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Exploring Purposes of Using Taxonomies

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Abstract. Taxonomies are artifacts that can be used for numerous purposes, including gap spotting, decision-making, and theory building. Despite the variety of usage purposes, we can observe that designers state that their taxonomies help to 'classify something'; leaving the full potential of taxonomies rather untapped. In order to lay attention on questions of for what taxonomies can be used, this short paper (1) raises awareness of the actual problem space and motivate the relevance of an overview of taxonomy use purposes, (2) outlines the overall project's research design to identify and structure the set of use purposes, and (3) proposes preliminary purposes extracted from analyzing a corpus of articles that built upon—and use—previously published taxonomies. In doing this, we seek to complement available methodological guidance to make more informed decisions in terms of a taxonomy's usage potential.

Keywords: Taxonomy, Classification, Methodology, Reusability, Usage.

1 Motivation and Problem Awareness

Good programmers know what to write. Great ones know what to rewrite (and reuse).
—Eric S. Raymond (Authors, software developer)

Taxonomies are artifacts that enable to explicate and organize knowledge. While they have a long history in natural and social science, they also play an essential role in the information systems (IS) discipline, especially given the speed of sociotechnical progress and the demand for understanding novel phenomena [1]. Following Raymond's idea of reuse, which has been present in disciplines such as software engineering for a while, and given the rising number of publications that propose a taxonomy in IS research, we asked ourselves why and for what taxonomies are actually used. The literature on classifications in general stresses a number of possible purposes, including grouping objects [2, 3], hypothesizing about relationships [4, 5], testing theories [6, 7], and exploiting new research fields [8]. Despite this wide range of potential usage purposes, we can observe that designers tend to state that their taxonomy is intended to "classify something" [9]. As a consequence, Usman et al. [9] concluded that "existing taxonomies do not fit their purposes well" (p. 52).

Making informed decisions and clear statements about the purpose of and how the taxonomy can be used in both academia and practice is important to guide taxonomy

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designers and users within and across iterative phases of *taxonomy building* [5], *evaluation* [1, 10], and *usage*. However, to the best of our knowledge, there is no holistic overview of taxonomy use purposes, leading to two major challenges:

First, concerning the design, researchers who want to build a taxonomy should be clear about the aim of their taxonomy [5], which also has a considerable impact on the evaluation that determines how well a taxonomy fulfills a particular purpose [10]. Knowing such purposes is a prerequisite for the advancement of methodological guidance. Given the fact that taxonomies are artifacts that capture the knowledge of a domain and can serve as a basic theory (*theory for analyzing* [11]), there should be an accumulation and evolution of this knowledge [12], requiring taxonomies to be reusable in different scenarios, by other users, and at another point of time [13]. That seems particularly relevant for taxonomy research because we face an increased amount of published taxonomies in IS focusing on the same phenomenon without building upon available taxonomy articles. As a notable exception, Dehnert et al. [14], provided a consolidated taxonomy that integrates existing taxonomies for data-driven business models. Although authors lay a specific lens on a phenomenon (meta-characteristic), previous knowledge should not be neglected while building new taxonomies.

Second, without an overview of taxonomy purposes academics and practitioners are less guided in what they can do with a given taxonomy (e.g., spotting research gaps, adopting characteristics, or classifying research outputs). In consequence, academics who conduct research that is supposed to be based on a taxonomy may ask themselves: 'Is a given taxonomy suitable for my specific purpose?' Likewise, practitioners may ask themselves: 'What can I use a given taxonomy for?' An overview supports designers in guiding users for what purposes a taxonomy can be employed.

To move towards identifying purposes for taxonomy usage, we raise the following research question: *What are the purposes for using taxonomies?* In attempting to answer this question, this short paper—as part of a larger research endeavor—raises awareness of the problem space and stresses the need for a structured overview of taxonomy use purposes, outlines the overall research design, and reports on preliminary results. Thereby, we particularly describe the first phase in which we performed a qualitative citation content analysis to examine how and to what extent research has built on previous taxonomies. As a result of analyzing 126 articles and 227 in-text citations, we identified an initial set of nine purposes for using a taxonomy.

2 Research Design

To disclose taxonomy use purposes, a multi-phased research design will be employed (see Figure 1). In **Phase 1**—this short paper—, we analyzed literature building upon taxonomies that are developed following the well-established taxonomy development method by Nickerson et al. [5]. Therefore, we conducted a citation-driven content analysis [15, 16], which qualitatively explores in-text citations across three steps: *First*, we performed a forward search on [5] using 'Publish or Perish' that draws on Google Scholar. As a result, we obtained 439 taxonomy articles and a total of 4.244 citations. To specify a manageable sample of articles and in-text citations, we selected

five articles that had the most citations (top articles to incorporate research that is frequently used by researchers) and five articles that were selected randomly (random articles to cover additional aspects). *Second*, based on the ten taxonomy articles, we selected several citing articles that potentially make use of published taxonomies. Therefore, from each of the ten selected articles, we again selected the ten most citing articles (100 top articles) and five random citing articles (50 random articles), which resulted in a sample of 150 articles. *Third*, from the 150 articles, we excluded those that were non-English/non-German, duplicates, bachelor and master theses, or fail citations. The final sample contains 126 citing articles, including a total number of 227 in-text citations; an in-text citation represents an article's sentence in which the citation towards the primary taxonomy article appears. These sentences act as a unit of analysis. For exploring taxonomy usage, we inductively examined each in-text citation by adding memos, observations, and additional remarks. After the coding, we started to cluster the results to arrive at an initial set of taxonomy use purposes. This set was refined based on discussion within the author team and on mapping each in-text citation to the set of purposes. As all in-text citations could be classified to one or more of the usage purposes, we terminated the procedure (see Section 3 for the results).

In the next steps, we plan to extract taxonomy purposes in methodological literature on taxonomy development and adjacent streams, such as typologies (**Phase 2**), analyze literature referring to taxonomies that are developed by following other taxonomy development approaches (**Phase 3**), and synthesize the results of all phases to provide a consolidated overview of taxonomy use (**Phase 4**).

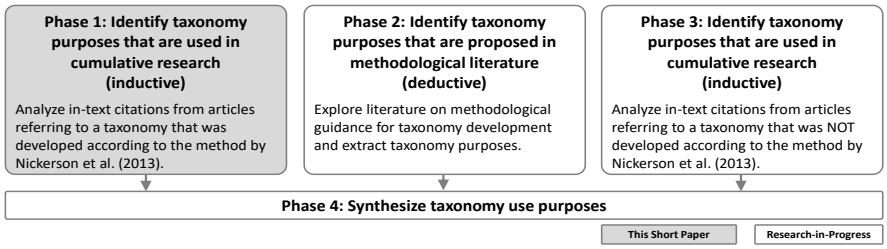

Figure 1. Overall research design to explore taxonomy use purposes

3 Phase 1: Preliminary Taxonomy Use Purposes

Based on our sample of 227 in-text citations, we identified 100 in-text citations in which authors make use of an actual taxonomy or at least a taxonomy article (e.g., referring to a phenomenon captured by a taxonomy). By following our research design, we iteratively derived and refined a set of nine different taxonomy use purposes:

- *Classification (1).* A majority of papers classified objects or conceptualized a phenomenon of interest utilizing a taxonomy. For instance, Mwilu et al. [17] applied a taxonomy to classify 120 papers and vom Brocke et al. [18] referred to Mrass et al.'s conceptualization [19] by arguing that "one can distinguish between three kinds of platforms: Commerce platforms […], sharing platforms […] and crowd working

platforms […]". As other exemplary illustrations, authors specified their coding tactics [20] and categorized previous research [21] by means of taxonomies.

- *Identification of dimensions and characteristics (2).* The largest group of papers in our sample used a taxonomy for choosing and adopting characteristics to their situation at hand. For instance, articles cited Prat et al.'s [22] taxonomy on evaluation criteria to select criteria for their studies, such as Heinrich et al. [23] who adopted practical applicability and effectiveness as their evaluation criteria.
- *Identification of objects (3).* Besides single elements, researchers sought to find objects based on a taxonomy. As an example, Grube et al. [25] "derived six drug adherence facilitators from a taxonomy of health IT and medication adherence".
- *Positioning of research output (4).* Several articles compared their results with existing knowledge via taxonomies. For instance, a new taxonomy is compared with available ones [24] and research findings are positioned [25]. Wass & Omland [26], for instance, positioned their findings by arguing that "[while] lean administration is relevant for some of the actors in our project, the analysis shows that business, relational, utilitarian, social and hedonic values seem more appropriate".
- *Disclosure of gaps (5)* and *research foci (6).* Taxonomies help to spot knowledge gaps in a domain of interest, such as indicated by Labazova [27] who argued that previous research on Blockchain falls short in considering the systems mutual impact. Comparable to gaps, on the other hand, the focus of available research in a field can be disclosed by stressing frequently addressed characteristics [28].
- *Description of a phenomenon (7).* As another purpose that is frequently mentioned in our sample, researchers make use of taxonomies to define a domain of interest by referring to common dimensions and characteristics [26].
- *Taxonomy construction (8)* and *refinement (9).* In addition to rather practical purposes (i.e., using a taxonomy for content-related reasons), we could obtain articles that aim to advance the taxonomy itself. Articles built new taxonomies based on available ones [29] as well as integrated/refined available taxonomies [15]. In doing this, they reuse knowledge and enable its accumulation and evolution [12].

In addition to the purpose of using the actual taxonomy, we also gathered in-text citations in which authors cite a taxonomy article because they adopt methodological guidance from them. In 33 in-text citations researchers, for instance, motivate and justify their research design by stressing that a taxonomy development approach is suitable to achieve a certain goal as well as transfer complementary steps, such as performing a cluster analysis based on a completed taxonomy.

4 Research-in-Progress and Expected Implications

Missing or insufficiently specified taxonomy purposes prevent designers and users from leveraging the full potential of taxonomies. We suspect that this is because little is known about why and for what to use taxonomies. In order to bridge this, this short paper (1) sheds light on the problem space, (2) outlines the aim of our research project, and (3) provides preliminary use purposes. Although we could find some examples that draw on available taxonomies, we observe that the degree of use in cumulative research

is still limited. That is indicated by the fact that from 227 in-text citations, only 133 can be classified to a taxonomy use purpose (i.e., cite an article for its taxonomy or development process); being aware that some articles can be cited for other reasons too. However, to boost taxonomy usage, future research might investigate how such endeavors can be supported. Despite performing the subsequent phases of our research approach (see Figure 1), selected questions for future directions might also include:

- *How to communicate taxonomies to be reusable in academia and/or practice?* (e.g., employing visualizations to increase the applicability [30]).
- *What evaluation criteria help to ensure that taxonomies can be used easily?* (e.g., comparable to Ivari et al.'s [31] reusability of design principles).
- *How to complement available procedure models?* (e.g., adding steps for grounding taxonomies on available taxonomic knowledge; knowledge accumulation [32]).

This short paper has **limitations**, which offer opportunities for the future. As a first limitation, the literature on classification schemas in general and adjacent domains has discussed additional use purposes [9, 33] that need to be taken into account (*Phase 2, deduction*). Also, we will extend the sample, which is currently restricted to our selection of ten top-cited and five random articles. Therefore, we plan to consider additional types of articles as well, such as articles that follow a different taxonomy design method (e.g., Gregor [11] or Cooper [34]) (*Phase 3, induction*). Referring to the analysis, we have focused on how citing articles use available taxonomies and thus examined only one direction—i.e., taxonomy to use. Future work could investigate how the knowledge that is generated through using taxonomies is played back into the broader body of knowledge. Lastly, dependencies between taxonomy purposes should be investigated more thoroughly; are there mandatory and/or optional taxonomy purposes when it comes down to achieving a specific goal.

Overall, we hope to initiate a **contribution** in three ways: First, provide designers with an overview of possible taxonomy purposes so that they are supported in making (better) informed decisions regarding their taxonomy's purpose. Second, provide target user groups with this overview to find out for which purpose a taxonomy is intended so that they can use them in a (more) targeted manner. In this vein, taxonomy providers might also reflect on the actual target group of their taxonomies in more detail, which can address both academics (e.g., producing novel artifacts based on taxonomies [35]) and practitioners (e.g., finding appropriate virtual assistants [36]). Third, we pave the ground for the future development of guidance on building, evaluation, and use of taxonomies. Taxonomy use purposes can influence all three activities and at the same time represent their connecting element; according to Nickerson et al. [5] taxonomy evaluations "may come down to seeing if others use it [...] and speculate on [its] potential use". In accordance to that, the identification, selection, and communication of taxonomy purposes can improve not only the building and evaluation but also the use of taxonomies, and thus (design) knowledge accumulation and evolution.

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