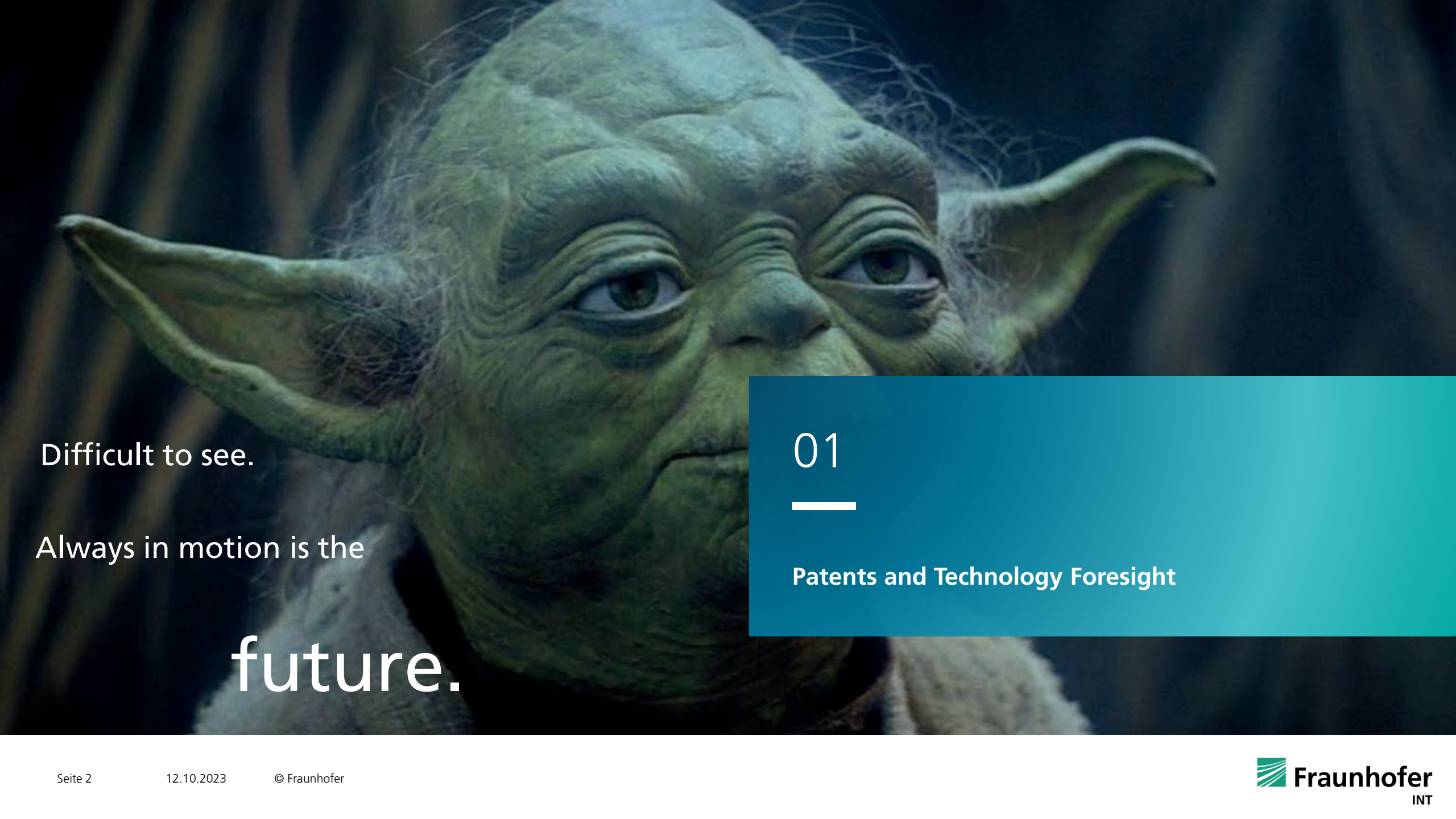


The use of patent analysis in foresight, insights and assessments of methods and approaches

Melanie Martini, Dr. Marcus John
Nordic Workshop in Bibliometrics and Research Policy 2023
12.10.2023

A close-up, slightly low-angle shot of Yoda's face. He has a serious, contemplative expression, looking slightly off-camera. His green, wrinkled skin and large, pointed ears are clearly visible. The background is dark and out of focus, suggesting a forest or cave setting.

Difficult to see.

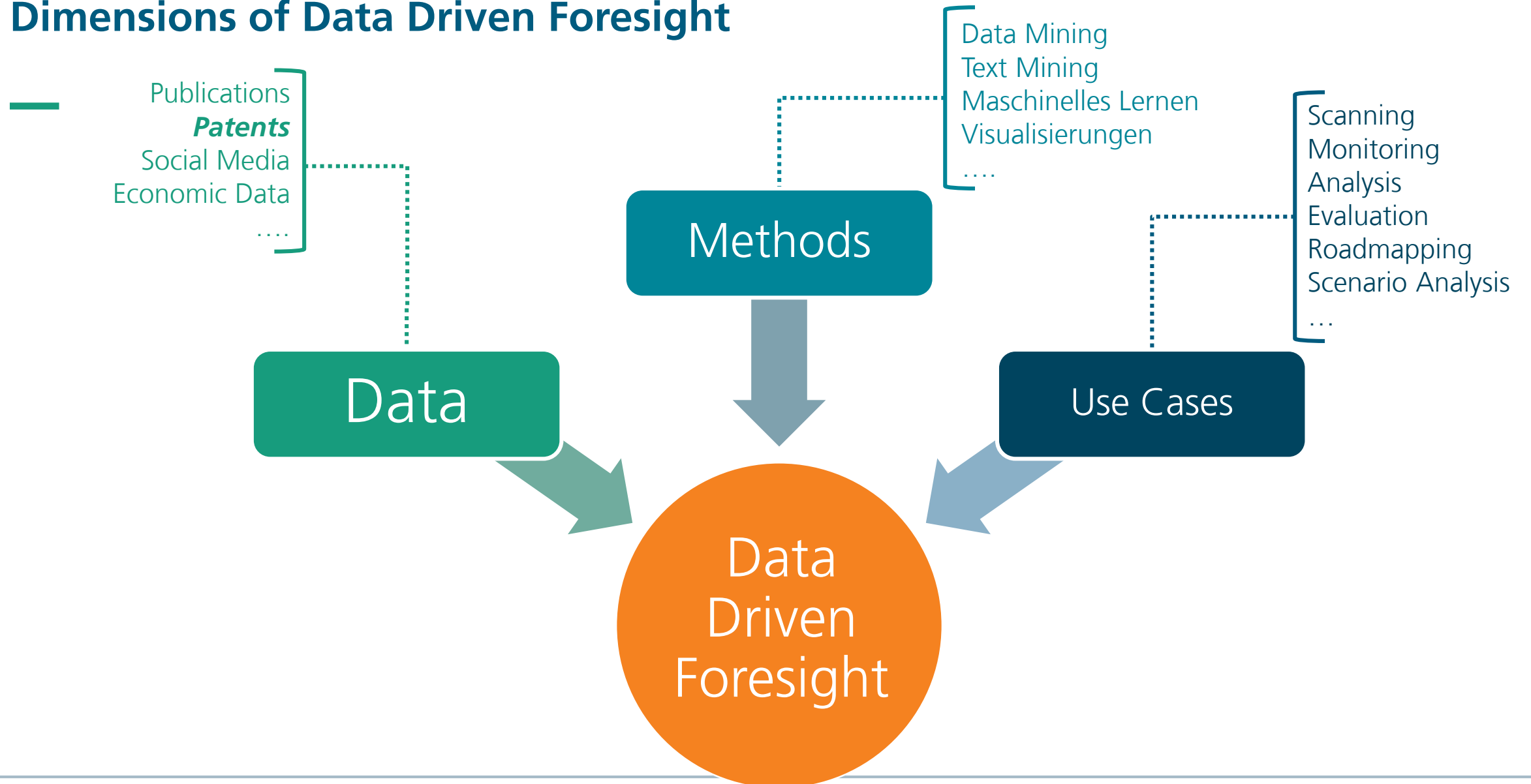
Always in motion is the

future.

01

Patents and Technology Foresight

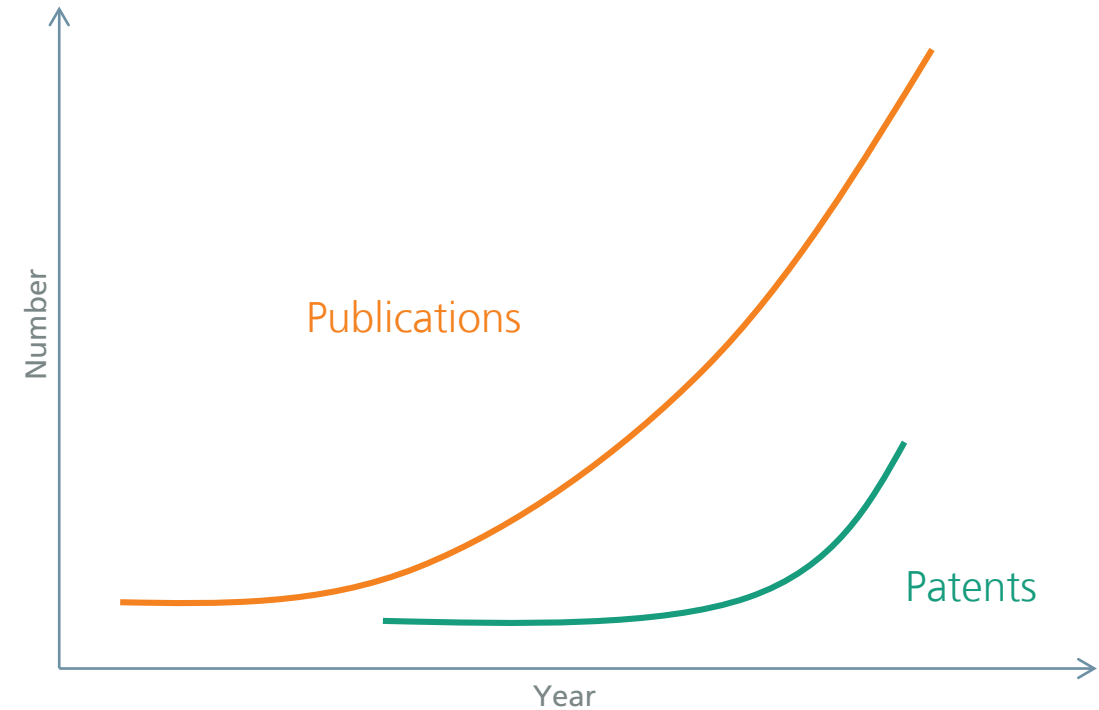
Dimensions of Data Driven Foresight



Use of Patent data for Data Driven Foresight

Motivation

- Analysis of **actors**
- Categorizing a topic, determining the **maturity** (e.g. Technology Readiness Level (TRL))
- **Structuring** a topic
- Identification of **Emerging Topics**
- Technology **Opportunity Analysis**, identification of **White Spots**
- ...

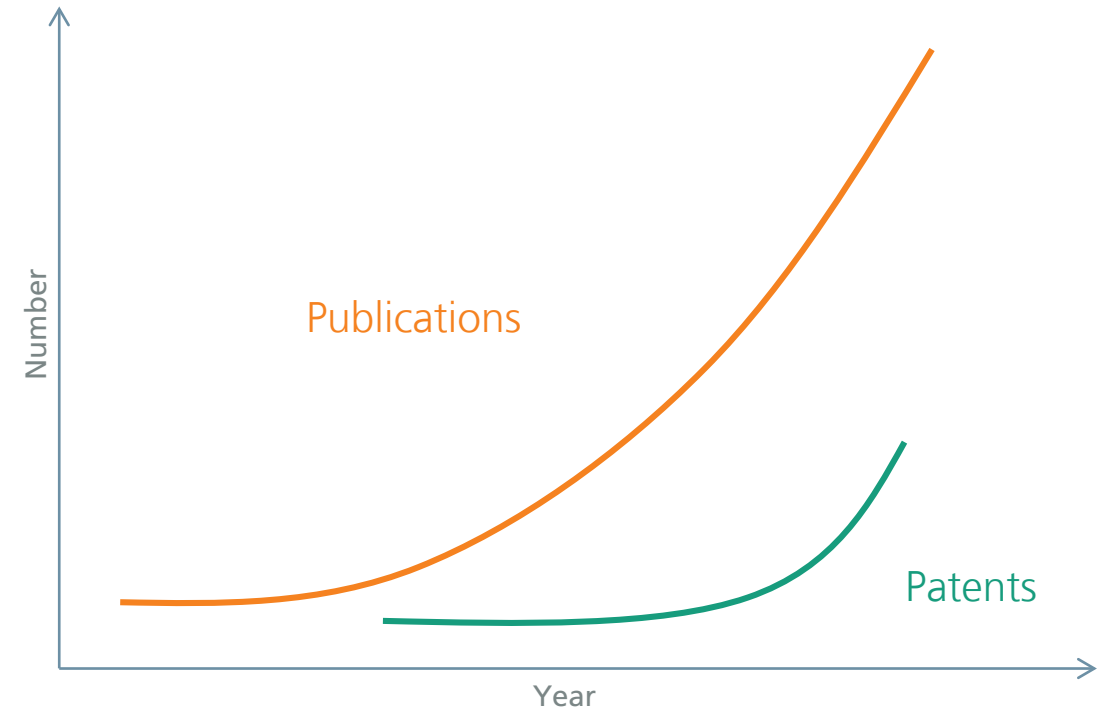


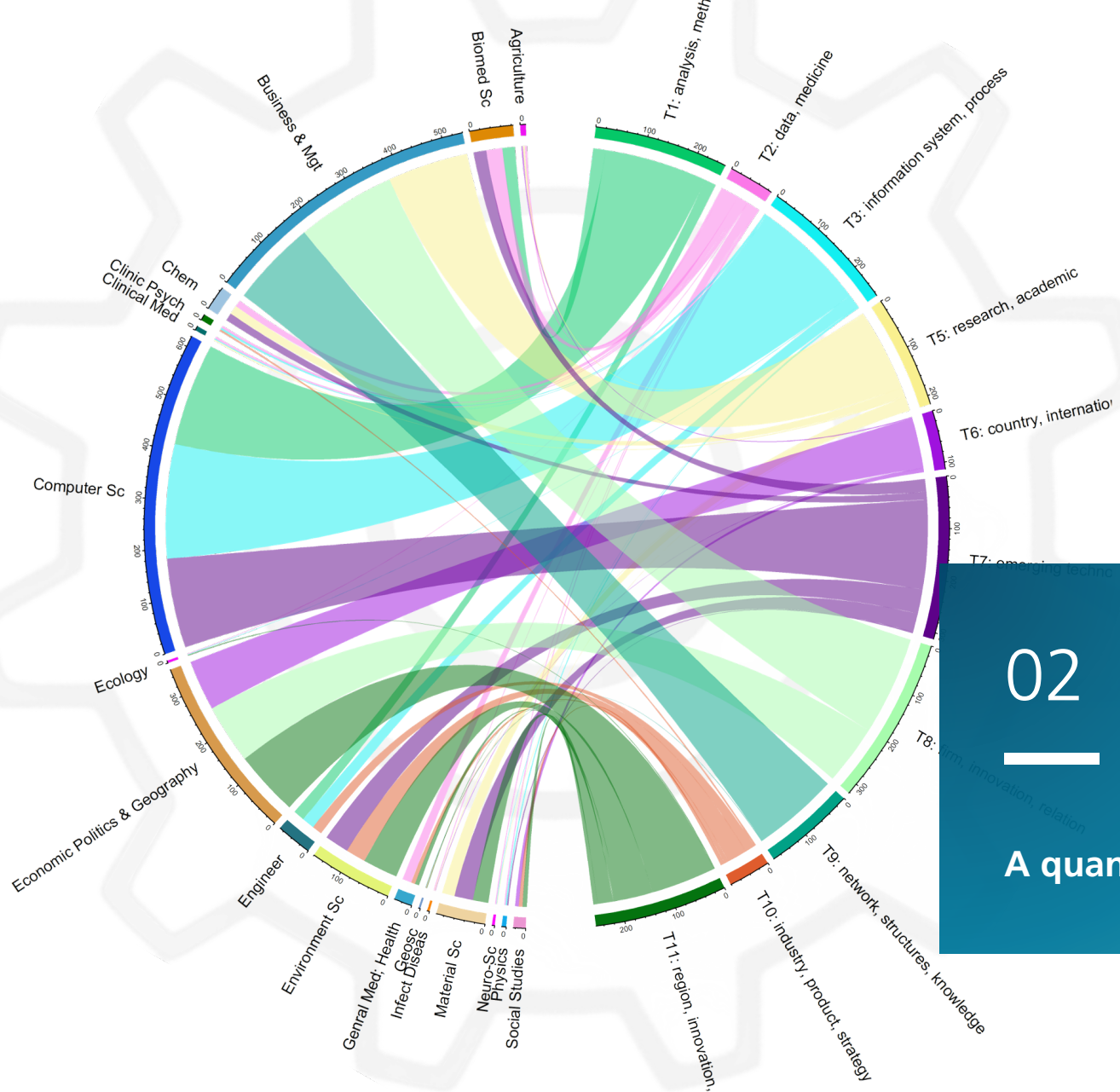
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- ...

➡ **Missing structure!**





02

A quantitative approach

Publication analysis

The basic search query

```
(((((("patent" OR "patents" OR "patent* strateg*" OR "patent* information" OR "intellectual propert*" OR "preliminar
"*USPTO*" OR "trademark" OR "patbase" OR "espacenet" OR "derwent") AND ("technolog* foresight*" OR "technolog* fore
"technolog* innovation" OR "technolog* life cycle" OR "technolog* manage*" OR "technolog* trend*" OR "technolog* ch
"technolog* emerg*" OR "technolog* develop*" OR "technolog* eval*" OR "technolog* intelligence" OR "innovation" OR "i
management" OR "innovat* system" OR "foresight assess*" OR "foresight method*" OR "futur* technolog*" OR "futur* data" OR
discover*" OR "knowledge gap" OR "knowledge spillover" OR "knowledge flow" OR "scien* innovation" OR "scien* push" OR "novelty
detection" OR "opportunity identification" OR "scenario analysis" OR "emerg* technolog*" OR "roadmap" OR "information technolog*" OR
"trend monitor*" OR "strategic foresight" OR "weak signal" OR "delphi" OR "researchdevelopment"~1 OR "R&D" OR "bibliometrics" OR
"morphological analysis" OR "trend analysis" OR "TRIZ") AND ("patentometrics" OR "*citation analys*" OR "*citation net*" OR
"*classification analysis" OR "*occurence analysis" OR "*supervised learning" OR "anomaly detection" OR "artificial intelligence" OR
"association" OR "bibliometric*" OR "classification" OR "cluster analys*" OR "clustering" OR "data analy*" OR "data min*" OR "data
science" OR "decision tree" OR "dimensionality reduction" OR "infometric*" OR "information science" OR "keyword analys*" OR "k-means"
OR "k-nearest neighbour" OR "machine learn*" OR "main path analysis" OR "Markov model" OR "naive Bayes" OR "natural language
process*" OR "net* analys*" OR "neural net*" OR "NLP" OR "outlier detect*" OR "pattern recognition" OR "random forest" OR
"regression" OR "reinforcement learn*" OR "scientometric*" OR "semantic analys*" OR "social net*" OR "stochastic model*" OR "support
vector machine" OR "SVM" OR "text min*" OR "visualisation" OR "web mining")) NOT ("patent foramen" OR "patent ductus arteriosus" OR
"un$derwent" OR "patent endoparasitism*" OR "traditional patent medicine" OR "chinese patent*"~1 OR "patent infarct*" OR "patent
trace*" OR "patent arter*"~2 OR "arter* patent"~3 )) NOT (wos_extended_subject:%Cardiovascular System & Cardiology%)) NOT
(journal:%CRITICAL CARE MEDICINE% OR journal:%MALARIA JOURNAL% OR journal:%JOURNAL OF MINIMALLY INVASIVE GYNECOLOGY% OR
journal:%GYNECOLOGIC ONCOLOGY% OR journal:%JOURNAL OF THE AMERICAN ASSOCIATION OF GYNECOLOGIC LAPAROSCOPISTS% OR journal:%EUROPEAN
JOURNAL OF OBSTETRICS & GYNECOLOGY AND REPRODUCTIVE BIOLOGY% OR journal:%GYNECOLOGIC AND OBSTETRIC INVESTIGATION% OR journal:%ANNALS
OF TROPICAL MEDICINE AND PARASITOLOGY% OR journal:%INTERNATIONAL JOURNAL FOR PARASITOLOGY% OR journal:%BMC UROLOGY% OR journal:%BMC
NEUROLOGY% OR journal:%JOURNAL OF ENDOUROLOGY% OR journal:%EUROPEAN UROLOGY% OR journal:%JOURNAL OF PEDIATRIC UROLOGY% OR
journal:%DIGESTIVE SURGERY% OR journal:%CLINICAL NEUROLOGY AND NEUROSURGERY% OR journal:%ARCHIVES OF OTOLARYNGOLOGY-HEAD & NECK
SURGERY% OR journal:%ANZ JOURNAL OF SURGERY% OR journal:%SURGERY TODAY% OR journal:%PLASTIC AND RECONSTRUCTIVE SURGERY% OR
journal:%ASIAN JOURNAL OF SURGERY% OR journal:%ANNALS OF SURGERY% OR journal:%EUROPEAN JOURNAL OF PEDIATRIC SURGERY% OR...
```

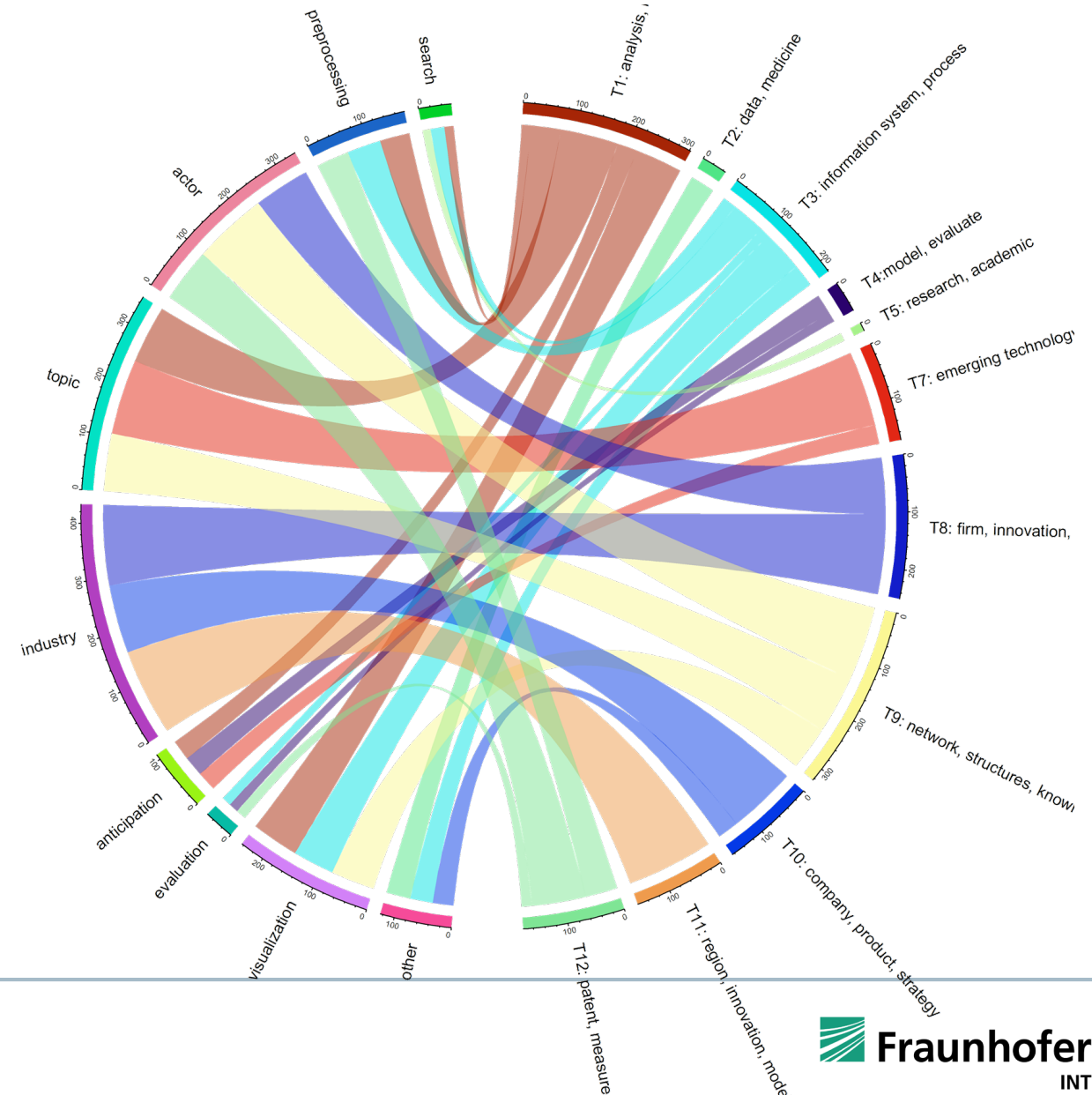
Over
3000
publications

Publication analysis

The analysis

- **How** is patent data used in foresight?
- **Who** uses patent analysis for foresight purposes?
- In which **steps** of the foresight process is patent data used?
- Where are **further possibilities** for the use of patent data in foresight?

Which **Process Steps** are preferentially influenced by which **LDA Topics**?



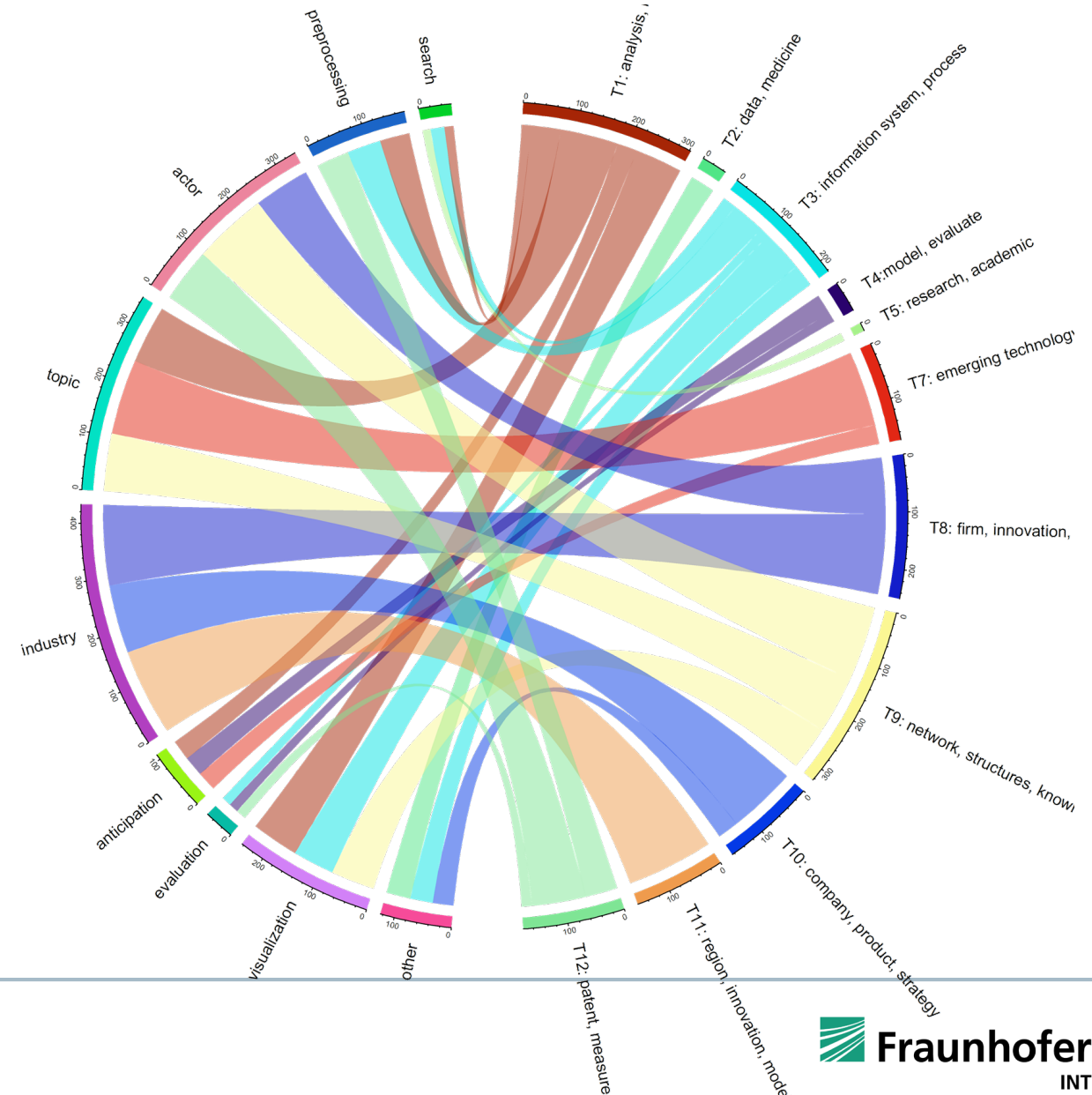
Publication analysis

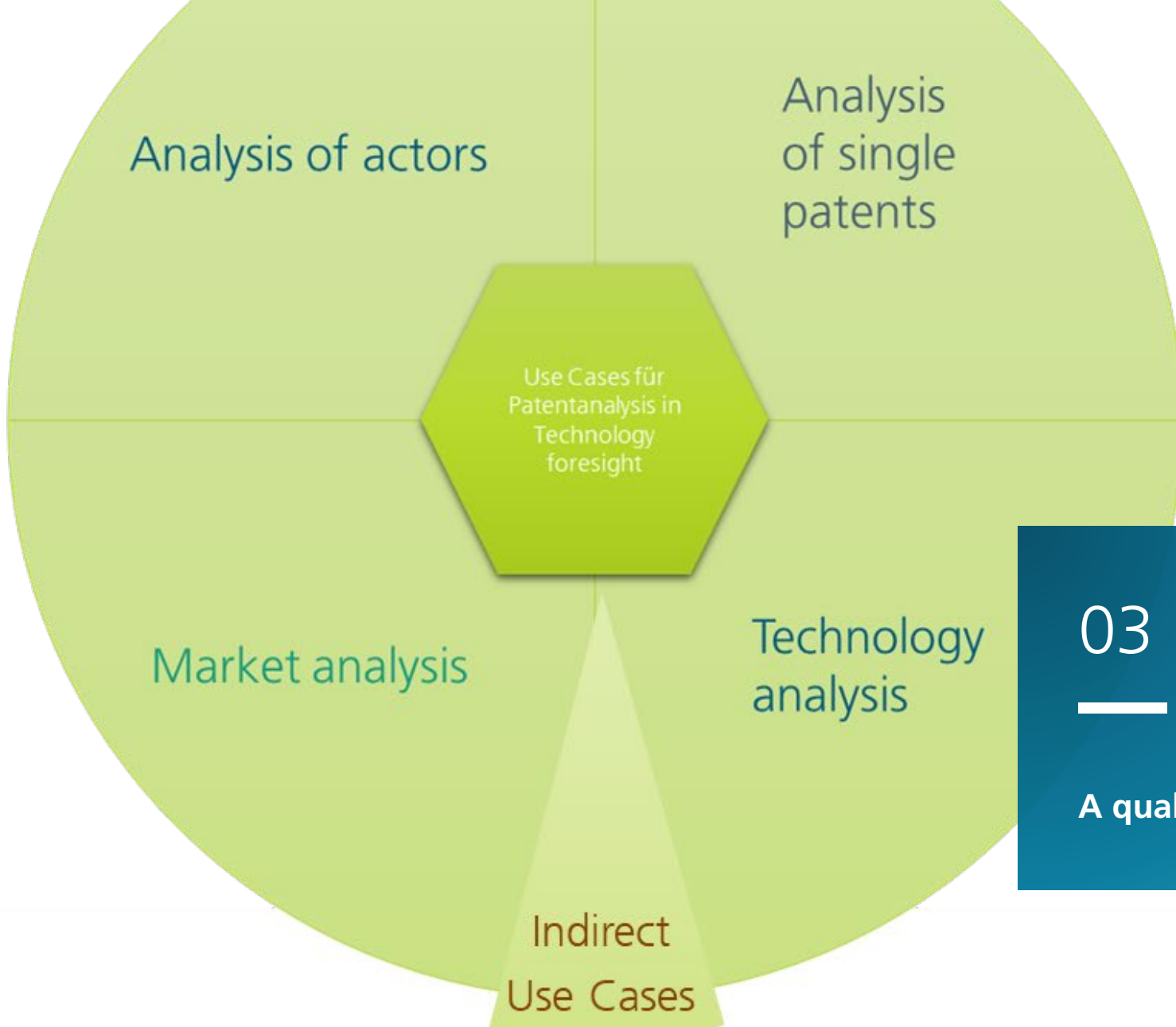
The analysis

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➔ Not detailed enough!

Which **Process Steps** are preferentially influenced by which **LDA Topics**?





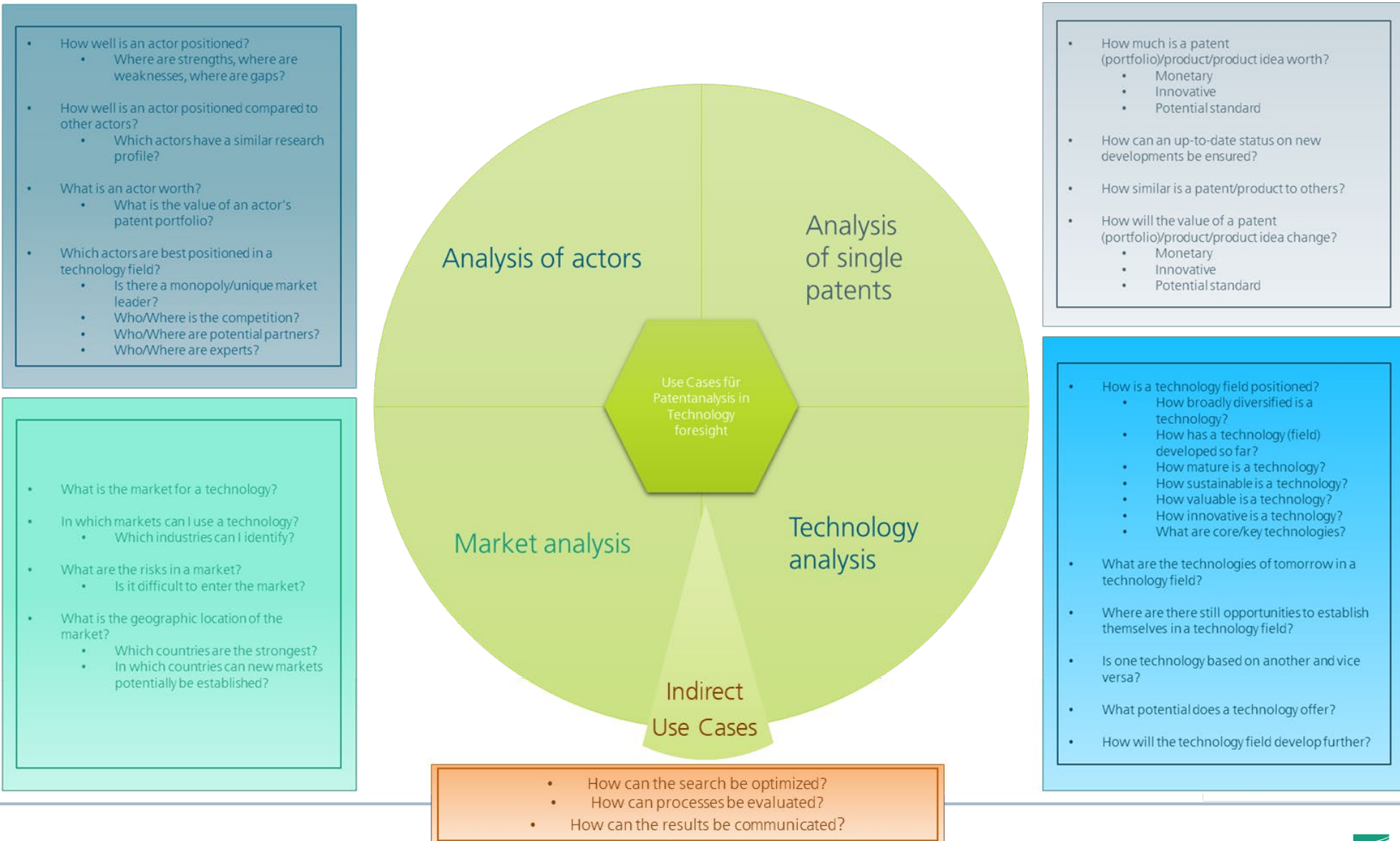
- How similar is a patent/product to others?
- How will the value of a patent (portfolio)/product/product idea change?
 - Monetary
 - Innovative
 - Potential standard

- How is a technology field positioned?
 - How broadly diversified is a technology?
 - How has a technology (field) developed so far?
 - How mature is a technology?
 - How sustainable is a technology?
 - How valuable is a technology?
 - How innovative is a technology?
 - What are core/key technologies?
- What are the technologies of tomorrow in a technology field?
- Where are there still opportunities to establish in a technology field?
- Is one technology based on another and vice versa?
- What potential does a technology offer?
- How will the technology field develop further?

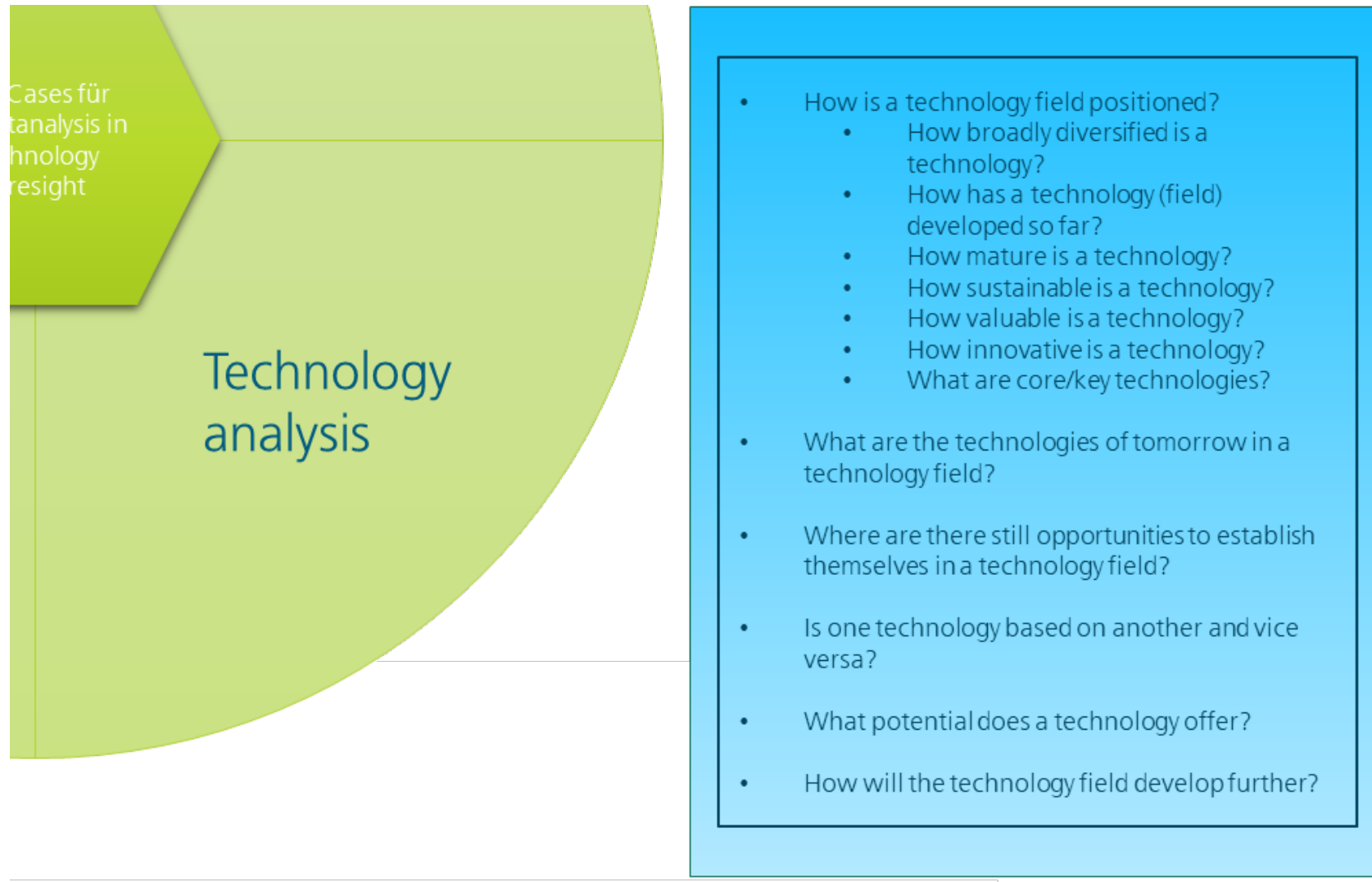
03

A qualitative approach

Use Cases for Technology Foresight with Patents



Use Cases for Technology Foresight with Patents



Data and Methods for Technology Foresight with Patents

Data Fields

- Title
- Abstract
- Claims
- IPC/CPC Classifications
- Assignees
- Inventors
- Publications/Priority date
- Citations
- Jurisdiction
- Image
- Family Size
- ...

Methods

- Statistical approaches
- Indicators
- Text Mining
- Topic Modelling
- Regression
- Clustering
- Machine Learning
- Neural Networks
- Network Analysis
- S-curve fitting
- Time series analysis
- ...

Methodology

For each use case:

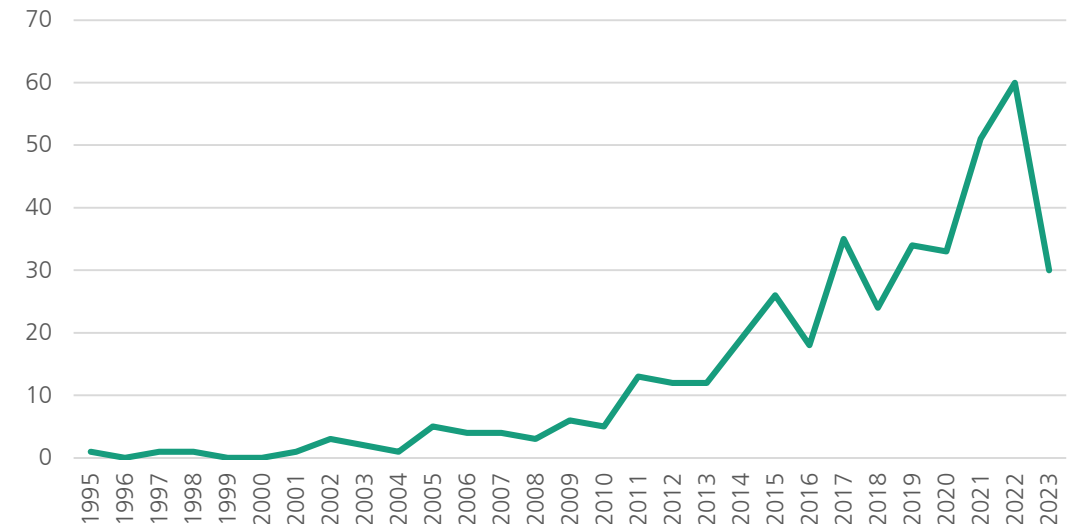
- Construct a **search query** based on the basic query
- **Extract methods** and **data** from each publication
- Bring it all together

Constraints of publications:

- No conference proceedings
- Only publications with english abstract
- Publications which are older than 3 years (2020 or earlier) need to have at least 5 citations

```
Basic query AND  
("white spot*"  
OR "technolog* opportunit*"  
OR "technolog* vacan*"  
OR "opportunity identificat*")
```

Publications analysed



5	11	4
2	1	0
12	14	3
1	2	0
2	2	0
0	0	0
0	1	1
9	7	2
1	2	0
10	16	0
13	18	5
0	4	0
9	10	1

04

Results and discussion

Use Cases, Data and Methods for Technology Foresight with Patents

It all comes together

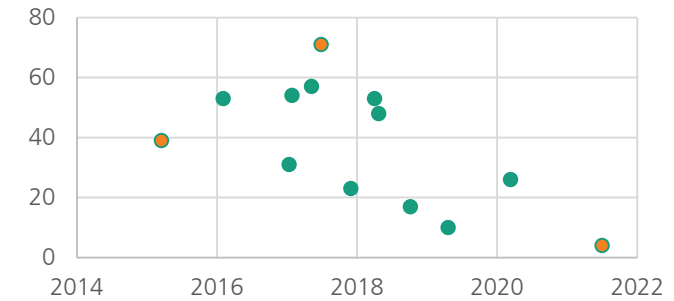
Use Case \ Indikator	(Probable) As Inventor	Publication D	Priority/Appli	Expected Exp	Document Ty	Status	DoA	Application R	Renewed
Technology Analysis									
How is a technology field set up? (landscape)	Statistics [91]	Statistics [219]	Statistics [91]	Statistics, NLP [238]; Statistics	Design patent	Statistics and network analysis (applications) [330]; Statistics			
How diffuse is it? (Diffusion, Technological Network)	Social Network	Subnetworks	Citation Network	Knowledge stock and knowledge stock intensity, convergence tests [237]; network analysis [290]; network					
How did it develop so far? (technological evolution)	Technological	Network-Mechanisms	Technology D	Statistics Technology Cycle	statistics [334]				
How mature is it? (maturity, technological maturity)	hidden Markov	Type of invention	S-curve model	cross-correlation analysis [165]	evolving patent citation networks and S-curve [94];				
How sustainable is it? (Sustainability)	Social Network analysis [118]	Tobin's Q for	network analysis, statistics [165]	green invention patent (GIN) and green utility model patent (GUP) regression					
How much is it worth?	Random Forest	Random Forest [165]		Random Forest [165]; Deep Neural Network, Linear Regression [168]; knowledge recombination, recombination					
How innovative is it? (original, novelty)	entropy-based	entropy-based	entropy-based	entropy-based indicator system [236]; Statistics	Granted patents [244]; Statistics (applications) [325]				
What are key technologies?	Statistics, network analysis [165]	Technology D	RFM score, network analysis	co-classification network analysis of SEPs [269][279]; statistics [334]					
How disruptive is it? (disruptiveness)	Statistics [207]	Text Mining, Statistics [324]	Statistics [207]; Text Mining, Statistics [324]; support vector machines (SVM) and neural networks, SVM						
What are the technologies of tomorrow?	Supervised learning	co-occurrence	Text Mining, knowledge	RFM score, network analysis, bibliographic coupling, text mining [300];	statistics/indicators [461]	Bibliometric coupling			
Where are white spots? (vacancies, opportunities)	Stacked Denoising AutoEncoder [395]; self-supervised	Text mining, Statistics, K-medoids clustering based on support vector clustering (KM-SVC) [310]; network							
Which potential does a technology have?	identify potential	entropy-based	Text Mining, knowledge	entropy-based indicator system [236]; text mining	Multi-Class Classification Model [76]				
How will a technology field develop?	Predict technology	Predict technology	Predict technology	Predict technology	Predict technology transfer	Predict technology transfer	statistics/indicators [461]		

Use Case \ Indikator	(Probable)		Priority/Applicat						Application		Classification			
	Assignee	Inventor	Publication Date	ion Date	Expected Expiry	Document Type	Status	DoA	Route	Renewed	(IPC/CPC)	Title	Abstract	Description
How is a technology field set up?	26	4	11	28	0	2	3	0	0	0	28	5	11	4
How diffuse is it?	8	4	7	4	0	0	0	0	0	0	9	2	1	0
How did it develop so far?	6	2	2	34	0	1	0	0	0	0	27	12	14	3
How mature is it?	3	2	5	15	0	1	0	0	0	0	7	1	2	0
How sustainable is it?	3	0	2	1	0	3	0	0	0	0	8	2	2	0
How much is it worth?	2	1	0	5	0	0	0	0	0	0	6	0	0	0
How innovative is it?	5	2	1	4	0	0	2	0	0	0	9	0	1	1
What are key technologies?	9	0	1	18	0	3	0	0	0	0	23	9	7	2
How disruptive is it?	3	1	0	3	0	0	0	0	0	0	2	1	2	0
What are the technologies of tomorrow?	11	4	3	21	0	0	0	0	1	1	21	10	16	0
Where are white spots?	8	0	0	21	0	0	0	0	0	0	18	13	18	5
Which potential does a technology have?	4	1	2	4	0	0	1	0	0	0	9	0	4	0
How will a technology field develop?	8	4	6	19	1	0	1	0	1	0	23	9	10	1
	96	25	40	177	1	10	7	0	2	1	190	64	88	16

Results

So far

Average age and number of publications



Use Case \ Statistics	Number of Publications	Average Age	Most Used Data Fields	Additional Datasources
How is a technology field set up?	53	2016,09	Assignee, Priority/Applicatio Date, Classification (28)	publications, literature reviews, expert opinions, grants, funding
How diffuse is it?	39	2015,21	Backward Citation (23)	publications, country information, xstandards, R&D data, cross-national brokerages, trademarks
How did it develop so far?	71	2017,49	Priority/Application Date (34)	publications, literature reviews, market data, product data, company data, Twitter, experts, funds, news
How mature is it?	31	2017,03	Priority/Application Date (15)	publications, standards, news, capital investments, clinical trials, product data
How sustainable is it?	26	2020,19	Classification (8)	publications, green R&D, R&D investment, capital stock, and GDP per capita, tertiary education and openness are shares of GDP, company data, country information
How much is it worth?	10	2019,3	Classificatio, Forward Citations (6)	publications, financial data, firm ownership data
How innovative is it?	23	2017,91	Classification (9)	publications, company data, inventor-establishment data set and establishment level NACE industry codes, cumulative (market-adjusted) abnormal returns (CAR)
What are key technologies?	54	2017,07	Classification (23)	publications, literature reviews, market analysis, SEPs, social information, experts, Twitter
How disruptive is it?	4	2021,5	Assignee, Priority/Applicatio Date (3)	publications, interviews, start-Ups, news, social media
What are the technologies of tomorrow?	48	2018,31	Priority/Application Date, Classification (21)	publications, market database, web data (futuristic websites), SEPs, experts, Wikipedia, Twitter, technical dictionary
Where are white spots?	57	2017,35	Priority/Application Date (21)	publications, news websites, product data, experts, unified structured inventive thinking (USIT), industry and firm specific data, market reports, product information from Korea Institute of Science and Technology Information (KISTI)
Which potential does a technology have?	17	2018,76	Classification (9)	publications, market data, user reviews, experts
How will a technology field develop?	53	2018,25	Classification (23)	publications, product data, commercial database, experts, funds, news, market data
Total: 404				

Results

So far

Additional Data Fields

- Assignee/Inventor Country
- Triadic patent
- Assignee type (public research institute, university, industry)
- Patent right transaction data, reassignments
- Patent litigation data and lawsuits
- Self-family citations
- Keywords
- Patent Office
- Number of pages
- Number of agents
- Priority country
- ...

(Probable) Assignee	96
Inventor	25
Publication Date	40
Priority/Application Date	177
Expected Expiry	1
Document Type	10
Status	7
DoA	0
Application Route	2
Renewed	1
Classification (IPC/CPC)	190
Title	64
Abstract	88
Description	16
Claims	43
Fulltext	93
Backward Citations	131
Forward Citations	127
NPL Citation	23
Jursidiction	31
Examineer/Applicant Citations	1
Image	2
Family Size	14

Discussion and next steps

Limitations of the approach

- Everything depends on the search query
- Time-consuming

Next Steps

- Evaluation of further Use Cases (Actors Analysis, Market Analysis,...)
- Evaluation of methods
- Focus on white spots in table

Questions?



Melanie Martini



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Research focuses on **data-driven** methods
for **foresight** with a specialization on
patents

