Using vacancy mining for validating & supplementing labour market taxonomies
Challenges and lessons learnt

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Content

- Use of AI and Big Data in LMSI at 3s;
- The Austrian PES’ central LM taxonomies;
- Testing AI-based methods for taxonomy management:
  - Goals & expectations;
  - Research questions;
  - Expected significance of results;
- Validation of terms;
- Enrichment of vocabulary & conceptual content;
- Lessons learnt & outlook.
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

- **'AMS-Berufssystematik'**
  - Occupations
  - Est. in 1999/2000
  - 13,500+ concepts
  - 84,000+ terms

- **AMS-Kompetenzenklassifikation**
  - Occ. requirements
  - Est. in 1999/2000
  - 17,500+ concepts
  - 29,000+ terms

- **Goal**: Comprehensiveness, high actuality, clarity, descriptive- ness, uniformity, proximity to everyday language;

- **Structure**: Thesaurus & taxonomy;

- **Usage context**: LM information / matching / research.

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...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

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<th>Research question</th>
<th>Goal</th>
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<td>Do taxonomy terms for occupational requirements actually occur in vacancies - and if yes, with which frequency?</td>
<td>➢ Validation of 'skills' designations</td>
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<td>Are terms which are frequently used in vacancies missing in the Austrian PES' taxonomies?</td>
<td>➢ Enrichment of vocabulary</td>
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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/iIn
- Interviewer/iIn 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 Agents (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

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Validation of ‘skills’ terms: Method used by Textkernel

- 29,000+ `skills` designations from AMS-Kompetenzenklassifikation
- Requirement descriptions from 850,000+ vacancies

Text string matching
Frequency counts
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 NeukundInnenakquisition (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;
- Supplementary enquiry in Jobfeed and other web resources 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

- Transversal specialist ‘skills‘ ➔ Bereichsübergreifende Kompetenzen
- IT ‘skills‘ ➔ Informationstechnologie
  (Kognitive Fähigkeiten und Problemlösungskompetenzen)
- ‘skills‘ related to economy/law ➔ Wirtschaft, Recht
  (Soziale Kompetenzen)
  (Sprachliche Kompetenzen)
  Tourismus, Gastgewerbe, Freizeitwirtschaft, Sport
  Verkehr, Transport und Zulieferdienste
  Wissenschaft und Forschung
  Zertifikate und Ausbildungsabschlüsse - Verkehr, Transport und...
  Zertifikate und Ausbildungsabschlüsse - Wirtschaft, Recht
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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