Blockchain Developer Experience: A Multivocal Literature Review

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AGENDA

1. Introduction
2. Methodology
3. Results
4. Discussion

Blockchain and Smart Contracts

Blockchain technology emerged in 2008 with Bitcoin as a pioneer in electronic peer-to-peer currency transactions.

Adopting **smart contracts** by Ethereum enabled programmable business logic executed as transactions on the blockchain.

This component has enabled the diffusion of **Decentralized Applications (dApps)**.

Blockchain-Oriented Software Engineering

DApp engineering requires practices tailored to:

- immutable databases,
- peer-to-peer networks,
- novel security mechanisms.

***Blockchain-Oriented Software Engineering* seeks to shape directions for effective software development for blockchain, serving as a bridge between conventional software engineering and these particular technical constraints [1], [2].**

[1] S. Porru, A. Pinna, M. Marchesi, and R. Tonelli, “Blockchain oriented software engineering: challenges and new directions,” in 2017 IEEE/ACM 39th International Conference on Software Engineering Companion (ICSE-C). IEEE, 2017, pp. 169–171.
[2] G. Destefanis, M. Marchesi, M. Ortu, R. Tonelli, A. Bracciali, and R. Hierons, “Smart contracts vulnerabilities: a call for blockchain software engineering?” in 2018 International Workshop on Blockchain Oriented Software Engineering (IWBOSE). IEEE, 2018, pp. 19–25.

Developer Experience (DEx)

Multiple development environments and a **steep learning curve** characterize the blockchain development ecosystem.

New approaches to enhance **Developer Experience (DEx)** as improvements in developer efficiency, security, and productivity can directly influence the success of system implementations.

"Developer Experience encompasses the experiences related to all types of artifacts and activities that a developer encounters in software development" [3].

[3] F. Fagerholm and J. M ünch, "Developer experience: Concept and definition," in 2012 international conference on software and system process (ICSSP). IEEE, 2012, pp. 73–77

Literature Gap

Research specifically addressing Blockchain Developer Experience (BcDEx) remains considerably limited.

No systematic mappings that capture how academic and professional communities approach aspects of BcDEx.

Conducts a **Multivocal Literature Review (MLR)** to analyze the distribution of BcDEx literature sources.

Combines insights from both academic and gray literature [...] providing a broader and up-to-date perspective.

Research Questions (RQs)

RQ1 What is the **distribution** and **nature** of academic and industry sources related to BcDEx?

RQ2 What **categories** of **practical sources** related to BcDEx have been discussed in the literature?

RQ3 In what **ways** have the sources discussed in the literature been **shaping** the BcDEx in **practice**?

Contributions

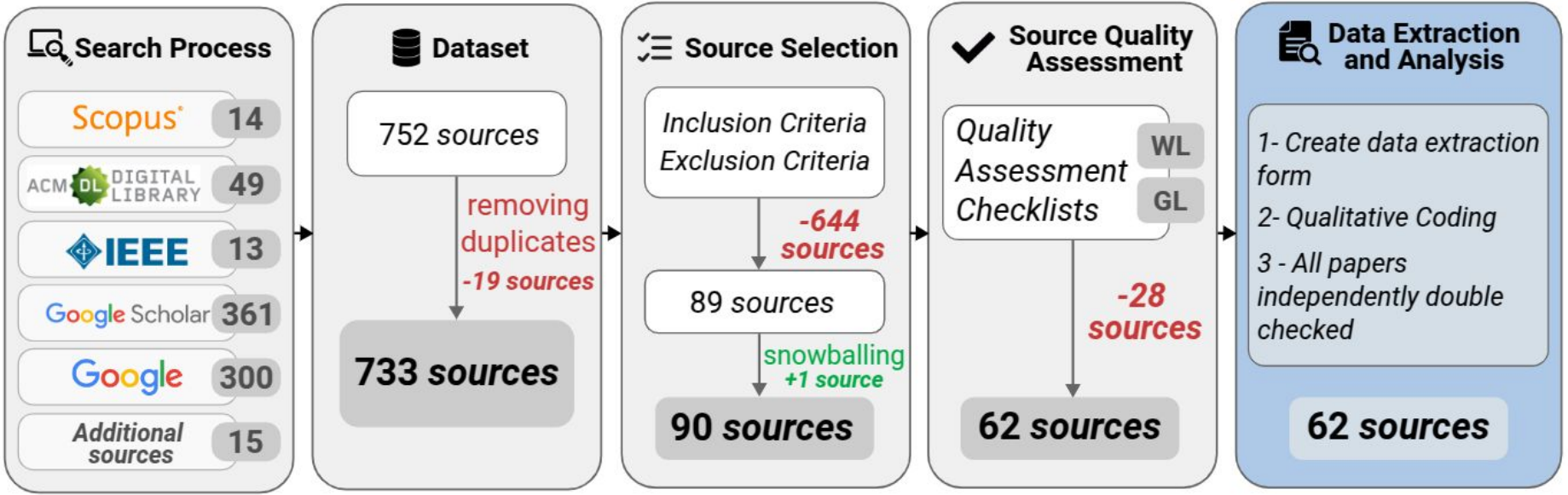
Academia

- **Bridges** the gap between **industry practices** and **academic research**.
- **Systematizing BcDEx** insights from industry sources.
- Highlight research **opportunities** in **empirical validation studies** and BcDEx assessment.

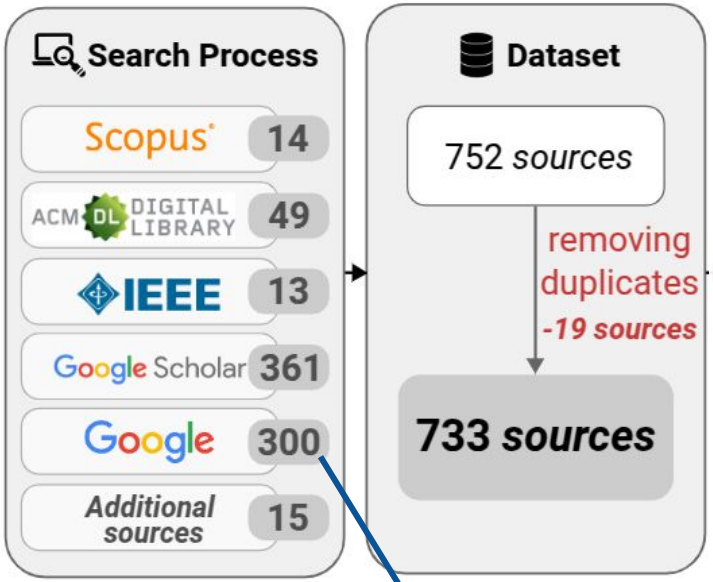
Industry

- Provide a **structured categorization** of the current context of BcDEx.
- Guide blockchain development teams in **making informed decisions**.

Multivocal Literature Review



Multivocal Literature Review



search string

("blockchain" OR "smart contract") AND ("developer experience" OR "developer usability" OR "software engineer experience" OR "programmer experience" OR "DevX" OR "DEx")

"effort-bounded" mechanism as stopping criterion for GL

Multivocal Literature Review

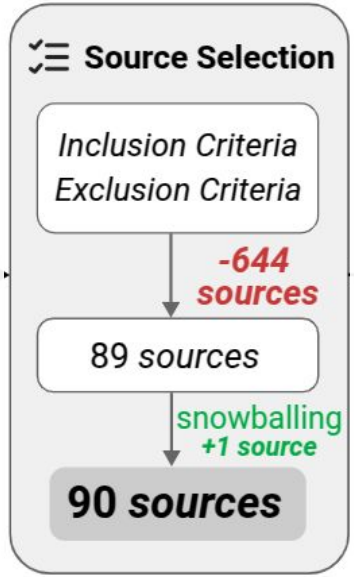
Inclusion Criteria

IC1: sources must be written in English

IC2: sources must focus on blockchain and mention or discuss DEx

IC3: sources must evaluate DEx factors in blockchain solutions

IC4: sources must present solutions that may impact DEx factors



Exclusion Criteria

EC1: sources without full-text availability

EC2: secondary or tertiary papers

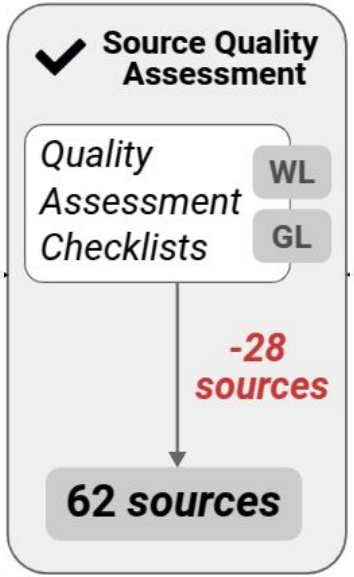
EC3: papers in the form of editorials, proceedings, etc.

EC4: sources where DEx is only mentioned without relation to BcDEx

Multivocal Literature Review

TABLE I
QUALITY ASSESSMENT CHECKLISTS

WL	**Quality Assessment Checklist**
Q1	Are the authors' intentions with the research made clear?
Q2	Does the study contain conclusion, implications for practice and future research?
Q3	Does the study give a realistic and credible impression?
Q4	Are the challenges or solutions adequately defined in detail?
GL	**Quality Assessment Checklist**
Q1	Does the source have a clearly aim?
Q2	Does the source have a clearly stated date?
Q3	Does the source give a realistic and credible impression?
Q4	Are the challenges or solutions adequately defined in detail?



3-point scale (0 – No, 1 – Partly, 2 – Yes)
Average of both reviewer scores
Included sources with rating of 0.7 or higher

Multivocal Literature Review

To answer RQ1,

Descriptive **quantitative analysis** of the **distribution** of primary sources.

Grey Literature

source type
publication platform

White Literature

authors' affiliation
publication type
publication venue
type of research

Data Extraction and Analysis

1- Create data extraction form

2- Qualitative Coding

3 - All papers independently double checked

62 sources

Multivocal Literature Review

To answer RQ2,

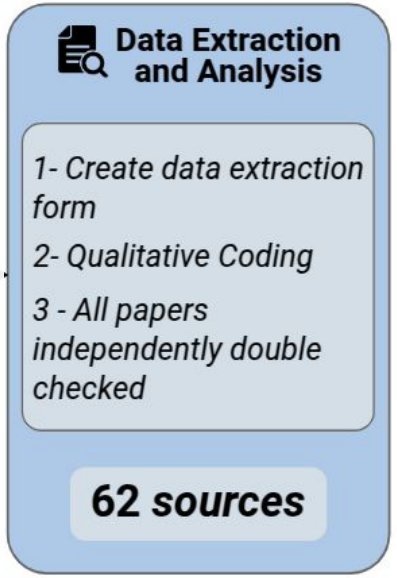
We employed a combined **deductive** and **inductive** coding approach. First, we classified each source into one of the following groups:

1st Group

Tool, platform/service, language, method/technique, model, process, or framework

2nd Group

Heuristic/guidelines, empirical results only, or other



We applied inductive coding for each group where factors emerged from iterative **'open' and 'axial' coding**.

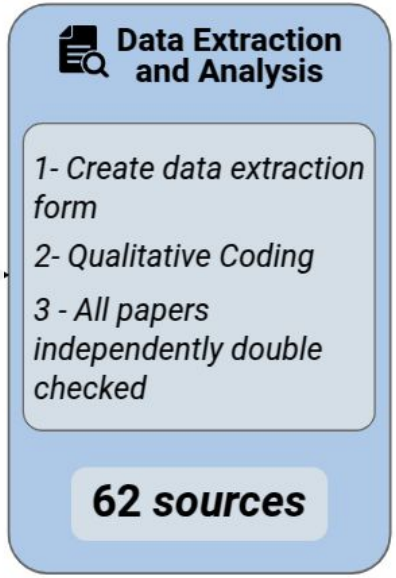
Multivocal Literature Review

To answer RQ3,

We employed an **inductive open coding approach** to extract aspects that demonstrate how the sources influence BcDEx.

We analyzed five key aspects:

- Approaches to abstract complexity and enhance usability
- Strategies for facilitating adoption
- Impacts on developer productivity and workflow
- Educational and support initiatives
- Empirical evaluations of BcDEx



Results

RQ1

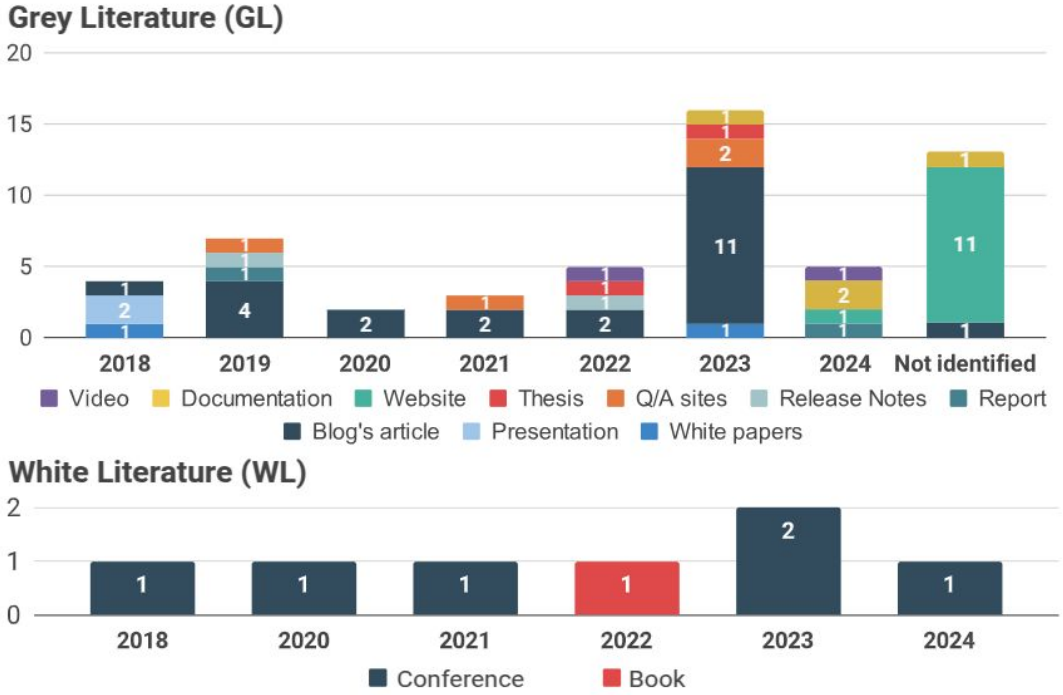
What is the **distribution** and **nature** of academic and industry sources related to BcDEx?

Blog's article (41.8%)

Websites (21.8%)

Conference (85.7%)

Book (14.3%)



55

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Fig. 2. Distribution of WL and GL type sources over the years.

Results

RQ1

What is the **distribution** and **nature** of academic and industry sources related to BcDEx?

Answer to RQ1: *Our findings show that the BcDEx knowledge ecosystem is predominantly driven by industry sources within GL, with blog articles (41.8%) and company websites (21.8%) offering practical guidance to developers. In contrast, we identified only seven studies in the WL, mostly classified as Solution Proposals and Validation Research, highlighting a research gap concerning empirical evaluations.*

Results

RQ2 What **categories** of **practical sources** related to BcDEx have been discussed in the literature?

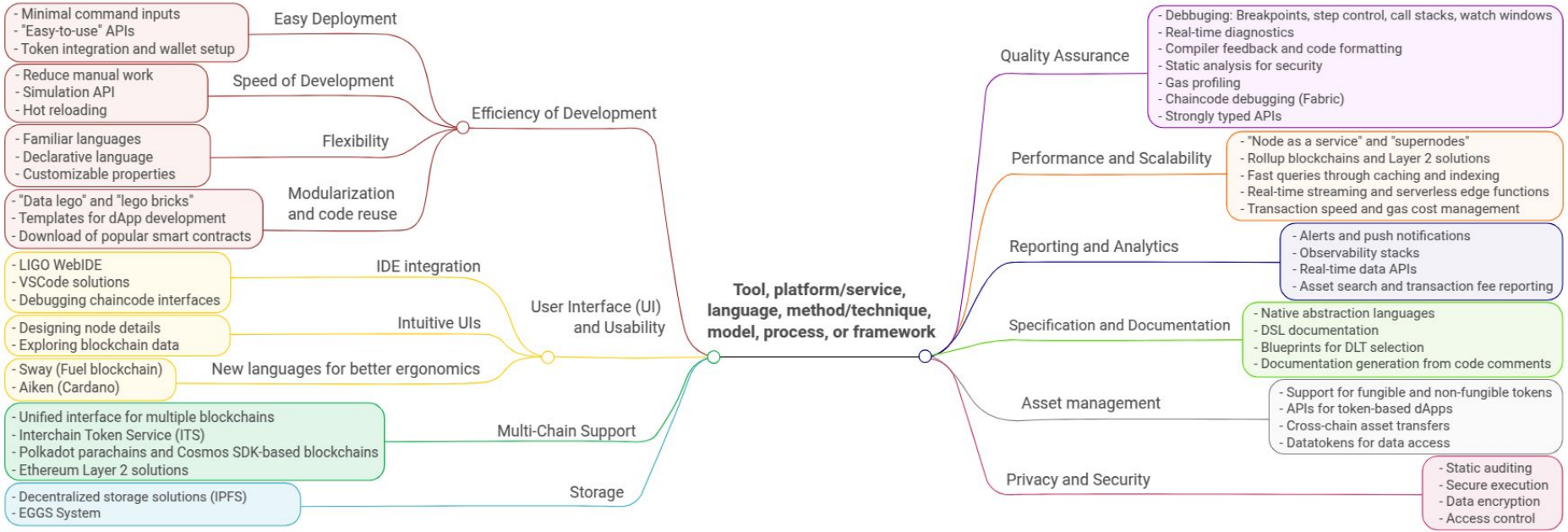

Fig. 3. Overview of sources related to Tool, platform/service, language, method/technique, model, process, or frameworks.

Results

RQ2 What **categories** of **practical sources** related to BcDEx have been discussed in the literature?

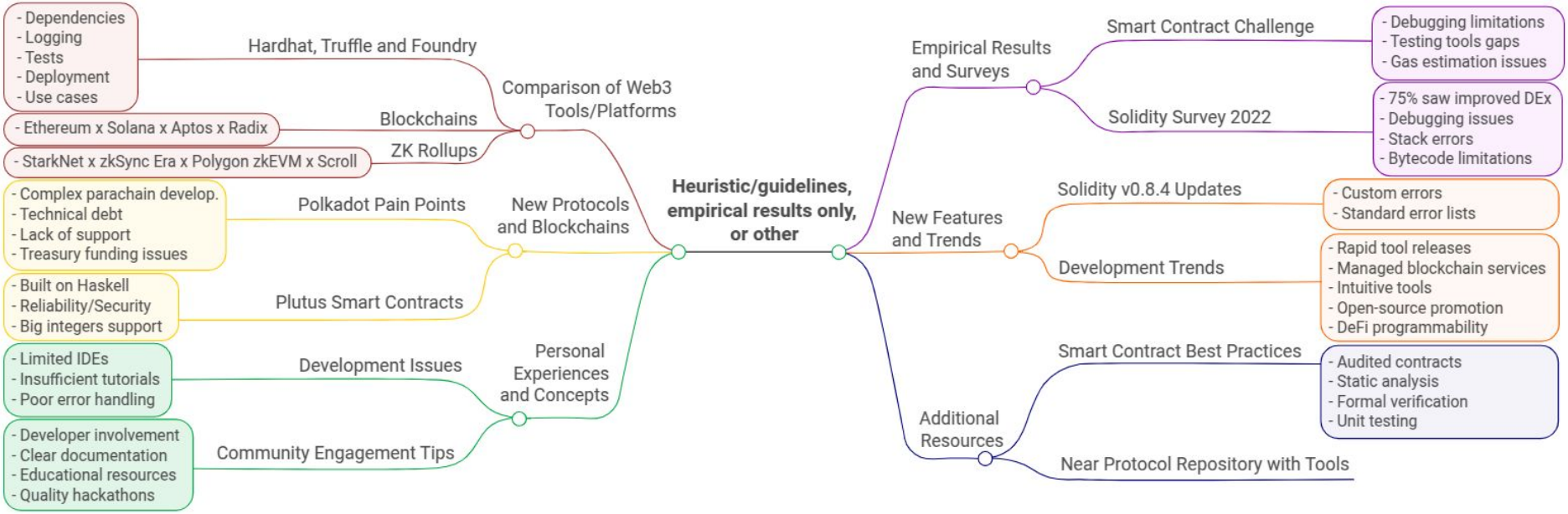

Fig. 4. Overview of sources related to heuristic/guidelines, empirical results only, or other.

Results

Literature Type	Reference	Year	[2nd Group] Discussed topics	[1st Group] Main features									
			–	Efficiency of Development	UI and Usability	Reporting and Analytics	Quality Assurance	Multi-Network Support	Performance and Scalability	Privacy and Security	Spec. and Documentation	Asset Management	Storage
WL01	[22]	2018		■					■	■			
WL02	[23]	2020					■						
WL03	[24]	2021			■						■		
WL04	[25]	2023		■	■			■				■	
WL05	[26]	2022		■						■		■	
WL06	[27]	2024		■			■						
WL07	[28]	2024									■		
GL01	[29]	2022	Empirical results or surveys										
GL02	[30]	2018		■							■		
GL03	[31]	2023											■
GL04	[32]	2023		■				■			■		
GL05	[33]	2019		■			■			■		■	
GL06	[34]	2023			■			■	■				■
GL07	[35]	n.d.	New features and trends										
GL08	[36]	2023	Tool comparison										
GL09	[37]	2019		■									
GL10	[38]	n.d.		■	■		■				■		
GL11	[39]	2023			■		■						
GL12	[40]	2023		■				■		■			
GL13	[41]	2019		■	■		■						
GL14	[42]	2018	Personal experiences										
GL15	[43]	2022		■		■	■	■	■				
GL16	[44]	2023	New protocols and blockchains										
GL17	[45]	2022	Tool comparison										
GL18	[46]	2023		■				■				■	
GL19	[47]	n.d.			■			■		■		■	
GL20	[48]	2022											
GL21	[49]	n.d.			■				■	■			
GL22	[50]	2019		■									
GL23	[51]	2024						■	■	■			
GL24	[52]	2019	Best practices										
GL25	[53]	n.d.		■		■				■		■	
GL26	[54]	n.d.		■		■				■	■		
GL27	[55]	2020		■	■			■		■			
GL28	[56]	n.d.		■				■					
GL29	[57]	2023	Tool comparison										
GL30	[58]	n.d.			■		■						
GL31	[59]	2024											
GL32	[60]	2024		■			■		■		■		
GL33	[61]	2021	New protocols and blockchains										
GL34	[62]	2023			■								
GL35	[63]	2023	Tool comparison										
GL36	[64]	2019		■									
GL37	[65]	2022	Tool comparison										
GL38	[66]	2018	Personal experiences										
GL39	[67]	2023		■									
GL40	[68]	2023	Tool comparison										
GL41	[69]	2019		■	■		■						
GL42	[70]	2023	Resource repository										
GL43	[71]	2023			■		■				■		
GL44	[72]	2021		■				■	■				
GL45	[73]	2023	New features and trends										
GL46	[74]	2021					■						
GL47	[75]	2023	Empirical results or surveys										
GL48	[76]	n.d.		■				■	■				■
GL49	[77]	n.d.		■				■	■	■			
GL50	[78]	2024		■						■		■	
GL51	[79]	2018		■		■		■		■			
GL52	[80]	2023		■			■						
GL53	[81]	n.d.		■				■	■	■			
GL54	[82]	n.d.		■	■	■		■	■	■		■	
GL55	[83]	n.d.		■		■		■	■	■		■	

Results

RQ2

What **categories** of **practical sources** related to BcDEx have been discussed in the literature?

Answer to RQ2: *Our analysis shows that 74.19% of sources (46) fall into the first group, covering tools, platforms/services, languages, methods/techniques, models, processes, or frameworks. The remaining 25.81% (16 sources) comprise the second group, which includes resources such as guidelines, empirical findings, and other insights. Within the first group, the most frequently mentioned aspects were development efficiency, multi-network support, and UI/usability. On the other hand, the most discussed topics in the second group included comparisons of Web3 tools, personal experiences, general concepts, and the complexities of protocols and blockchains.*

Results

RQ3

In what **ways** have the sources discussed in the literature been **shaping** the BcDEx in **practice**?

Simplifying complexity through abstraction and enhancing usability

- Solutions abstract the complexity of blockchain connectors.
- Interact with arbitrary blockchains through simple syntax.
- Eliminate infrastructure setup and maintenance needs.
- "Invisible blockchain experience".

Facilitating blockchain technology adoption

- Solutions reduce entry barriers for developers.
- Enable smooth transition from Web2 to Web3 technologies.
- Provides user-friendly experience for all skill levels.
- Supports different ecosystems and Web2 stacks.

Impact on developer productivity

- Reduces programmer overhead.
- Saves development time and operational costs.
- Offers multiple services on a single platform.
- Enables teams to work together more efficiently.

Results

RQ3

In what **ways** have the sources discussed in the literature been **shaping** the BcDEx in **practice**?

Education, training, and support

- Guidelines help developers understand blockchain concepts.
- Resources teach efficient and maintainable code writing.
- Hackathons and boot camps provide hands-on training.
- Community sharing enables learning from real-world challenges.

BcDEx evaluation

- Developers performed better using ParaSpell SDK vs PolkadotJS XCM UI.
- Developer engagement indicates platform success.
- Task analysis assessed smart contract development challenges.
- Studies track source code consultation patterns.

Results

RQ3

In what **ways** have the sources discussed in the literature been **shaping** the BcDEx in **practice**?

Answer to RQ3: *We identified five key perspectives through which sources in the literature have been shaping BcDEx in practice: abstraction for usability, blockchain adoption facilitation, productivity impact, developer education and support, and BcDEx evaluation. Together, these aspects enhance BcDEx by lowering entry barriers, optimizing workflows, and supporting continuous improvement.*

Discussion

RQ1 - Distribution and nature

Takeaway

Academic research lags industry engagement, creating **opportunity for academic exploration**.

RQ2 - Categories of practical sources

Takeaway

Practical tools for enhancing BcDEx are available and supported by i**ndustry initiatives**, yet there remains considerable scope for further academic study to **validate these contributions systematically**. The community could establish more **robust BcDEx practices** by combining **industry-driven innovation** with academic rigor.

RQ3 - Sources shaping BcDEx

Takeaway

BcDEx has a dual impact, affecting both technical **productivity and developer satisfaction**. Recognizing and addressing these dimensions is relevant for improving **developer retention** and **fostering sustainable** project communities. Developing standardized methods for evaluating BcDEx could enable more **objective and consistent assessment**.

Threats to Validity

Study inclusion/exclusion bias

Threat:

- Scarcity of relevant studies in white literature

Mitigations:

- Included grey literature sources with snowballing techniques
- Conducted pilot search for terminological variations

Researcher bias and Repeatability

Threats:

- Qualitative coding limited to textual content
- Feature extraction limited to main product pages

Mitigations:

- Used quality assessment framework
- Second reviewer validation of data

Robustness of classification

Threats:

- No standardized definition of "developer experience"
- Grey literature lacks rigorous peer review

Mitigation:

- Adopted Fagerholm and Münch's framework [14] for technical aspects, emotional responses, and value perception

Future Works

Future work should complement this direction by focusing on developing **best practices for BcDEx**.

Establishing **effective frameworks** for its **evaluation**.

Apply **empirical studies** to capture **individual developers' personal experiences** and perceptions directly.

Summary

Research Questions (RQs)

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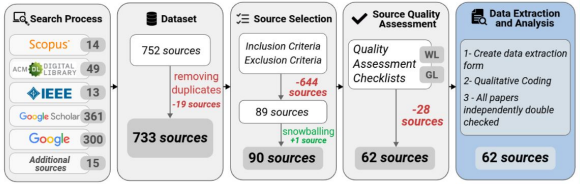

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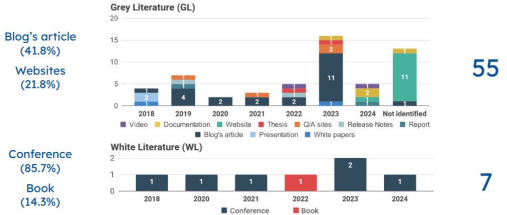

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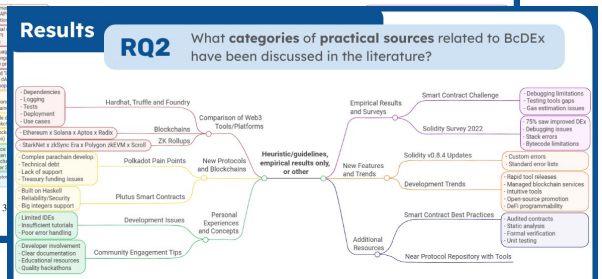

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Questions?

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