Jusletter IT

Differentiation and Empirical Analysis of Reference Types in Legal Documents

This paper proposes an extensible model distinguishing between reference types within legal documents. It differentiates between four types of references, namely fully-explicit, semi-explicit, implicit, and tacit references. In addition, this paper describes a generic technology stack, including linguistic and semantic analysis of texts, that is suitable to determine those reference types. Based the German laws we conducted a case study to evaluate the model and proposed differentiation. We adapted text mining algorithms to determine and classify the different references according to their type. The evaluation shows that the consideration of additional reference types heavily impacts the resulting network structure by inducing a plethora of new edges and relationships. This work extends the approaches made in network analysis and argues for the necessity of detailed differentiation between references throughout legal documents.

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1. Introduction

[Rz 1] Network analysis is well established in the domain of legal informatics and is becoming increasingly popular. Since more and more data is becoming digitally available supporting this analysis with data mining technologies is very attractive. Recent workshops, such as «NAIL Network Analysis in Law», and leitmotivs of relevant conferences, such as «IRIS 2016: Networks», support this trend.

[Rz 2] Throughout legal systems various complementary dimensions inducing networks exist. Network structures can emerge on and throughout different levels such as nations, companies, organizations, institutions, people (roles), ... , and legal documents. The latter is in particular interesting for the present research paper. Although many different attempts have already been made to describe, model, analyze, visualize, or evaluate networks arising from legal texts, surprisingly less effort has been spent on the differentiation of reference types between legal documents (see Section 1). This paper's contribution narrows this gap by providing a constructive and extensible differentiation of four different reference types (see Section 2). Furthermore, it discusses the impact on the FRBR[1] by the additional reference types (see Section 3). Based on this differentiation the paper proposes a technology stack, that can be used to automatically determine those references in legal documents (see Section 4). In Section 5 we present the results and the evaluation of the reference analysis in German legislative texts, showing that many different relationships beside the well-studied citations exist and that those can be automatically determined.

2. Related Work

[Rz 3] In 2007 ZHANG and KOPPAKA proposed a prototypical implementation of a semantic-based legal citation network taking into account the content of a citation[2]. Thereby, they discussed the semantic multi-dimensionality of legal citations from a data science perspective. In contrary, the work of BOULET ET AL. focus more on mathematical approaches, such as spectral analysis, to analyze the structure of the French citation networks[3]. AGNOLONI ET AL. have also investigated the relevancy of cases based on the citation network from the Italian constitutional court[4]. Network analysis has also attracted legal scientists from international economic law, such as ALSCHNER ET AL.[5]. They analyzed emerging network structures regarding similarities, relatedness, and differences of articles in bilateral investment treaties and visualized[6] them accordingly. WINKELS ET AL.[7] explicitly set the focus on the detection and resolving of explicit references in Dutch case law to build a recommender system. Thereby, they used the number n of citations between articles to weigh ($W = {}^1/n$) the impact of the link.

[Rz 4] Rather less effort has been spent on the analysis of the network arising from German jurisdictional data[8]. Decades ago, in 1971, BERGER[9] has proposed a taxonomy of reference types, that is still valid nowadays (see DEBUS[10]). BERGER'S differentiation consists of four reference types, namely «voll-explizit», «halb-explizit», «implizit», and «stillschweigend». He provides more than 50 criteria to distinguish between them. Thereby, the «voll-explizit» reference, which identifies another legal text by official nomenclature, such as § or §§ for norms or the document id for court documents, is most probably the best studied reference type nowadays.

3. A Conceptual Framework for Reference Types in Legal Texts

[Rz 5] This section introduces different reference types that can be observed in legal documents. Thereby, the focused is on reference types of legislative texts, namely laws. We restricted our analysis to the network structures arising from the legal texts. It does not take into account metadata, such as authorship, publishing dates, places, persons, roles, or institutions, etc.

[Rz 6] We seize on the differentiation of BERGER and discuss the impact on the bibliographic model of legal data. We show how and which technology can assist within the detection of the proposed reference types and briefly discuss a

generic tool-support to examine and explore legal data with respect to automatically determined references.

[Rz 7] Many attempts have already been made to analyze, extract and visualize the network structure throughout legal texts. Rather less effort has been spent on the differentiation between reference types. Beside the well-known citation that can be determined using basic technology, e.g., regular expressions [11], there exist three more reference types that heavily impact the interpretation of legal texts. Table 1 presents the different reference types, a short description, some illustrative examples, and additional literature providing detailed information and further readings.

Reference Type	Description	Example(s)
Full-explicit reference (FR) [12]	The referenced norm, respectively document, is explicitly stated and provides the full information about paragraph and document.	§81 Abs. 1 Satz 3; §§32 und 34; §126 Abs. 1 Satz 2 Nr. 3 der Grundbuchordnung;
Semi-explicit reference (SR) [13]	The reference norm, respectively document, is named but provides no explicit information about the referenced article or document.	«[...] finden die Vorschriften über die Hypothek entsprechende Anwendung [...]» (see §1192 BGB)
Implicit reference (IR) [14]	The referencing norm uses a term, that is legally defined in another – notexplicitly mentioned – norm.	«Wer eine fremde Sache beschädigt oder zerstört [...]» (see §228 BGB); The term «Sache» is defined in §90 BGB.
Tacit reference(TR) [15]	The connection between the norms emerges due to systemic interpretation and cannot not be determined by exclusively analyzing the norm text.	«lex posterior derogat lex inferior»; Connections between general part (book 1) and specific part (book 2) of the BGB.

Table 1. Structured consolidation of different reference types present in legal documents.

[Rz 8] The taxonomy shown in Table 1 is not enclosed and could be extended with new reference types or by differentiating present reference types. This is could be the case, if additional document types, such as court decisions, regulations, etc. are analyzed regarding their network structures. As other researchers (e.g., ZHANG/KOPPAKA [16]; DEBUS [17]) already pointed out references can also have additional properties, which are summarized in Table 2. Although it is possible to determine whether a legal reference is out-bound, in-bound, onward, or backward, it is in general not possible to determine whether a reference is static or dynamic by solely investigating linguistic features. Even if the context of a legal reference is considered, there are many occurrences in which this cannot be decided [18].

Attribute	Description
Dynamic	The references refers to the current present and valid version of the target document.
Static	The references refers to the explicitly specified version of the target document. The default value is the date of the creation of the referring document.
Inbound	The reference target is within the same document as the reference.
Outbound	The reference target is in another article, chapter, document, legislation, etc.
Backward	The reference refers to a section that lies behind the references section.
Onward	The reference refers to a section that lies ahead of the references section.

Table 2. Additional characteristics of references within legal documents.

[Rz 9]   This conceptual framework serves as a base line for the proposed technology stack and implementation (see Section 4). Thereby, we will discuss if and how the different reference types can be determined using algorithms.

4.   Extension of the Bibliographic Model

[Rz 10]   The bibliographic model shown in Figure 1 is extended by the reference types that exist between expressions and a work. Those linguistic or semantic phrases, occurring in the expression of a work and indicating the reference, can either refer to an abstract work or the expression of a work. This represents a workaround for the problem of resolving static and dynamic references [19]. By referring to an expression, the reference is statically bound to a fixed version and by referring to the work, the reference will dynamically adapt to its latest expression.
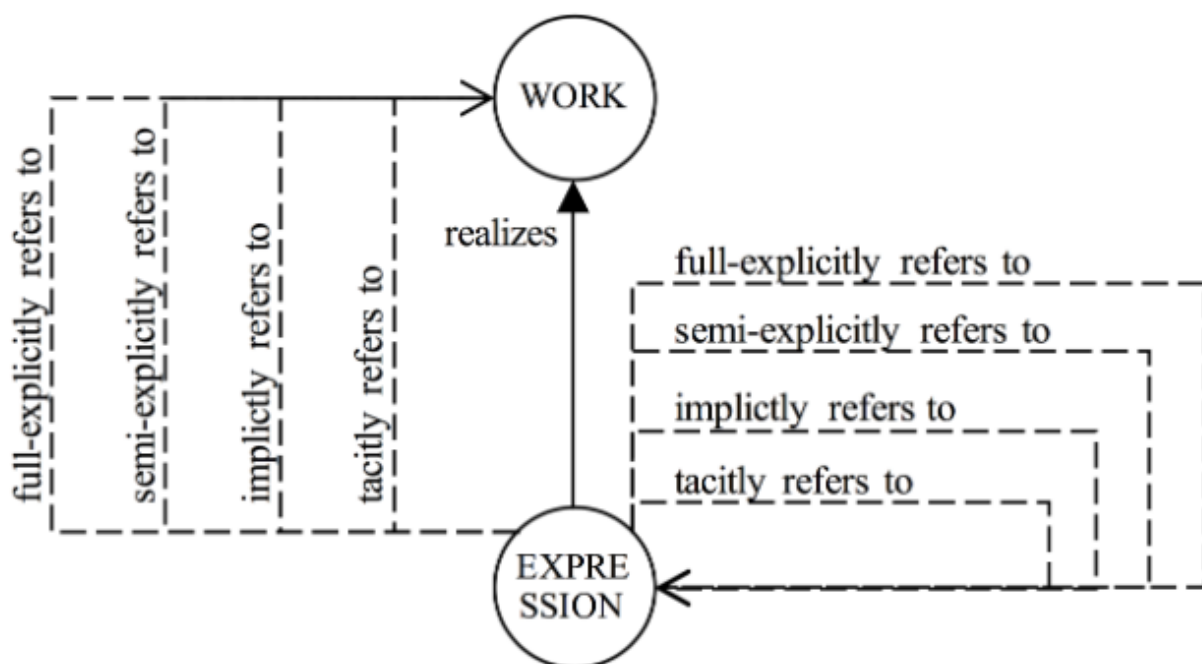

Figure 1. An extension of the FRBR by the four reference types of legal texts shown in Table 1.

[Rz 11]   The model contains the four different reference types, namely fully-explicit (FR), semi-explicit (SR), implicit (IR), and tacit (TR) references. Multiplicities of the relationships are omitted in the figure but they are n to m, since an expression can refer to many expressions, respectively works, and vice versa. The extended bibliographic model allows the reconstruction of the characteristics or dynamic vs. static and outbound vs. inbound references according to an expression or work. However, the determination whether it's a backward or onward reference depends on the concrete scenario, i.e. instantiation of the model (cf. Figure 2).
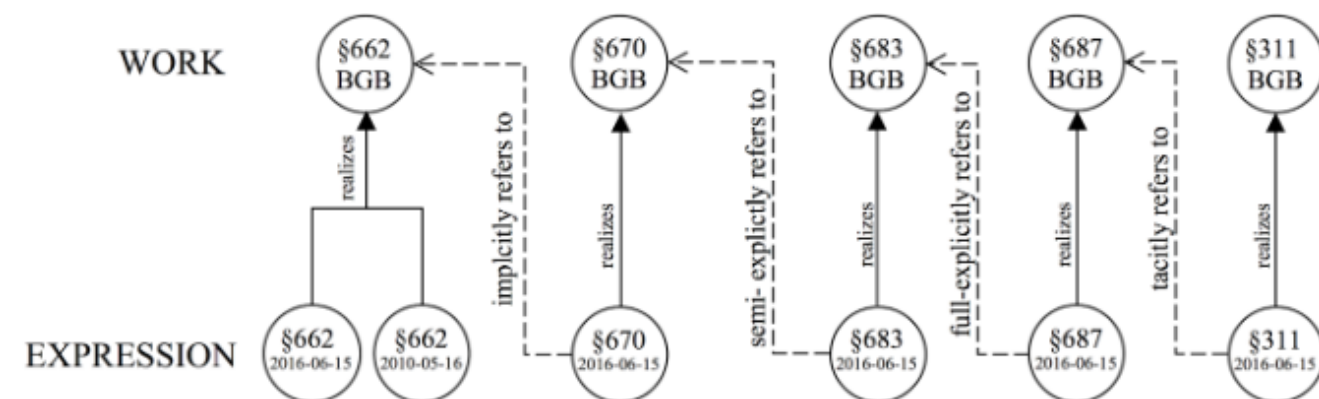
Figure 2. A real world scenario of the extended FRBR.

[Rz 12]   Figure 2 shows an exemplary and real-world instantiation of the bibliographic model. Thereby, § 683 BGB[20] is fully-explicit referenced by article § 687 BGB. The illustration shows three additional norms, §§662, 670, and 311 BGB. Through the usage of the legally defined concept *mandate*, which is legally defined in §622 BGB, within the norm corpus the implicit reference between §662 and §670 emerges. The evaluation provided in Section 5 will show that those implicit references heavily exist throughout legal documents. The determination of those legal definitions is more complex than the extraction of fully-explicit references using algorithms, but can be achieved by extracting linguistic patterns, e.g. [...] «as defined by law» (see also Section 4.3). At this point it becomes clear, that only those legal definitions can be recognized that are indicated with linguistic patterns. There may exist more subtle definitions that cannot be determined with this method. The norm §683 semi-explicitly refers to §670 because it textually states that during its interpretation the specific regulations regarding mandates have to be considered. Beside other norms these explicitly include the norm §670 although not explicitly addressed by its name or number. A tacit reference exists between the norms §311 and §687. No textual phrase indicates a relationship between them. Consequently, there does not exist a reference type as in the examples above. However, during interpretation of §687 the content of norm §311 is highly relevant, since it defines the characteristics of a legal transaction (dt. Rechtsgeschäft) and a mandate (dt. Beauftragung) is one particular type of a legal transaction. In judgments those two norms are co-cited and their semantic relationship can be determined. This tacit relationship can arise from various semantic relationships such as related legal concepts, legal causes or legal effects, i.e. general clause[21]. BERGER also argues that the systemic interpretation of norms, especially the occurrence of collision rules, such as «lex specialis derogat lex generalis», heavily induce tacit relationships. And again, if indicating linguistic features and textual phrases are not available the way forward is using additional and external relevant documents. However, the automated determination of those semantic relationships using computer-linguistic methods requires – if possible – highly specified and trained algorithms.

[Rz 13]   The next chapter describes how the different reference types can be determined and a technology stack required to unveil these references by either analyzing lexical, semantic, or structural properties.

5.   Analysis and Implementation of the Reference Type Model

5.1.   Full-explicit references

[Rz 14]   The extraction of fully-explicit references in legislative but also jurisdictional data has been done several times and can be achieved reasonably well with syntactical parsers, e.g. regular expressions[22]. WINKELS ET AL. achieved a precision of 87 % and a recall of 99 % for case law[23]. AGNOLONI ET AL. have reached a precision of 98.4 % and a

recall of 91.7 % for case law of the Italian constitutional court[24]. In the extraction of inand outbound full-explicit references in the German Civil Code (BGB) a precision of 96.88 % and a recall of 96.67 % can be achieved[25].

> **Examples** §894; §81 Abs. 1 Satz 3; §§32 und 34; §§664 bis 670; §126 Abs. 1 Satz 2 Nr. 3 der Grundbuchordnung.

[Rz 15] Depending on the quality of the linguistic expression of a FR it is also possible to determine the referred document. Unfortunately, the quality of codifying references within legal document deviate from best practice or given standards, such as the BMJV[26], which diminishes the detection and resolving rate.

5.2.   Semi-explicit references

[Rz 16] Determining SR is relevant to case law and legislation as well. However, it is hardly investigated from a data science perspective and to the best of our knowledge no comprehensive attempts have been made to unveil those reference structures in legal documents. Based on the German Civil Code, we have selected various different phrases indicating a semi-explicit reference in a norm.

> **Examples** «Die [...] geltenden Regelungen über [...] gelten sinngemäß.»[27] (§736 BGB); «[...] gelten die Vorschriften über das Pfandrecht [...]»[28] (§1293 BGB); «eine analoge Anwendung der Vorschriften über Strukturmaßnahmen» (BGH II ZB 26/12).

[Rz 17] An analysis of SR is possible since their appearance is always indicated with explicit phrases, such as «die Vorschriften über»[29] . The detection of the referring norm (containing the phrase) is possible by searching for the various phrases. However, it is challenging to determine the set of norms that are referenced. This is due to the fact, that norms are identifiable with their number but are hardly grouped by the labels used in semi-explicit references. Exceptions are of course headlines and titles of sections. Official look-up tables, bridging between those labels and a set of norm numbers, are not provided by the legislator and difficult to create and maintain.

5.3.   Implicit references

[Rz 18] The determination of implicit references and emerging network structures requires the analysis of the linguistic and semantic level of legal texts. Thereby, the focus lies on enriching the text with annotation information that contains information about the contextual linguistic semantics, such as legal definitions and legally defined terms. Within this work we restrict implicit references to those references induced by legal definitions and the usage of legally defined terms.

> **Examples**[30] «**Sachen** im Sinne des Gesetzes sind nur körperliche Gegenstände.» (§90 BGB); «Die Anfechtung muss [...] ohne schuldhaftes Zögern (**unverzüglich**) erfolgen» (§121 BGB); «Die Eltern haben die Pflicht und das Recht, für das minderjährige Kind zu sorgen (**elterliche Sorge**).» (§1626 BGB).

[Rz 19] The examples show how the legislator defines legal terms. Those definitions heavily impact the interpretation and also subsumption. Consequently, it is necessary to be aware of those existing definitions while interpreting a legal norm, respectively judgment, relying on these terms. However, their determination is more complex than determining fully-explicit references, since the pattern definitions also have to take linguistic information, such as lemmatization, parts-of-speeches, and parsing information, e.g., auxiliary sentences, into account. Thereby,

technologies like the Jape grammar or the Apache Ruta[31] have to be used. Approaches in the international law have also used q-grams to compare norms with each other and find similarities among their vocabulary[32].

5.4. Tacit references

[Rz 20] The reconstruction of tacit references cannot be achieved by analyzing the text of a norm exclusively. Theoretical concepts with practical implications, like the consideration of systematical interpretation of norms[33] and the resolution of conflicting laws, respectively norms, have to be addressed. These systematical interpretations can be reconstructed by analyzing co-citations, that are induced by additional legal documents, such as cases, judgments, or commentaries. Up to a certain degree it is possible to determine connections between norms, that cannot be reconstructed by analyzing fully-explicit, semi-explicit or implicit references. Those connections cover for example relationships like legal cause (Rechtsgrund) or legal effect (Rechtsfolgen) and general clauses.

> **Examples** «[...], dass die Vorschrift des §902 BGB [...], auf den Beseitigungsanspruch des §1004 BGB keine Anwendung findet» (BGH V ZR 141/10)

[Rz 21] Co-citations derived from relevant case law reflect – at least to a certain degree – argumentation structures and therefore the semantic relationship between norms. As other researchers already pointed out[34], there is still a gap between what is technologically feasible and what is desirable from a legal perspective. Thereby, legal data science still misses a comprehensive theory on the reasons for citing, which is partially addressed by this present work. The reconstruction of the *Why?* would also contribute to reconstruct tacit references, that exist throughout legal texts. A detailed examination of tacit references is due to the complexity not subject of this present work. Although contained in the model this reference type is not part of the evaluation.

5.5. Consolidation and Technology Stack

[Rz 22] We have described the reference types as introduced in Section 2. Thereby, the differentiation has been discussed in more detail and examples have been given to illustrate the concepts. Furthermore, we have discussed and sketched how the different reference types complement each other and how legal data science can contribute to determine those references. We consolidated the findings in Table 3.

Reference Type	Technology Stack
Full-explicit reference	Lexical analysis, e.g., regular expressions, JFlex, etc.
Semi-explicit reference	Lexical analysis, e.g., regular expressions, JFlex, etc.Text annotation frameworks, e.g., Jape grammar, or Apache Ruta
Implicit reference	Text annotation frameworks, e.g., Jape grammar, or Apache RutaMachine learning, e.g., deep and shallow learning algorithms (e.g. word2vec)
Tacit reference	Text annotation frameworks, e.g., Jape grammar, or Apache RutaMachine learning, e.g., deep and shallow learning algorithms (e.g. word2vec) Network pattern analysis, e.g., graph databases, Blueprints[35], Gremlin[36], etc.

Table 3. Reference types and associated technological requirements (capabilities).

6. Empirical Analysis of German Laws

[Rz 23] This section summarizes the analysis and evaluation on a subset of German federal laws. Thereby, we implemented an prototype to perform the analysis and selected ten (out of more than 6'000) German laws containing the most tokens (i.e. words).

6.1. Implementation of Navigation, Exploration and Evaluation Prototype

[Rz 24] In Figure 3 our prototypical support for evaluation and exploring the data set is shown. The Java back-end including an implementation of Apache Ruta and a pipes-and-filters architecture is described in [37].
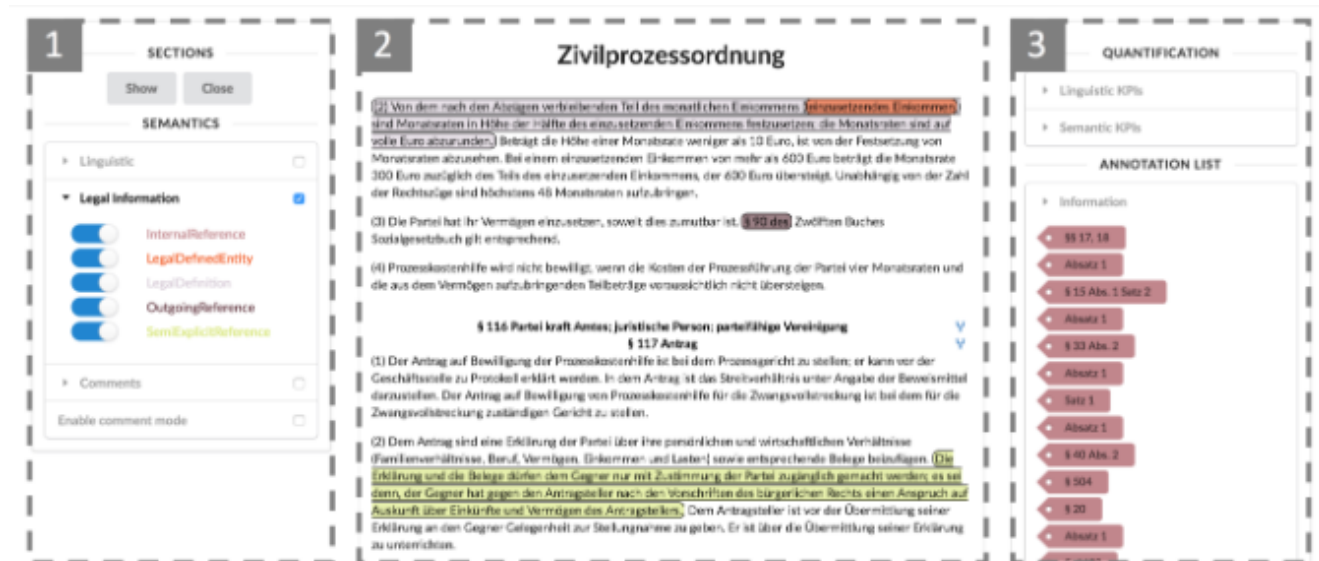

Figure 3. A web based user interface to view the determined references in legal texts (e.g., code of civil procedure). Within the content area (2) legal definitions (light gray), legally defined concept (orange), an outbound full-explicit reference (brown) and a semi-explicit reference (yellow) are highlighted.

[Rz 25] The user interface contains in the left area (1) multiple control mechanisms to visualize the various different automatically determined references in an arbitrary legal text. Selected reference types are automatically highlighted in the content area (2) of the user interface. In the right hand side, a list of the references is provided. The listed references can be clicked to navigate to the respective reference. The user interface supports the evaluation, navigation and exploration of the analyzed data.

6.2. Empirical Analysis of Reference Types: Dataset, Analysis, and Evaluation

[Rz 26] Based on German laws we have analyzed the usage and occurrence of the various reference types. Thereby, we have selected ten federal laws containing the most tokens out of more than 6000 available federal laws. Table 4 summarizes the key findings.

[Rz 27] Table 4 shows that the German Civil Code contains 2'072 FR, of which 1'918 are inbound and 154 are outbound. In addition, there exist 411 SR, ($\triangleq$ 19.84% compared to FR) and 2'570 IR ($\triangleq$ 124.03% compared to FR). This analysis

shows that the mere consideration of FR neglects a huge part of the emerging links between norms of a law.

[Rz 28] 2'981 (= 411 + 2'570) references are additionally induced by linguistic and semantic relationships. Similar conclusions can be drawn for the Capital Investment Law (KAGB). Thereby, the law heavily uses concepts and terms, that are legally defined within the law.

Law	#T ↓	#§	FR (in, out)	SR	SR (rel)	IR	IR (rel)
BGB	185'751	2'381	2'072 (1'918, 154)	411	19.84%	2'570	124.03%
SGB5	147'621	456	4'678 (4'220, 458)	52	1.11%	426	9.11%
KAGB	113'166	356	3'157 (2'781, 376)	64	2.03%	3'701	117.23%
KredWG	91'145	208	2'657 (2'234, 423)	37	1.39%	1'393	52.43%
HGB	90'877	643	1'733 (1'514, 219)	102	5.89%	496	28.62%
ZPO	90'421	1'003	927 (794, 133)	83	8.95%	94	10.14%
SGB 6	84'683	413	1'165 (901, 264)	78	6.70%	344	29.53%
AMG	77'002	216	2'281 (2'112, 169)	34	1.49%	420	18.41%
StPO	74'887	644	1'757 (1'426, 331)	38	2.16%	48	2.73%
StGB	62'986	518	1'313 (1'234, 79)	4	0.30%	48	3.66%

Table 4. Analysis of the reference types on German laws. The table shows the selected law, number of tokens (#T), number of articles (#§), full-explicit references (FR, inbound and outbound), semi-explicit references (SR), semi-explicit references relative to FR (SR rel), implicit references (IR), and implicit references relative to FR (IR rel).

[Rz 29] The evaluation showed that those terms are mainly specific abbreviations, such as AIF, OGAW, or terms like «Ausgabepreis», «Rücknahmepreis». The usage of abbreviations and highly specified terminology makes the evaluation difficult since the demarcation between legal definition and domain specific term becomes ambiguous.

[Rz 30] We manually derived the regular expressions and respective Apache Ruta scripts on the product liability act and the general part of the German Civil Code. Thereby, we have created the expressions and rules to determine full-explicit, semi-explicit and implicit references (i.e., legal definitions). We evaluated the precision and recall on a subset (n = 100≙ 19%) of the German Penalty Law (StGB) articles with respect to full-explicit references (precision: 98%; recall 97%), semi-explicit references (precision: 80%; recall 80%), implicit references (precision: 93%; recall 93%). We additionally evaluated a subset (n = 50 ≙ 23%) of the articles of the banking act (KWG) articles, with respect to full-explicit references (precision: 89%; recall 88%), semi-explicit references (precision: 82%; recall 60%), and implicit references (precision: 96%; recall 92%). The results are satisfying but could be further improved, e.g., recall of semi-explicit references.

[Rz 31] Table 4 shows that German laws differ heavily by the amount of FR, SR, and IR. However, considering those heavily impact the resulting network structure, since various additional relationships, i.e. links, are induced.

7.   Conclusion and Outlook

[Rz 32] Beside the well-studied citations several additional reference types exist throughout legal documents. We argued that beside full-explicit references, it is necessary to consider at least three additional reference types to comprehensively analyze the network emerging within legal documents. Consequently, in order to fully capture links between legal documents at least those four reference types have to be considered. Using existing data and

text mining methods we proposed a technology stack that is suitable to determine those references based on linguistics, e.g., regular expressions, or more elaborate semantic features, e.g., Jape grammar, Apache Ruta.

[Rz 33] We also made a prototypical implementation to determine and evaluate the detection of references according to their type. Using publicly available data from German legislation we analyzed laws regarding the occurrence of full-explicit, semi-explicit and implicit references. The results show that beside the full-explicit reference numerous semi-explicit and implicit references exist in legal documents. In the German Civil Code the number of references induced by terminology, i.e. implicit references, is even higher than the full-explicit references (124%). Although, the evaluation has shown that accuracy drops for laws, that are domain specific, such as the Capital Investment Law (KAGB), the results are promising and additional effort in training the patterns would be necessary to ensure sufficient accuracy.

[Rz 34] The differentiation of reference types helps in understanding the network structures arising within legal documents and can be used in various subsequent applications, such as recommender systems.

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16 See above, note 2.

17 See above, note 10.

18 A comprehensive discussion can be found in Berger (note 9).

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25 Landthaler et al. (note 8).

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27 The provisions on [...] apply with the necessary modifications.

28 The pledge of a bearer instrument is governed by the provisions on the pledge of movable things.

29 The provisions on.

30 Legally defined term highlighted.

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