
Identification of Emerging Technologies with Security Implications: Experience and Results from the ETCETERA project

Beatrix Wepner
Guido Huppertz

Austrian Institute of Technology, Vienna, Austria
Fraunhofer Institute for Technological Trend Analysis, Euskirchen, Germany



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...ETCETERA

Evaluation of critical and emerging technologies for the elaboration of a security research agenda

Etcetera WP4 – Project Workflow

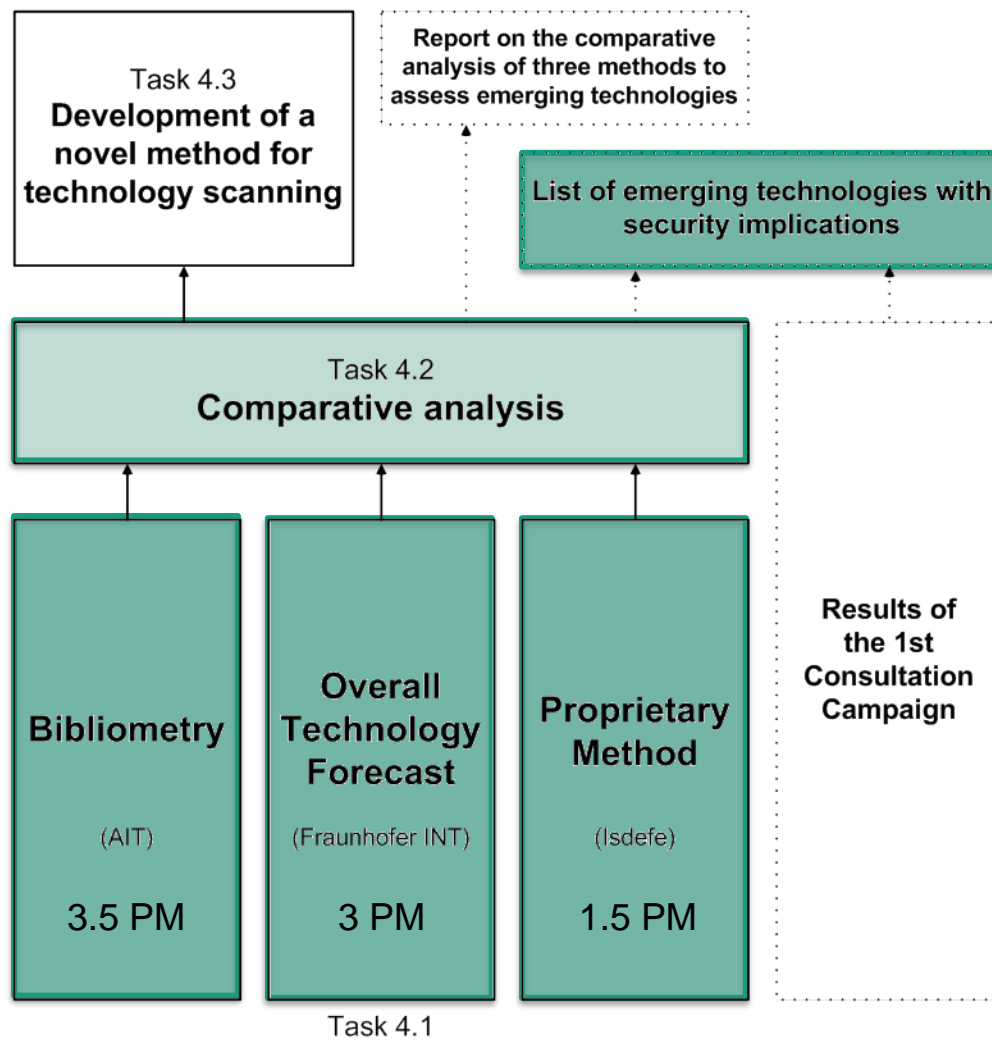
Task 4.1: 10/2011 – 03/2012

- Identification of **Emerging Technologies ...**
- ... with **security implications**
- ... in **time frame 2020 to 2030**
- ... based on three different methods by AIT, INT and Isdefe.

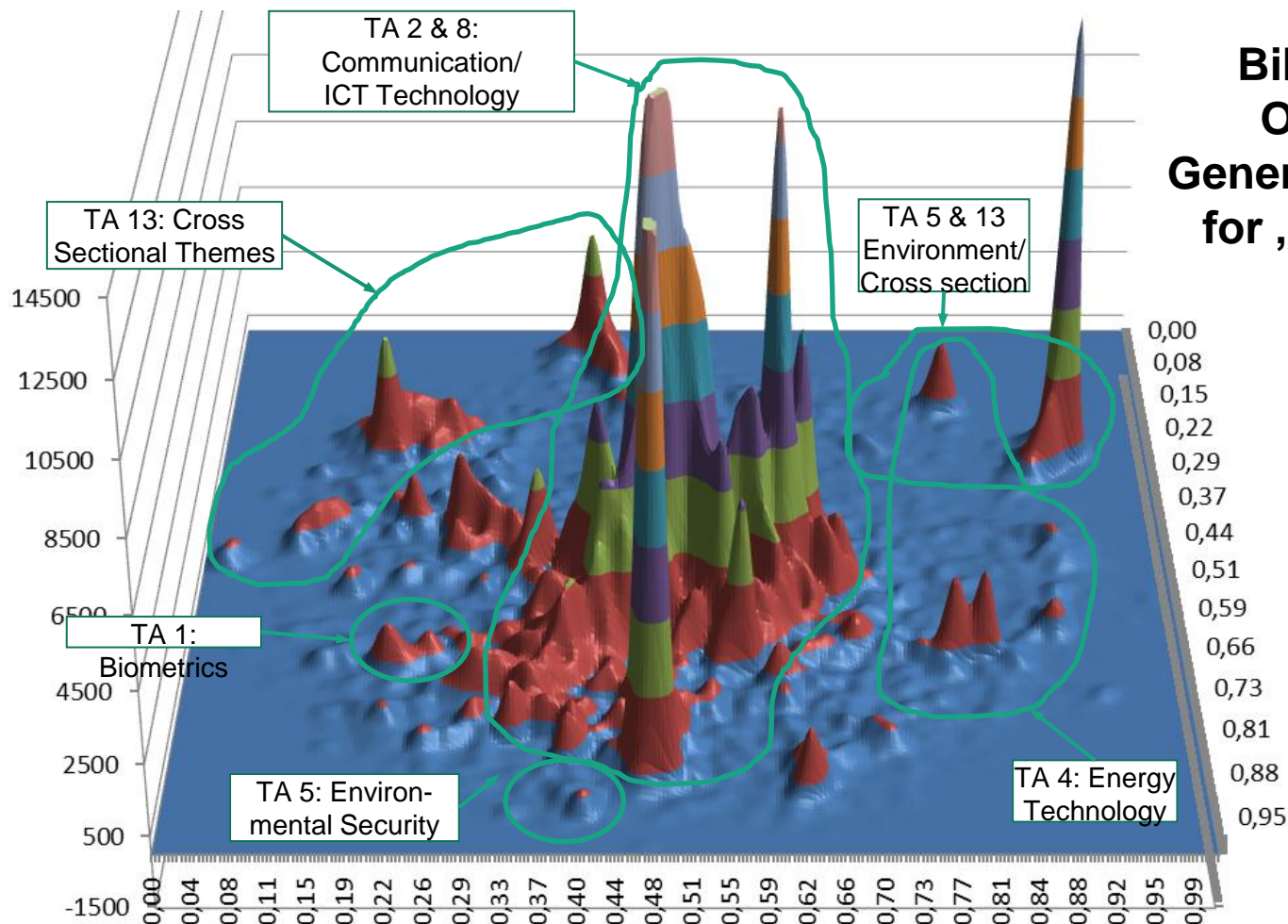
- AIT → Bibliometry
- FhG INT → Desk Research (inhouse experts)
- Isdefe → Desk Research (core team inhouse, external experts)

Task 4.2: 02/2012 – 07/2012

- Harmonisation of individual lists
- Prioritisation of technologies
- Evaluation of methods



Etcetera WP4 – Technology Scanning using Bibliometry



**Bibliometric
Overview –
General Search
for „Security“**

Density map of *bibliographically coupled* publications, cos-weighted moving average filter $pw=c(x,y) \times p(x,y)$; Total # of Pubs 20974; Time Span: 2006; 2010

Etcetera WP4 – List and Description of Emerging Technologies

“Provisional List” – WD4.1

127 Emerging Technologies sorted in

13 Technology Areas were identified, containing

10 Technology Demands.

Altogether 140 Emerging Technologies were identified by partners AIT, Isdefe and FhG INT

“Technology Cards” – Amendment to WD4.1

serve to establish a common understanding for the following prioritisation step

The image shows three overlapping technology cards. The top card is titled '1. "Cancelable biometrics"' and is associated with 'Task 4.1 | WD4.1 "AIT" – "28"'. The middle card is titled '5. "New coatings and surface treatments"' and is associated with 'Task 4.1 | WD4.1 ISDEFE-24'. The bottom card is titled '7. "Post-quantum Cryptography"' and is associated with 'Task 4.1 | WD4.1 Fraunhofer INT – 049'. Each card contains a description, relevance, and expectations section. The bottom card also includes a small image of a quantum circuit diagram.

1. "Cancelable biometrics"
Task 4.1 | WD4.1
"AIT" – "28"

5. "New coatings and surface treatments"
Task 4.1 | WD4.1
ISDEFE-24

7. "Post-quantum Cryptography"
Task 4.1 | WD4.1
Fraunhofer INT – 049

Description
Form a privacy (storage and misrepresent emergimproving public. One advantage: password is lost naturally available: cancel or reissue. Cancelable biometric feature: compromised, if a new template, categories for biometric features.

Relevance
All data, including processing state, protection and...
A distinct advanced template technique transformed biometric original ones, so CB offer the ability systems, provided level.

Sources: [1] Cancelable Biometrics, EURASIP Journal on Signal Processing, 2008, vol. 2008, pp. 1-10.

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Description
It refers to dependence on the function...
Nanostructured plasma, layer of microwave gratings.

Relevance
Applications:
- To increase resistance to cracking, to attack gases, etc..
- Paints and coatings with color, electromagnetic environmental protection.
- Unknown negative effects.
- Some research on these technologies upscaling expected.

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Description
Most currently popular public-key cryptosystems such as RSA (Rivest, Shamir, Adleman) and ECC (elliptic curve cryptography) can be efficiently broken by quantum computers. Post-quantum cryptography refers to cryptosystems that run on conventional computers and are not breakable using classical or quantum computers.

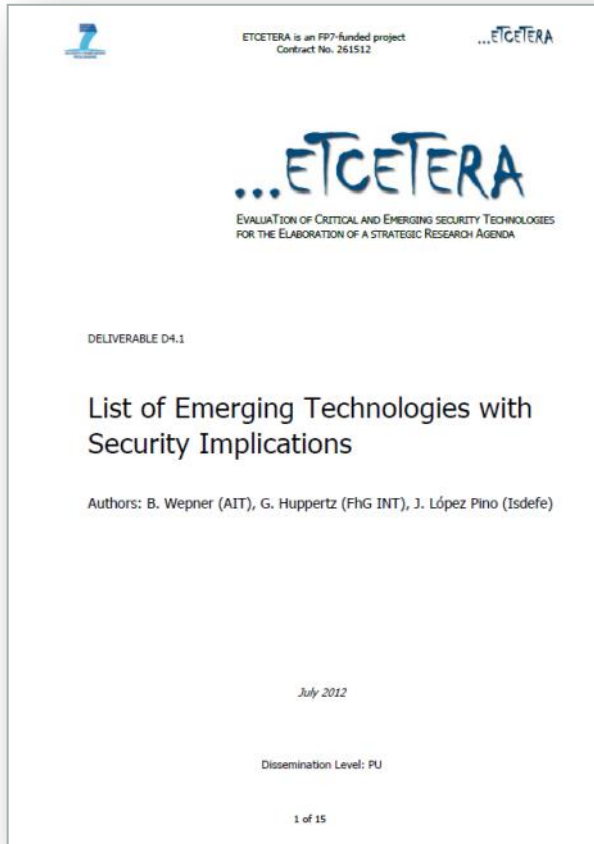
Relevance
Post-quantum cryptography provides protection for sensitive information against attacks by quantum computers.

Expectations
There are currently several proposals for public-key cryptosystems, e.g. multivariate cryptography, which are believed to be immune to a quantum computer attack.
The technology readiness is low to medium. Practical cryptosystems may become available in about 10 years.

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Etcetera WP4 – Assessment of Emerging Technologies

“Prioritised List” – D4.1



ETCETERA is an FP7-funded project
Contract No. 261512

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TA4: Energy Technology						
	SecRel	Time	Market	Appl	Ethics	
10	Smart Power Grid	4	0	3	3	0
11	Hydrogen Production and Storage Technologies	3	3	3	1	6
12	Small-scale Energy Harvesting	2	6	3	3	4
13	Electrochemical Energy Storage Materials	2	3	3	3	6
14	UUV/USV – Energy Storage and Propulsion	2	3	-1	1	6
15	Biomass-to-Liquid Biofuel / Fischer-Tropsch Synthesis	1	0	3	-1	6

TA5: Environmental Security						
	SecRel	Time	Market	Appl	Ethics	
16	Earthquake Prediction	0	1.5	-3	3	6
17	Climate Engineering	3	1.5	3	0	6
18	Carbon Sequestration	1.5	6	3	0	6
19	Nanocomposites for Oil Removal	1.5	6	1.5	0	3

TA6: Human Machine Interface						
	SecRel	Time	Market	Appl	Ethics	
20	Automated Human Behaviour Analysis	5	3	3	3	0
21	Dark Web Terrorism Research	5	0	-3	3	0
22	Broad-Spectrum Antiviral Therapeutics	4.5	6	3	3	6
23	Reality mining - Machine Perception and Learning	1	3	3	-3	0
24	Agent based Modelling	1	3	1	-1	4

TA7: Human Science						
	SecRel	Time	Market	Appl	Ethics	
25	Quantum Computers	3	3	-1	1	4
26	Nanocomputers	1	0	1	-3	6

TA8: ICT and Electronics						
	SecRel	Time	Market	Appl	Ethics	
27	Semantic 3D Scene Interpretation	6	3	1	3	0
28	Exo-Skeletons	5	3	1	1	2
29	Small Satellites	5	6	1	3	2
30	Stratospheric Platforms	5	6	-1	3	0
31	Autonomous Passenger Cars	4	3	3	1	4
32	Kinodynamic Motion Planning	4	4	3	-3	6
33	Active Protection Systems	4	6	-1	1	4
34	Indoor Navigation	3	3	3	1	0
35	E-Enabled Aircraft	2	3	3	3	6
36	Walking Machines	2	0	1	1	4
37	Chemical Robots – ChemBots	2	3	-1	1	0
38	Space Debris Removal	2	3	-1	-3	6
39	Biomimetic UUVs	2	6	-1	3	4
40	UUV/USV – Collision and obstacle avoidance technologies	2	3	-1	1	4
41	Ducted Fan Air Vehicles	1	6	3	1	2
42	Personal Air Vehicles / Flying Cars	1	0	-1	3	4
43	UUV/USV – Advanced Algorithms for Classification	1	3	-3	-1	6

5 of 15

Content:

70 Emerging Technologies after prioritisation using WBAM

After completion of the technology scanning phase at AIT, Isdefe and Fraunhofer INT a synchronised list of emerging technologies was produced. This complete list was assessed by technology experts in the three institutions by filling in an Excel sheet with the possibility to rate certain aspects of each technology by ticking boxes. The following screenshot gives an example on how the Excel sheet was organised.

Fig. 3.1.1: Structure of the Excel file used for technology assessment.

Fig. 3.1.2: Depiction of the technology assessment file, showing the applied WBAM factor values and the gathered ratings for technology area “Energy Technology”.

Etcetera WP4 – Assessment of Emerging Technologies

WBAM – Weighted Bit Assessment Method

Assessment of WBAM result for prioritisation:

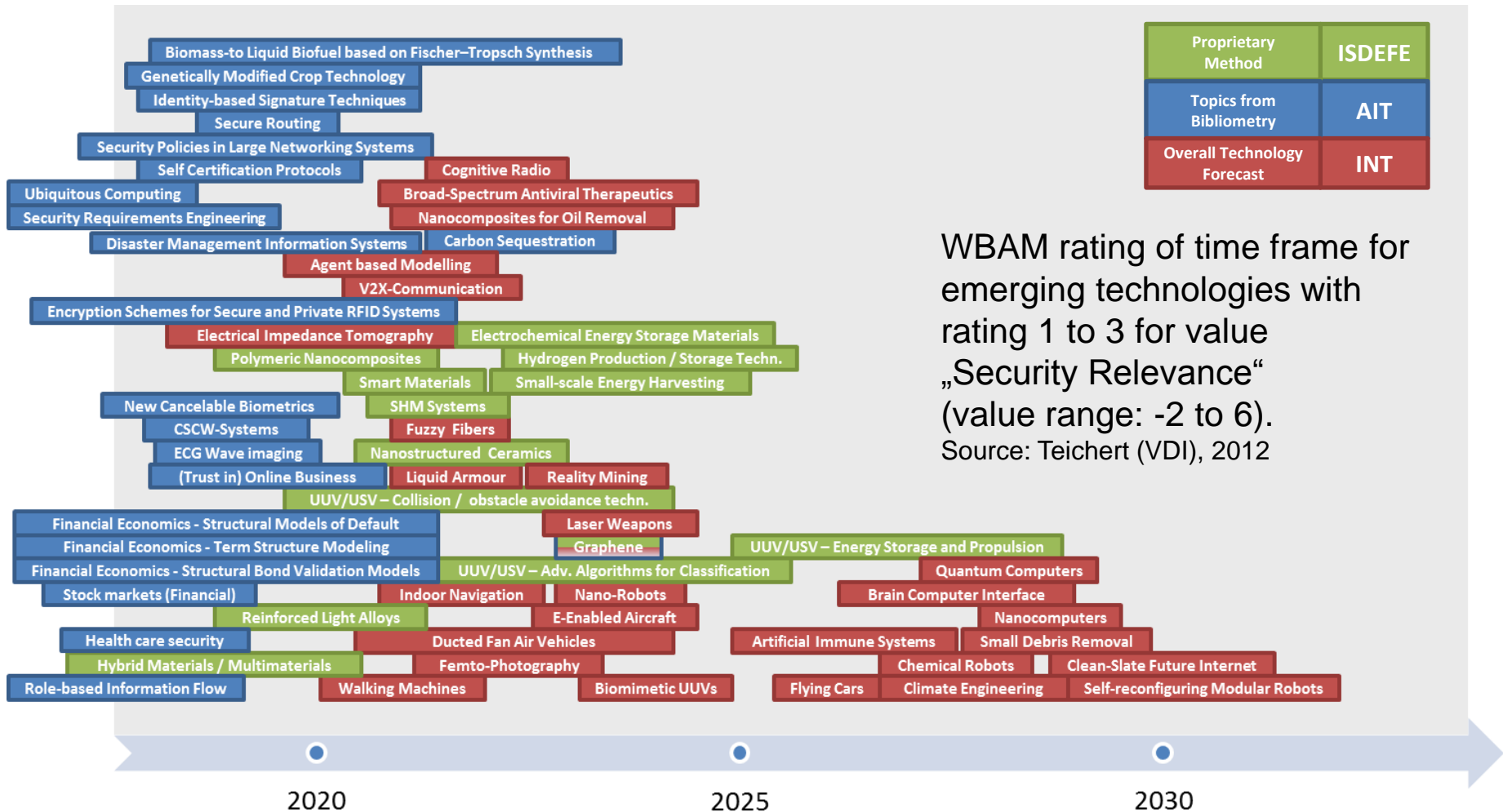
- Five parameters
 - Security Relevance
 - Time Frame 2020-2030
 - Market Potential
 - Application Potential
 - Ethical Consideration

- WBAM can serve to overcome inconsistent “meanings” about technologies

- The method proves very useful, however results needs to be interpreted with care and under consideration of process factors (number of evaluators, level of expertise, interpretation of technology theme etc.)

TA5: Environmental Security		SecRel	Time	Market	Appl	Ethics
16	Earthquake Prediction	6	1.5	-3	3	6
17	Climate Engineering	3	1.5	3	0	6
18	Carbon Sequestration	1.5	6	3	0	6
19	Nanocomposites for Oil Removal	1.5	6	1.5	0	3
TA6: Human Machine Interface		SecRel	Time	Market	Appl	Ethics
TA7: Human Science		SecRel	Time	Market	Appl	Ethics
20	Automated Human Behaviour Analysis	5	3	3	3	0
21	Dark Web Terrorism Research	5	0	-3	3	0
22	Broad-Spectrum Antiviral Therapeutics	4.5	6	3	3	6
23	Reality mining - Machine Perception and Learning	1	3	3	-3	0
24	Agent based Modelling	1	3	1	-1	4
TA8: ICT and Electronics		SecRel	Time	Market	Appl	Ethics
25	Quantum Computers	3	3	-1	1	4
26	Nanocomputers	1	0	1	-3	6
TA9: Mobile Platform Technologies		SecRel	Time	Market	Appl	Ethics
27	Semantic 3D Scene Interpretation	6	3	1	3	0
28	Exo-Skeletons	5	3	1	1	2
29	Small Satellites	5	6	1	3	2
30	Stratospheric Platforms	5	6	-1	3	0
31	Autonomous Passenger Cars	4	3	3	1	4
32	Kinodynamic Motion Planning	4	4	3	-3	6
33	Active Protection Systems	4	6	-1	1	4
34	Indoor Navigation	3	3	3	1	0
35	E-Enabled Aircraft	2	3	3	3	6

Etcetera WP4 – Example of WBAM assessment result



Proprietary Method	ISDEFE
Topics from Bibliometry	AIT
Overall Technology Forecast	INT

WBAM rating of time frame for emerging technologies with rating 1 to 3 for value „Security Relevance“ (value range: -2 to 6).
Source: Teichert (VDI), 2012

Etcetera WP4 – Findings

Methodic strength of approaches (tentative result):

- Desk Research
 - Early recognition of developments in monitored areas
 - Assessment of technology meaning and relevance
 - Assessment of future development resp. time horizon
- Bibliometry
 - Detection of developments in areas outside monitoring focus (timeframe)
 - Quantitative description of development up to now (hype cycle etc.)
 - Quantitative description and visualisation of research activities

- Discussion on strengths and weaknesses of the methods in deliverable D4.2.
- Recommendation how to combine individual strengths in deliverable D4.3.

Etcetera WP4 – Findings

Recommendation for a 3-step approach to identify emerging technologies (tentative result):

- **Step 1: Bibliometry** for collection of material (based on pre-defined search query)
 - Delivers a widespread and unbiased overview on a topic (Backcast)
 - Identifies research „hot spots“ and visualises their interaction

- **Step 2: Desk Research** for assessment of material
 - Identification of relevant developments in a technology area
 - Assessment on application potential, complementary and concurrent developments
 - Assessment of the future development (Forecast)

- **Step 3: Bibliometry** for affirmation of results (based on refined search query)
 - Affirmation of completeness regarding publications, researchers, institutes
 - Complement to the assessment of thematic experts regarding the current status (past to present) of the temporal development

Contact and Acknowledgement



Austrian Institute of Technology
Vienna, Austria

Beatrix Wepner
beatrix.wepner@ait.ac.at



Fraunhofer Institute for
Technological Trend Analysis,
Euskirchen, Germany

Guido Huppertz
guido.huppertz@int.fraunhofer.de

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