Using vacancy mining for validating & supplementing labour market taxonomies

Challenges and lessons learnt

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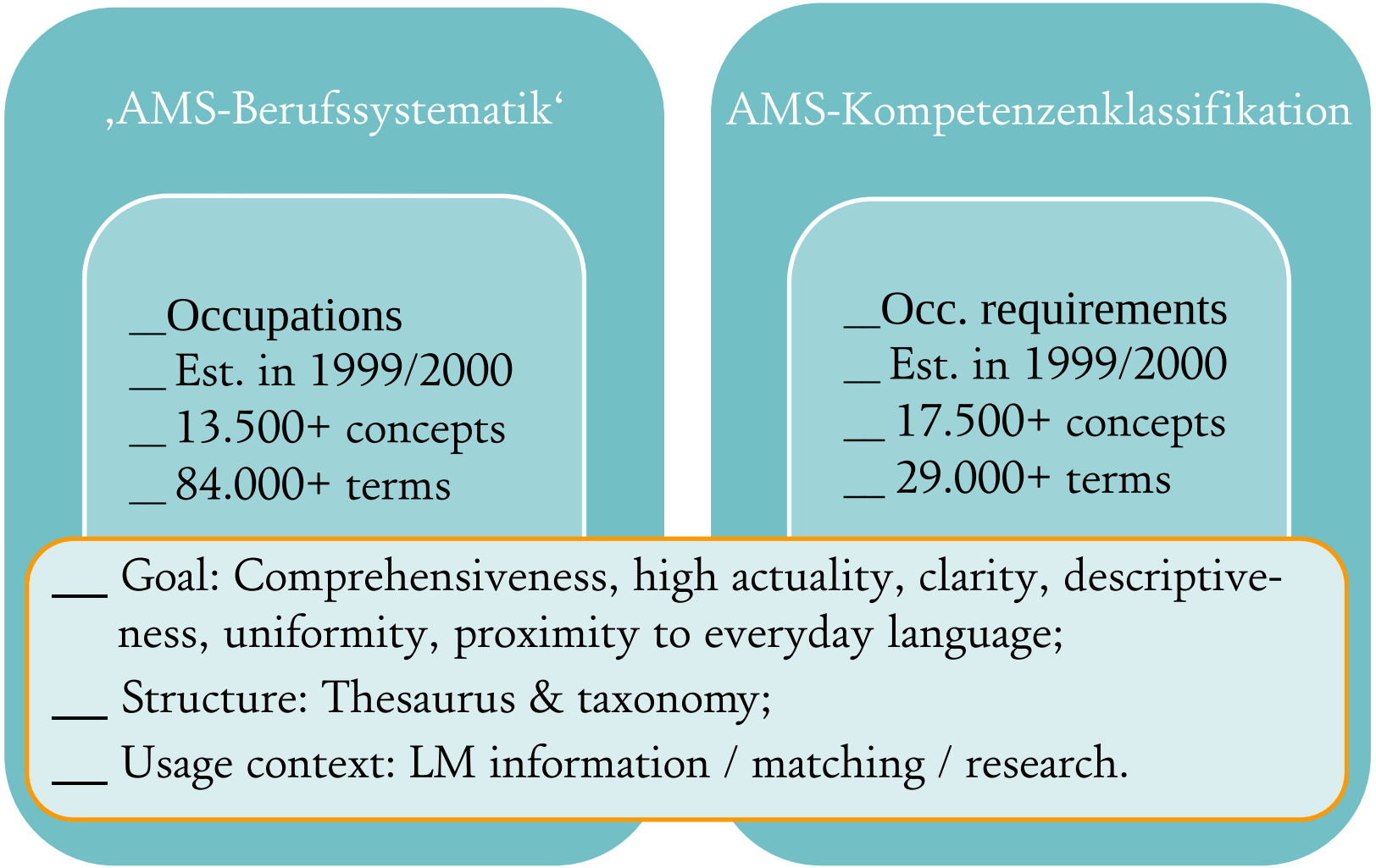
Use of AI and Big Data at 3s

- 2013: 3s & Textkernel (www.textkernel.com) test automatised coding of free text survey results (occupations, occ. requirements, training needs);
- 2014/15: 3s tests semantic technologies for validating occupational skills profiles (in the context of Cedefop's mid-term skills supply and demand forecasts);
- 2015: Jobfeed AT (www.jobfeed.com/at/home.php) goes online (big data platform for systematically querying the Austrian online job market);
- 2017: Pilot project to test potential of semantic technologies for taxonomy maintenance tasks;
- 2017 & 2018: Analysis of Austrian online vacancy market (based on data from Jobfeed; results implemented in AMS Skills Barometer (bis.ams.or.at/qualibarometer).

The Austrian PES' central LM taxonomies



...and their maintenance

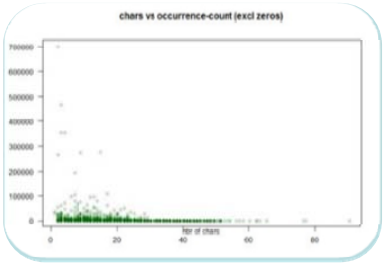
Impulse for amendments comes from

- Expert and non-expert users of these taxonomies;
- Guided, but also spontaneous feedback;
- User-independent quality checks;

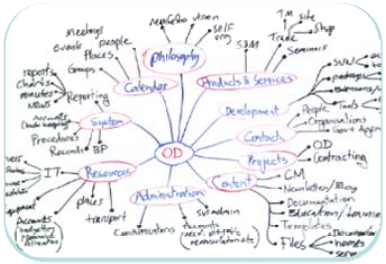
Techniques used in maintenance

- Editorial evaluation of user input/feedback;
- Functional analysis;
- Gap analysis;
- Semantic analysis;
- Terminology control;
- Computer-assisted evaluation of vacancy text. 

Testing AI-based methods for taxonomy management: Goals and expectations



Validation



Enrichment

Insights

Savings

Testing AI-based methods for taxonomy management: Research questions

Research question	Goal
Do taxonomy terms for occupational requirements actually occur in vacancies - and if yes, with which frequency?	➢ Validation of ‚skills' designations
Are terms which are frequently used in vacancies missing in the Austrian PES' taxonomies?	➢ Enrichment of vocabulary ➢ Detection of new concepts

Testing AI-based methods for taxonomy management: Expected significance of results

Lacking frequency of occurrence cannot be considered as incontrovertible evidence for a thesaurus term's futility because

- Taxonomies do not duplicate but interpret and structure reality; they aim at building a comprehensive model of a specific section of our world – and thus also contain 'structuring elements' without any observable LM relevance.
- It cannot be taken for granted that vacancy text always contains perfectly balanced occupational skills profiles (e.g. concealment of tacitly expected requirements, inflationary use of soft skills);
- Job titles (vacancy headings) and professional titles ('occupations') have different linguistic functions and context which is reflected in their wording.

Testing AI-based methods for taxonomy management: Expected significance of results - continued

Words/phrases extracted from vacancy text must always undergo terminological control prior to inclusion into a taxonomy, because

- Taxonomy terms aim at clarity, descriptiveness and consistency; taxonomy concepts are given unique preferred names that follow specific terminological rules, whereas the 'language of the labour market' at the most only follows conventions;
- Vacancy text exhibits the usual characteristics of naturally occurring language: misleading or vague wording, orthographic and grammatic errors, discriminatory practices, stylistic blunders, etc.

Testing AI-based methods for taxonomy management: Expected significance of results - examples

Job title → professional title /occupation:

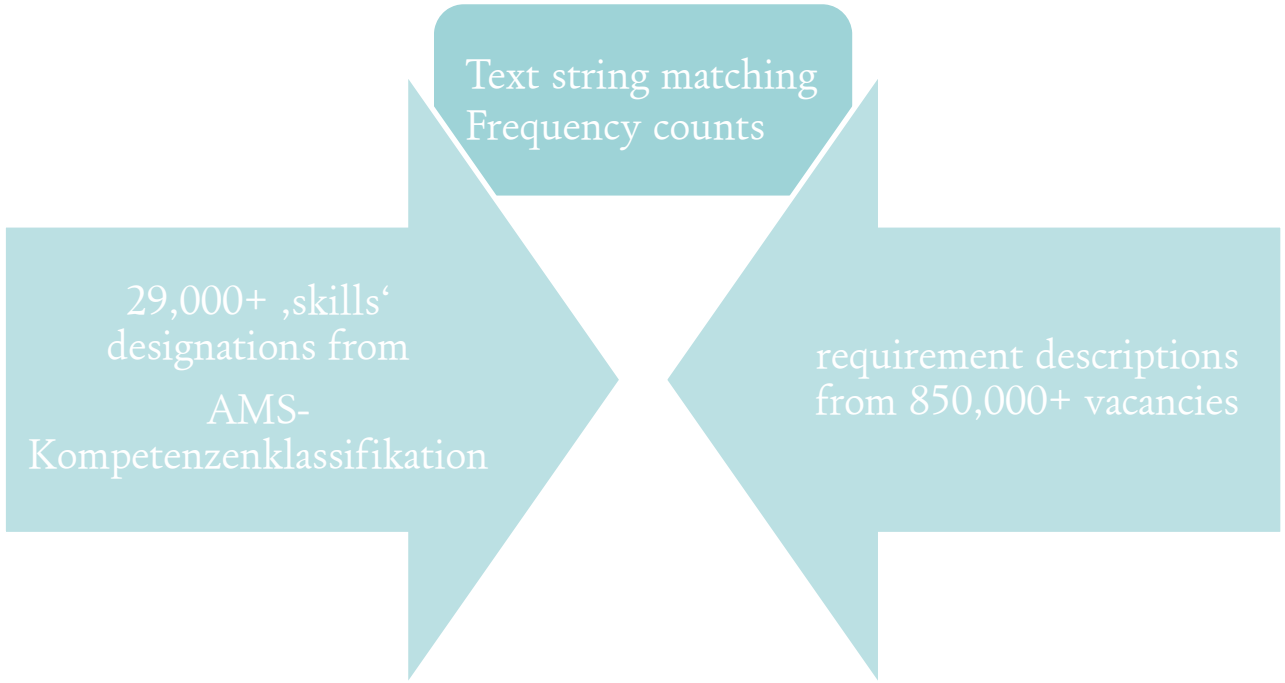
- ~~Senior~~ Projektmanager~~/i~~In
- Interviewer~~/i~~In ~~auf Werkvertragsbasis~~
- CATIA-KonstrukteurIn ~~im Flächendesign mit V5 / NX (w/m)~~
- BilanzbuchhalterIn ~~(m/w) mit Konzernerfahrung~~
- Brand ManagerIn ~~(w/m) für erfolgreiche Top-Marke im Food-Bereich~~;
- Customer Care Agent~~s~~ (m/w) ~~(TZ 30 Std./Wo)~~

Textstrings from vacancies → ‚skills' concepts:

- kommissionieren mit einem Handscanner im Kühlhaus
- Arbeiten mit Handscanner
- Scanntätigkeiten mit dem Handscanner
- Erfahrung mit Handscanner
- Kommissionierung und Umgang mit Handscanner
- Kommissionieren mit Handscanner
- Buchungen mittels Handscanner

Umgang mit Handscannern

Validation of ‘skills’ terms: Method used by Textkernel



Validation of ‘skills’ terms: Results

- 56% of AMS-Kompetenzenklassifikation‘s ‚skills‘ terms never appeared in vacancies;
- Negative correlation between term length and frequency of occurrence;
- Frequency distribution of +/- appearance in vacancies barely differed between preferred and non-preferred terms...
- ...but some non-preferred terms (NPTs) occurred much more frequently than their affiliated preferred term (PT);
- Some sub-sections of the ‚skills‘ taxonomy are closer aligned with the language of recruiters than others.

Validation of 'skills' terms: Results - some examples

No occurrence in vacancies, e.g.

- *Baugeräte warten und reparieren*
- *Verkaufspreis ermitteln (Grundkenntnisse)*
- *Tierbälge gegen Schädlingsbefall imprägnieren*

Frequency > 60.000:

- *Berufserfahrung*
- *Deutschkenntnisse*
- *Reisebereitschaft*

NPT more frequent than PT:

- NPT *Neukundengewinnung* (F=1.778) - PT *NeukundInnen-akquisition* (F=50)
- NPT *Raumplanung* (F=239) – PT *Raumplanungskenntnisse* (F=0)

Enrichment of vocabulary & conceptual content of the ‚skills' thesaurus: Mix of methods

Automated methods:

- Key word extraction;
- Frequency counts;
- Data cleansing (detection of spelling variants, declensions and typing errors);
- Key word classification;
- Text string matching;
- Co-occurrence analysis.

Editorial methods:

- Identification of additional open source data of related content;
- Exclusion of spelling variants, declensions, typing errors;
- Interpretation of quantitative output;
- Analogous & supplementary searches;
- Semantic analysis;
- Terminology control.

Enrichment of vocabulary & conceptual content of the ‚skills' thesaurus: subsequent editorial processing

- Editorial evaluation of amendment candidates;
- Supplementory enquiry in Jobfeed and other web ressources to clarify content, context and relevance of amendment candidates;
- Terminological adjustment of automatically detected terms to fit prescribed thesaurus format;
- Addition of NPTs, hidden search words, definitions and scope notes;
- Integration of new terms/concepts into semantic structure of taxonomy.

Enrichment of vocabulary & conceptual content of the ‚skills' thesaurus: from automatic detection to editorial integration

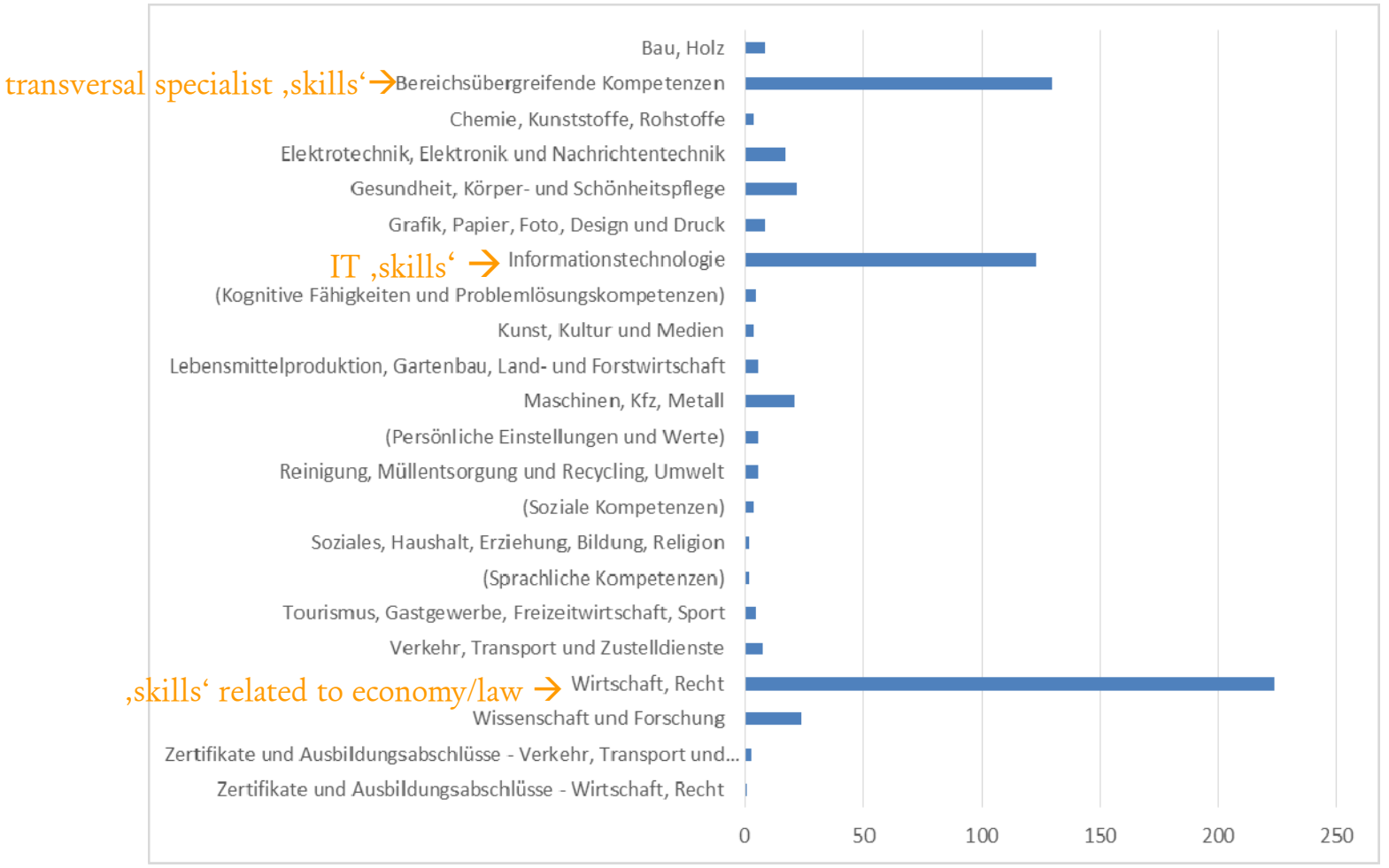
Output of 'skills'mining:

- 1.900+ potentially 'new' occupational requirements;
- approx. 900 of these resembled specialist 'skills';
- all 'skills' terms listed with frequency of occurrence and context (most frequently co-occurring occupation);

Result of subsequent editorial processing (focus on specialist 'skills'):

- Addition of 635 terms to the 'skills' thesaurus, of these
    - 366 NPTs;
    - 172 hidden search terms;
    - 97 PTs (= new concepts).

Enrichment of vocabulary & conceptual content of the ‚skills' thesaurus: Results



Lessons learnt & outlook

Text mining is a highly effective method for identifying evidence-based amendment needs for thesauri, but it comes at a price.

→ repeat text mining only at larger intervals.

There is a hard to reconcile tension between controlled vocabulary and natural language, especially

- pre-coordinated (e.g. *Schablonen herstellen und Dekorationstechniken kennen (Grundkenntnisse))* and
- formally disambiguated terms (e.g. *Hamster (Mail Transfer Agent))*

hamper the applicability of a taxonomy in automated vacancy coding.

→ Taxonomy should also include formats predominately found in vacancy text as NPTs or hidden search words to improve automated normalisation of requirement text.

Thank you for your attention!

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