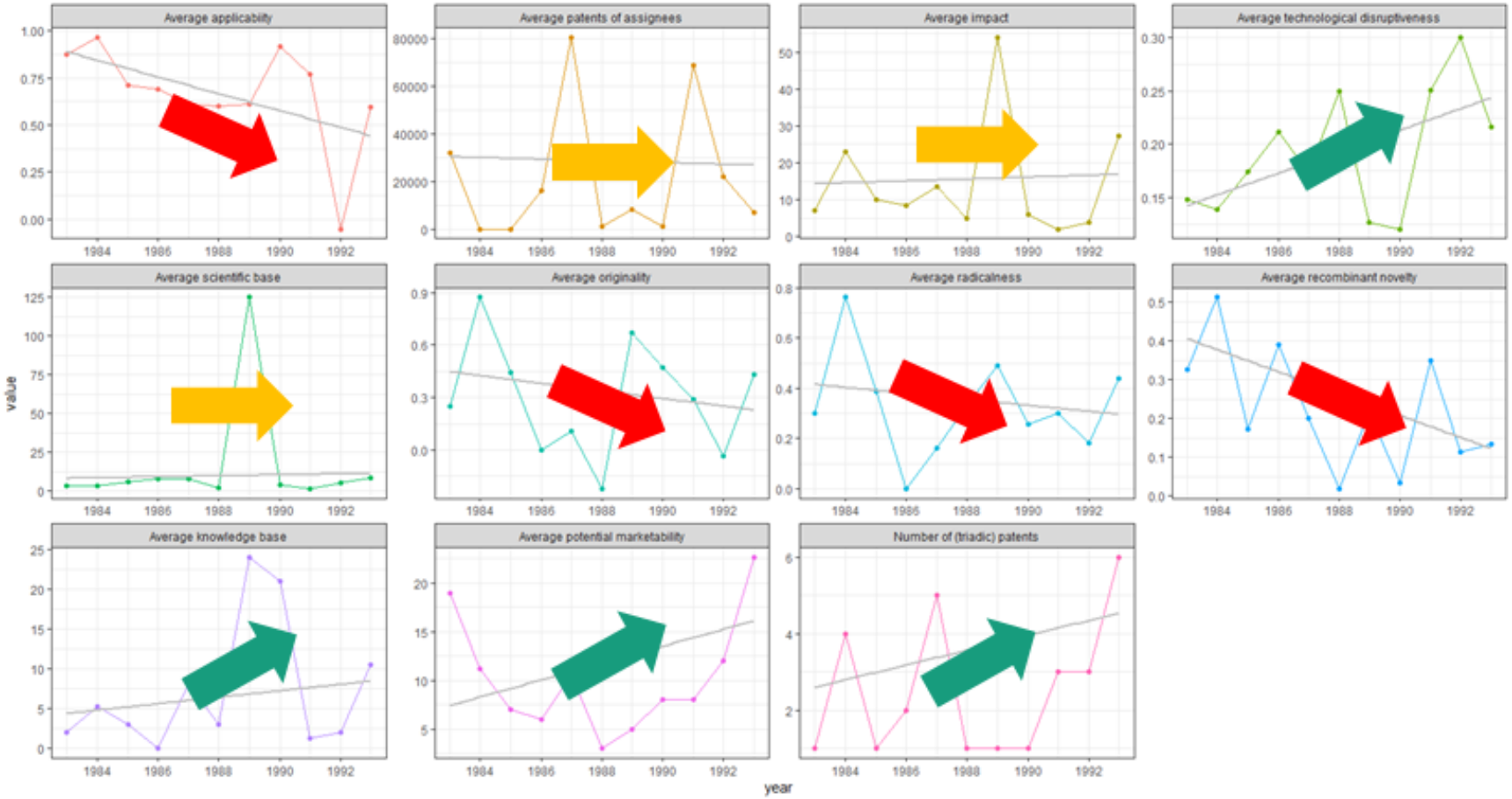
Table 2 Patent indicators of patent zero.

Indicator	Details	Patent zero	
Knowledge base	Number of backward citations	5	→ Low -> little proir art
Originality	Ratio of backwards citations in focal IPC classes	0.75	→ High, as expected
Radicalness	Ratio of backwards citations with different IPC classes	0.83	→ High, as expected
Technological Disruptiveness	Proportion of forwards citations which have the same backwards citations	-0.69	→ Low, indicator from Park et al. (2023) might not suffice
Scientific base	Number of Non-Patent-Literature references	9	→ High, strong scientific base
Impact	Number of forward citations	145	→ High, as expected
Applicability	Ratio of forwards citations not in focal IPC classes	0.9941	→ High, large field of application
Recombinant novelty	Ratio of pairwise combinations of IPC classes which have not been patented before	0.0017	→ Low
Potential marketability	Number of jurisdictions of patent	70	→ Patented in many countries, as expected
Number of patents of assignees	Number of (overall) patents of applicant	262	→ Approximation for the size of the disruptor

Martini, M., Tietze, F., John, M., Aristodemou, L., Schönmann, A., & Schimpf, S. (2024). Conceptualizing disruptive innovation paths, patent zero and patent-data based operationalization. CTM Working Papers (5/24), University of Cambridge. https://doi.org/10.17863/CAM.111428
Park, M., Leahey, E. & Funk, R.J. Papers and patents are becoming less disruptive over time. Nature 613, 138–144 (2023). https://doi.org/10.1038/s41586-022-05543-x

Level 3: data

Analysis of incumbents with the example of SQL



Analysis of indicators for all triadic patents in IPC G06F12 and G06F17 from 1983 to 1993.

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Level 3: data

Expansion of the analysis

  Public

Summary

- Limitations:
  - Small sample
  - Further analysis necessary
- Contribution:
  - A theoretical framework for trajectories of disruptive innovations
  - Introduction of patent zero
  - First results
- Conclusion:
  - Results are promising
  - Further specification of indicators and analysis is necessary
  - Further understanding for the identification of patent zero is necessary

Goal:

Development of an early warning system for the automatic identification of potentially disruptive innovations

Contact

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Thank you for the attention!

Literature

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