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

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

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Etcetera WP4 – Project Workflow

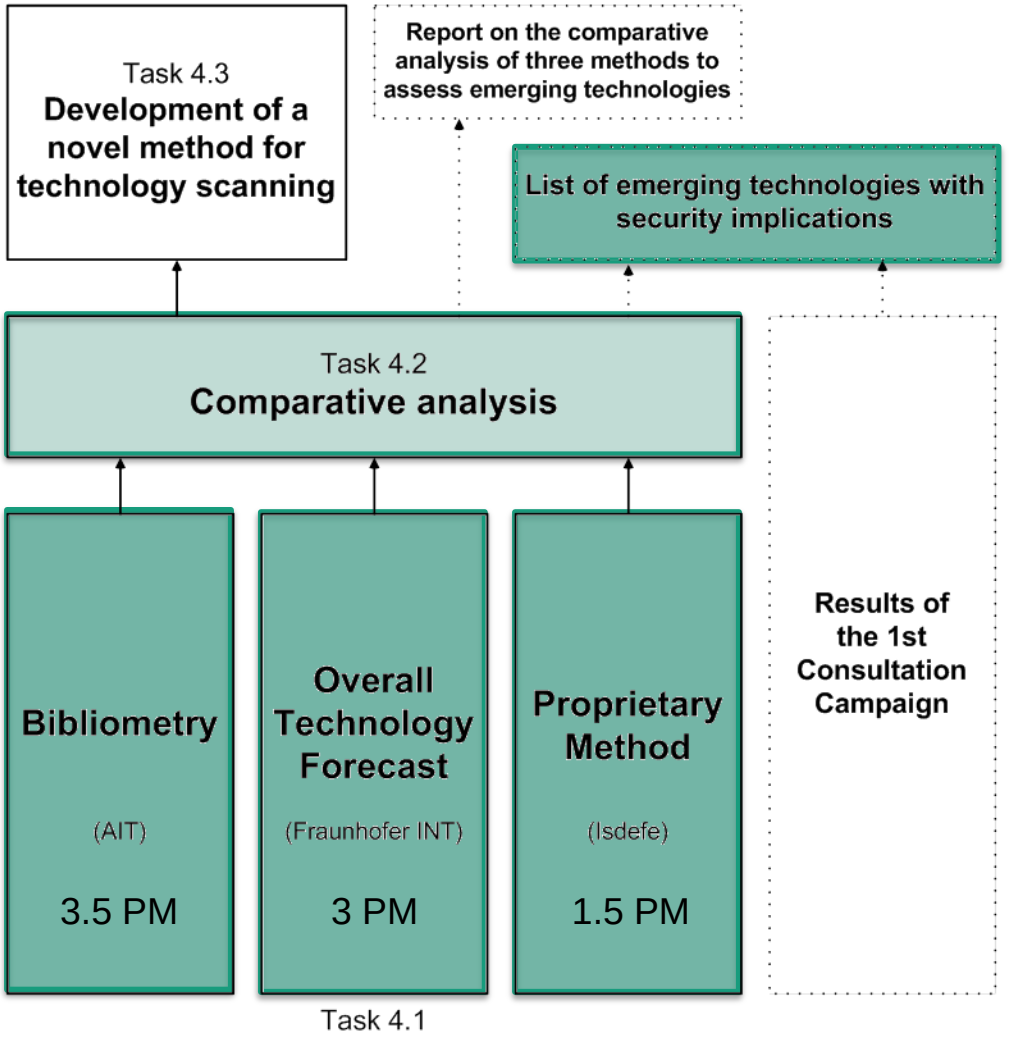
Task 4.1: 10/2011 – 03/2012

- 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



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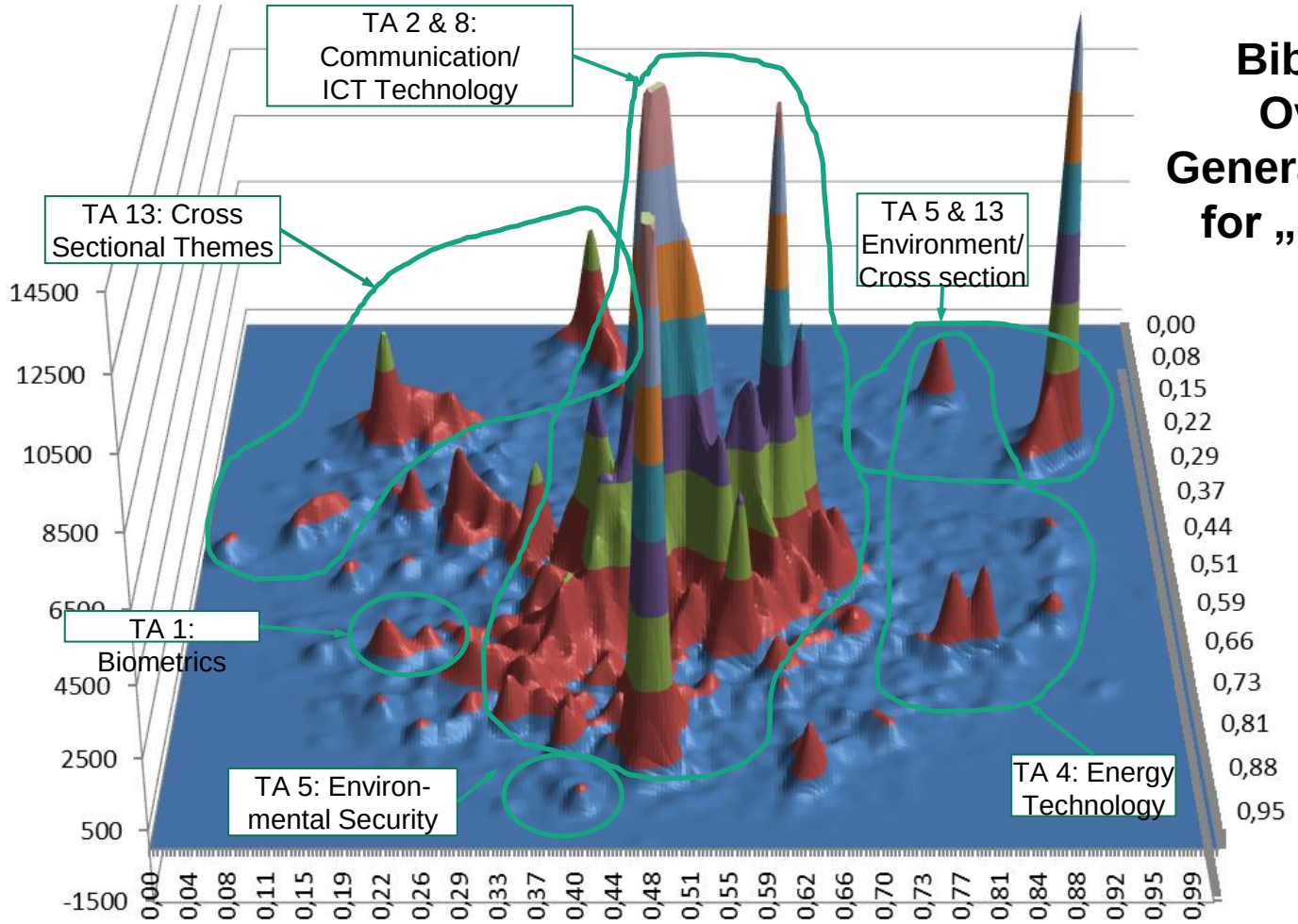
Etcetera WP4 – Technology Scanning using Bibliometry



Bibliometric Overview – General Search for „Security“

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

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Etcetera WP4 – List and Description of Emerging Technologies

"Provisional List" – WD4.1

127 Emerging Technologies
sorted in

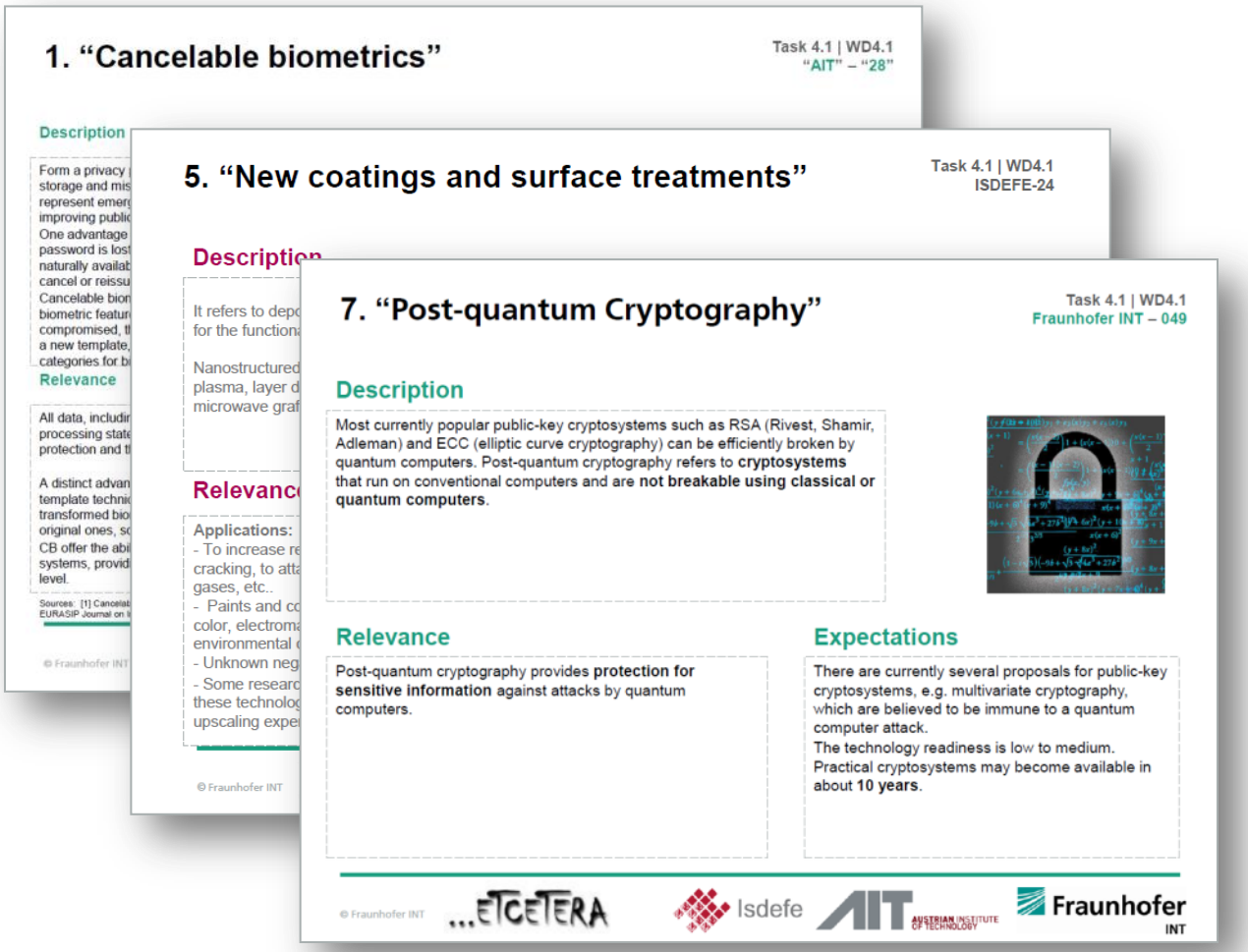
13 Technology Areas
were identified, containing

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



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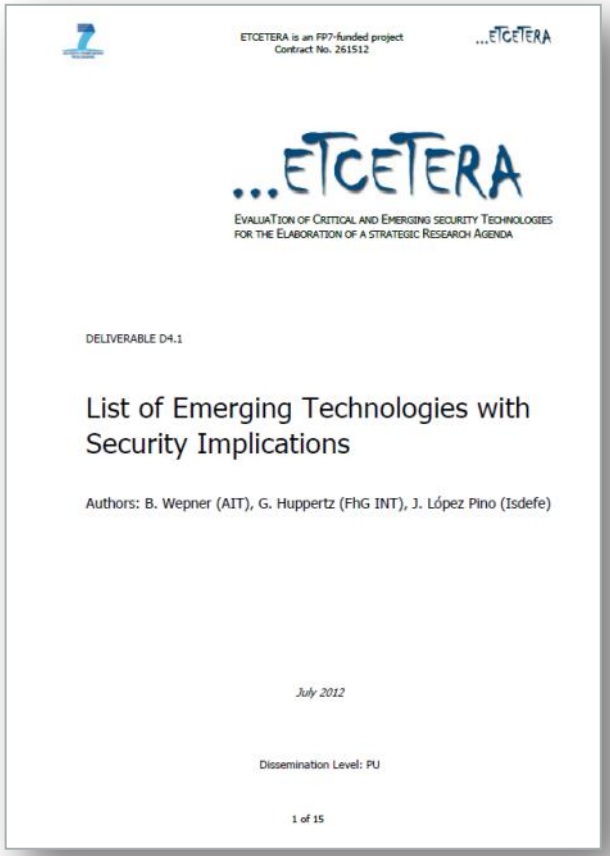
Etcetera WP4 – Assessment of Emerging Technologies

“Prioritised List” – D4.1



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EVALUATION OF CRITICAL AND EMERGING SECURITY TECHNOLOGIES FOR THE ELABORATION OF A STRATEGIC RESEARCH AGENDA

DELIVERABLE D4.1

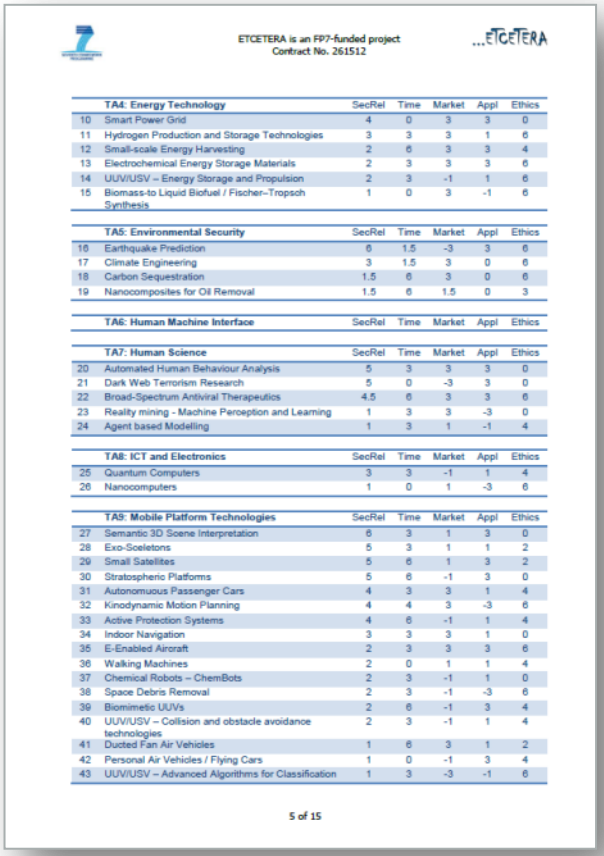
List of Emerging Technologies with Security Implications

Authors: B. Wepner (AIT), G. Huppertz (FhG INT), J. López Pino (Isdefe)

July 2012

Dissemination Level: PU

1 of 15



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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	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	Autonomuous 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 screen shot gives an example on how the Excel sheet was organised.

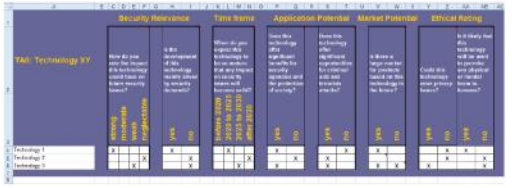

Fig. 3.1.1: Structure of the Excel file used for technology assessment.

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”.

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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
  - Maket 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
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20	Automated Human Behaviour Analysis	5	3	3	3	0
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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

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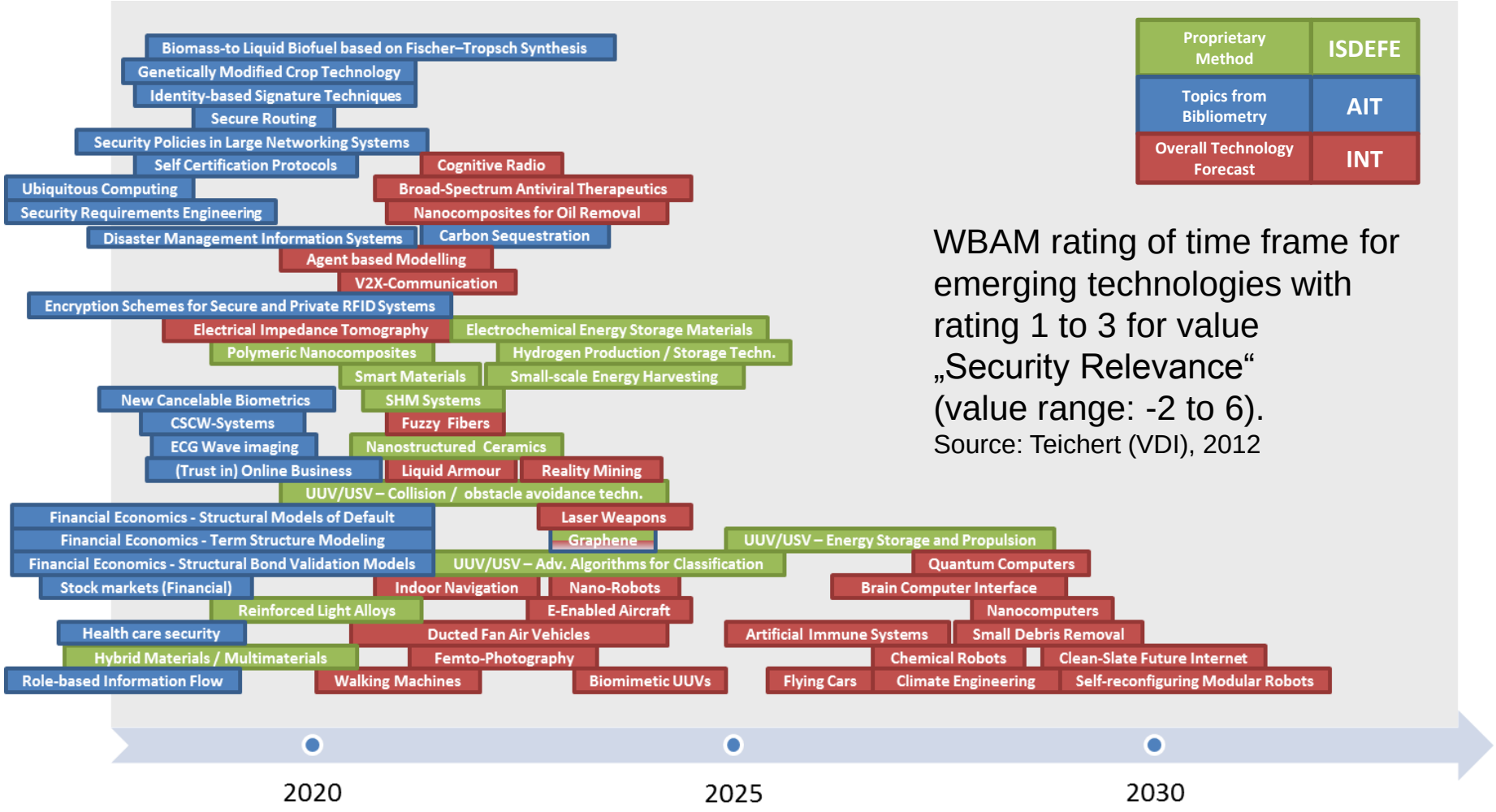
Etcetera WP4 – Example of WBAM assessment result



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

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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.

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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

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Contact and Acknowledgement

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