Review execution

Research identification

Initially 6 queries have been run against the 6 databases resulting in 84 hits as shown in Table 1 in appendix D. After testing the initially formulated 6 queries have een reduced to 4 queries. The first two queries search for "business process management" or BPM in the title. The last two queries search for "business process engineering" or business process reengineering" in the title.

1. TI=("business process management" or BPM) AND (AB=(compliance) OR KP=(compliance))
2. TI=("business process management" or BPM) AND (AB=("regulat*") OR KP=("regulat*"))
3. TI=("business process *engineering") AND (AB=(compliance) OR KP=(compliance))
4. TI=("business process *engineering") AND (AB=(regulat*) OR KP=(regulat*))

The initial list (**?@tbl-database-searches**) contains a total of 84 records. An additional 6 records were found from other sources (**?@tbl-other-sources**). The total is 90 records. This list includes preprints and conference papers. Filtering the journal articles results in a list of 25 records (**?@tbl-review-abstracts**).

In the case of Web of Science (WoS) the four queries have been taken together using the "OR" operator. This final query yields 42 results when using the the Vlerick WoS subscription[1]. The search strings have be adapted to suit the specific requirements of the databases.

Selection of studies

The initial searches were done on all database fields. The search was subsequently made more specific by searching titles and abstracts. Lastly we searched titles, abstracts and keywords.

Across the 6 datasoures 84 articles have been identified, and an additional 6 records have been added from different sources. The found records are listed in Appendix D: **?@tbl-database-searches** and **?@tbl-other-sources**.

The process to get to the final **?var:literature.journal_articles** papers included in this literature study is visualized in the flowchart in **?@fig-slr-flowchart** in Appendix C.

The WoS search yielded 29 hits. Excluding 4 articles with BPM in the title where BPM has a different meaning than "Business Process Management". For example where BPM is an abbreviation of "Biodiesel Particulate Matter". Excluding 1 article as it is a double, also ocuring in the dblp search.

[1]Web of Science: Core Collection
Subscription : Vlerick Business School
Editions : A&HCI , ESCI , CPCI-SSH , CPCI-S , SCI-EXPANDED , SSCI
Date range: 2014-2024

The SD search yielded 7 hits. On the basis of article type (1 book chapter and 1 short communication) we have excluded two articles. An additional article was excluded as the title referred to "Business Process Management Map", which is a different concept.

The SSRN search yielded 2 results, both excluded as they are preprints.

The arXiv search yielded 0 records when looking for articles with "Business Process Management" or BPM in the title field. Two records where found on the basis of abstract and keyword matches. All the same these records have been subsequently excluded when the exclusion criteria have been applied.

The dblp search yielded 41 records, including 2 books and 35 conference papers. After exclusion 4 records remain, 3 journal articles and one PhD thesis. For the next step, the abstract scan, the thesis has been replaced by a journal article by the same author about the same topic.

The Zenodo search yielded 0 records when looking for articles with "Business Process Management" or BPM in the title field.

Six additional records have been included identified via different sources: 4 journal articles, 1 PhD thesis and 1 conference paper. Here too, for the next step in the process the thesis has been replaced by a journal article by the same author about the same topic.

In summary:

Table 1: Result set

Database	Found	Additional	Subtotal	Excluded	Result set
WoS	29		29	-19	10
SD	7		7	-7	0
SSRN	0	+2	2	-2	0
arXiv	0	+4	4	-4	0
dblp	42		42	-37	5
zenodo	0				0
additional	0	+6	6		6
total	78	+12	90	-69	21

The abstracts of the remaining 21 articles are listed in Appendix G, **?@tbl-review-abstracts**.

Study Quality Assessment

The first quality indicator is about the type of journal. Peer reviewed articles are deemed to be of better quality than, for example, conference papers. The second quality indicator is an a indirect measure of both the quality of the journal and the relevance of the article to

the Information Systems field. The third quality indicator is a proxy for the quality of the article. The fourth indicator is deemed to be representative for the quality of the scholars.

The outcome for QA1 through QA4 is either 1 or 0 (1 means yes, 0 means no).
QA1: the article is of the type peer-reviewed journal article
QA2: the journal is in the eligible journals list
QA3: the article has been referenced an average of 5 times per year since publication
QA4: author 1 and author 2 have together authored at least 50 articles
The detail of the calculation for QA3 en QA4 is shown in appendix F.

Table 2: Quality assessment

Seq	Source	QA1	QA2	QA3	QA4	Score
1	WoS_02	1	0	0	0	1
2	WoS_03	1	0	0	1	2
3	WoS_04	1	0	1	1	3
4	WoS_05	1	0	0	1	2
5	WoS_06	1	1	0	1	3
6	WoS_10	1	0	1	1	3
7	WoS_14	1	0	1	1	3
8	WoS_15	1	0	1	1	3
9	WoS_16	1	0	0	1	2
10	WoS_17	1	0	0	0	1
11	dblp_01	1	0	0	1	2
12	dblp_03	1	0	1	1	3
13	dblp_08	1	0	0	0	1
14	dblp_13	1	0	0	1	2
15	dblp_28	0	0	0	0	0
16	other_01	1	0	1	0	2
17	other_02	1	0	0	1	2
18	other_03	1	0	1	1	3
19	other_04	1	0	1	1	3
20	other_05	0	0	0	1	1
21	other_06	1	0	1	1	3

For the final list we only consider the **?var:literature.fulltexts_included** articles where three or more conditions are met (see: appendix E, **?@tbl-full-text-included**).

Data collection

The output of each query has either been a bib file or a ris file. All bib files have been converted to ris files. The mapping of bibliographic elements to the ris fields differs per data sources. A script has been written to get to a uniform ris-format.

The open access databases do not contain the full text articles if the articles are not open access. DBLP also doesn't contain abstracts. The absence of full text articles or abstracts is explained by constraints imposed by copyrights.

The excel file containing the article lists has been stored on zenodo for future reference (zenodo 10795823).

Synthesis of extracted data

8-12 years ago: the two oldest papers in the dataset are (**?**) and (**?**). The article of Irene Vanderfeesten is on the subject of her PhD thesis ((**?**)). It describes the concept of a Product Data Model which, in workflow systems, can be compared to a Bill of Material in manufacturing systems. The article doesn't mention future research but does mention collaboration with industrial partners to incorporate a PDM in a commercial tool. The Hadasch paper is a quantitive study about users' process compliance as a function of process explanations either in textual or diagram format (DE/DDE). Broadly stated, the paper concludes that the better explanations result in better compliance. Other than a recommendation that the findings of the paper be leveraged in future research, there is no specific guidance about future research.

4-8 years ago: the four papers published in the 2016-2019 timeslot are (**?**), Hashmi and Governatori (2017), (**?**) and (**?**). The van der Aalst paper compares and contrasts spreadsheet technology with process mining technology. It mentions checking for compliance as the activity whereby a process as run in reality is compared to a normative model. The article mentions future process mining research should be about automatically improving processes by changing underlying process models. The first Hashmi paper compares six Compliance Modeling Frameworks (CMFs). There are two pointers to future research directions. 1) Studying the formal semantics of the norms modeling languages. 2) Studying the useability of the norms modeling constructs in practice. The second Hashmi paper is a SLR where 79 papers were included in the study. The study provides a comprehensive overview of the attributes of compliance in BPM. There is a general direction for future research given: to improve modeling languages to take into account all compliance requirements. The article by van der Aa et al. is about the possible divergence of process descriptions and graphical process models. A quantitive analysis is performed on 53 real-life model-text pairs. One of the suggested future research directions is to also capture process information in other formats. Among the examples given of such other formats are rules and regulations.

0-4 years ago: the three most recent papers in the set are the papers and (**?**), (**?**) and (**?**). The Kir paper introduces *agile*BPM, a modeling methodology. The main differentiator is that next to control flow *agile*BPM also captures knowledge, rules and goals. A prototype of the system is compared to other similar systems (ADEPT, SmartPM, Planlets, Go4Flex). The paper doesn't mention future research. The Bernardo paper includes a SLR, interviews and expert consultations. Agile BPM is defined. Future research is suggested to be on practices necessary for empirical application of BPM in organizations. The Viriyasitavat article is a SLR on the use of blockchain technology for business process compliance. The paper argues that blockchain technologies can and are applied for business process compliance.

Existing work has a focus on technical implementation of the functionalities of traditional BPM systems. However the use of blockchain technologies also allows for new functionalities. The further research section specifically mentions organizational and legal aspects.

Table 3: Relevance to research question

	Year	Article	Alignment Concepts	Future Research
1	2011	Vanderfeesten et al.	ProductData Model	N
2	2016	Hadasch et al.	(Diagram)Descriptive Explanations	N
3	2017	Van der Aa et al.	Consistency between representation	Y (specific)
4	2018	Van Der Aalst	Prescriptive Analytics	Y (general)
5	2018	Hashmi et al.	Compliance Modeling Frameworks	Y (specific)
6	2018	Hashmi et al.	Compliance Modeling Languages	Y (general)
7	2021	Kir et al.	Context Awareness / Norm adoption	N
8	2023	Viriyasitavat et al.	Blockchain	Y (general)
9	2023	Bernardo Junior et al.	-	Y (general)

All papers mention approaches for alignment of business processes with regulatory requirements except the Bernardo Junior paper about agile BPM.

From these 9 papers reviewed, 6 mention future research directions. Two papers mention specific future research topic, for example around "consistency between different process representations" and "the useability of norm modelling constructs".

Hashmi, Mustafa, and Guido Governatori. 2017. "Norms Modeling Constructs of Business Process Compliance Management Frameworks: A Conceptual Evaluation." *Artificial Intelligence and Law* 26 (September): 251–305. https://doi.org/10.1007/s10506-017-9215-8.