Appendix

Can We Leverage Process Data from ERP Systems for Business Process Sustainability Analyses?

Dominik Schäfer^{1,3}, Finn Klessascheck^{2,4}, Timotheus Kampik^{3,5}, and Luise Pufahl^{2,4}

```
<sup>1</sup> Technical University of Munich, School of CIT, Munich, Germany dominik.maximilian.schaefer@tum.de
```

² Technical University of Munich, School of CIT, Heilbronn, Germany firstname.lastname@tum.de

³ SAP Signavio, Berlin, Germany timotheus.kampik@sap.com

⁴ Weizenbaum Institute, Berlin, Germany

⁵ Umeå University, Umeå, Sweden

Abstract. Sustainability is an increasingly important issue, which organizations need to take into account when assessing and improving their business processes. Doing so can contribute to enhancing an organisation's overall sustainability. Green Business Process Management is a line of research concerned with supporting organisations to integrate a sustainability perspective into their processes. However, existing approaches that assess sustainability on activity and process levels using, for instance, Life-Cycle Assessment (LCA) are often time-consuming and complex. Therefore, this work explores whether Key Ecological Indicators (KEIs) used to assess the sustainability of a business process can be calculated using data already available within an organisation. Following a case study methodology, we analyse nine realworld datasets extracted from a business process analysis system of a large enterprise software vendor. Results indicate that current data availability is insufficient for exact assessments. To address this issue, we introduce a high-level conceptual model and provide recommendations for action based on the observations of the case study.

Key words: Sustainability, Green Business Process Management, Key Ecological Indicators, Process Data Analysis

1 Appendix

This appendix includes three tables presented in two sections. Section 1.1 presents two tables outlining the results of the two synonym searches conducted. Section 1.2 outlines one table representing the complete search protocol.

1.1 Synonyms

Synonyms were sought not only for the three final KEIs (Energy Consumption, Emissions, and Material Use & Waste Generation) used in the original paper but for the six initial KEIs (Energy Consumption, GHG Emissions, Emissions, CO₂ Footprint, and Material Use & Waste Generation) identified in the literature and listed in Table 1 of the original paper, from which the three final KEIs were derived. This was done to broaden the search and capture as many synonyms as possible. Table 1 lists the synonyms identified for each individual word (e.g., Energy and Consumption) that collectively form the six initial KEIs (e.g., Energy Consumption) mentioned above. Table 2 presents the results of the synonym search for the compound terms of the initial six KEIs (e.g., Energy Consumption).

In both Tables 1 and 2, the first column displays the final KEI for which synonyms were searched. The second column assigns each entry a unique identifier, representing all synonyms in that entry. For example, the code S1 represents all synonyms Energy, dynamism, electricity, heat, potential, service, strength and power. The third column represents the term, for which synonyms were searched. In Table 1, these terms are derived by considering each individual word that constitutes the original six KEIs. In Table 2, these terms are obtained by considering the initial KEIs as compound terms, with abbreviations both written out and not written out. The fourth and fifth columns contain in both tables the synonyms found for the term respectively searched in [1] and [2].

| KEI | Code | Keyword | Synonyms [1] | Synonyms [2] |
|--------------------------------|--------|-------------|--|--|
| | S1 | Energy | , ,, | , Power |
| | | | potential, service, strength | |
| Energy sumption | Con-S2 | Consumption | drinking, expenditure, utilization | - using up, use, loss, waste, drain, consuming, expenditure, ex- haustion, depletion, utilization, dissipation |
| | S3 | Greenhouse | arboretum, conservatory, nursery | -glasshouse, conservatory, hothouse |
| | S4 | Gas | smoke, vapor | fumes, vapour, mist, fog, haze, smoke, breath, steam, fumes, dampness, miasma, exhalation |
| Emissions | S5 | Emission | discharge, radiation | giving off, giving out, release, shedding, leak, radiation, discharge, transmission, venting, issue, diffusion, utterance, ejaculation, outflow, issuance, ejection, exhalation, emanation, exudation |
| | S6 | Carbon | graphite, soot | - |
| | S7 | Dioxide | = | - |
| | S8 | Footprint | footstep, impression, imprint | impression, mark, track, trace, outline, imprint, indentation |
| | S9 | Material | cloth, component, element equipment, goods, ingredient machinery, object, stuff, sub- stance, supply, textile | |
| | S10 | Use | 1 / 11 0/ 1 0/ | consume, go through, exhaust, spend, waste, get through, run through, deplete, squander, dissipate, expend, fritter away |
| Material U Waste Ge tion | | Waste | debris, rubbish, scrap, trash | rubbish, refuse, debris, sweepings, scrap, litter, garbage, trash, leftovers, offal, dross, dregs, leavings, offscourings |
| | S12 | Generation | bearing, breeding, formation genesis, origination, procreation propagation, reproduction | production, manufacture, manufacturing, creation, forma- tion, origination, production, breeding, creation, formation, reproduction, genesis, propa- gation, begetting, procreation, origination, engenderment |

Table 1. Synonyms for every word forming each KEI

4 Dominik Schäfer et al.

| KEI | \mathbf{Code} | Keyword | Synonyms [1] | Synonyms [2] |
|--------------------------|-----------------|-----------------------------|---------------------------------------|--------------|
| Energy Con-S13 | | Energy Consump | | - |
| sumption | | tion | | |
| | S14 | Greenhouse Gas | - | - |
| | S15 | Greenhouse Gas Emissions | 3 - | - |
| | S16 | GHG Emission | - | - |
| Emissions | S17 | Carbon Dioxide | carbonic acid, carbonic acid gas, CO2 | - |
| | S18 | Carbon Dioxide Footprint | · - | - |
| | S19 | CO ₂ Footprint | - | - |
| Material Use & S20 | | Material Use | - | - |
| Waste Genera-S21 tion | | Waste Generation | ı - | - |

 Table 2. Synonyms for each compound KEI

1.2 Search Protocol

A detailed explanation of this search protocol is found in the original paper.

| Nr. | KEI | Code | Example | [#] |
|-----|------------------|---|------------------------------------|-----|
| 1 | | S1 | "Energy" | 29 |
| 2 | Energy | S2 | "Consumption" | 62 |
| 3 | Consumption | $S1 \times S2$ | "Energy" x "Consumption" | 0 |
| 4 | | S13 | "Energy Consumption" | 0 |
| 5 | | S3 | "Greenhouse" | 0 |
| 6 | | S4 | "Gas" | 0 |
| 7 | | S5 | "Emission" | 30 |
| 8 | Emissions | S6 | "Carbon" | 0 |
| 9 | | S7 | "Dioxide" | 0 |
| 10 | | S8 | "Footprint" | 0 |
| 11 | | $S3 \times S4$ | "Greenhouse" x "Gas" | 0 |
| 12 | | $\mathrm{S3} \ge \mathrm{S4} \ge \mathrm{S5}$ | "Greenhouse" x "Gas" x "Emission" | 0 |
| 13 | | $S6 \times S7$ | "Carbon" x "Dioxide" | 0 |
| 14 | | $S6 \times S7 \times S8$ | "Carbon" x "Dioxide" x "Footprint" | 0 |
| 15 | | S14 | "Greenhouse Gas" | 0 |
| 16 | | S15 | "Greenhouse Gas Emission" | 0 |
| 17 | | S16 | "GHG Emission" | 0 |
| 18 | | S17 | "Carbon Dioxide" | 0 |
| 19 | | S18 | "Carbon Dioxide Footprint" | 0 |
| 20 | | S19 | "CO2 Footprint" | 0 |
| 21 | | S9 | "Material" | 142 |
| 22 | | S10 | "Use" | 74 |
| 23 | | S11 | "Waste" | 4 |
| 24 | Material Use & | S12 | "Generation" | 52 |
| 25 | Waste Generation | $\mathrm{S9} \ge \mathrm{S10}$ | "Material" x "Use" | 2 |
| 26 | | $S11 \times S12$ | "Waste" x "Generation" | 0 |
| 27 | | S20 | "Material Use" | 1 |
| 28 | | S21 | "Waste Generation" | 0 |

Table 3. Search Protocol

6 Dominik Schäfer et al.

References

- [1] Dictionary.com (LLC). URL: https://www.thesaurus.com/ (visited on 08/21/2024).
- [2] HarperCollins Publishers Limited. URL: https://www.collinsdictionary.com/dictionary/english-thesaurus (visited on 08/21/2024).