Enhancing Data Storytelling: A Conceptual Framework

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Abstract

In an era of rapid technological advancements and constant innovation, businesses must continually adapt their processes to maintain efficiency and competitive advantage. Business Intelligence and Analytics (BI&A) have become critical tools in this adaptation, aiding organizations in refining decision-making processes and extracting actionable insights. Within this context, data storytelling emerges as an important factor, necessitating a thorough conceptualization to enhance its application. This paper reviews the current state of data storytelling within BI&A, exploring its multifaceted nature to propose a framework and future areas for research that incorporate data-centric and user-centric elements. By enhancing the definition and application of data storytelling, it aims to support organizations in their data-driven decision-making processes.

Keywords: Data storytelling, business intelligence & analytics, literature review, decision making

1. Introduction

In today's data-driven environment, where organizations continuously collect and manage vast amounts of data, data storytelling has become increasingly important (Ramm et al., 2021). This process supports business users in managing, translating, and interpreting complex data, transforming insights into actionable decisions (Boldosova & Luoto, 2019). Indeed, studies have shown that there is a direct link between the concept of data storytelling and business performance (Daradkeh, 2021). More specifically, data storytelling facilitates comprehension and makes the information more understandable (Chen et al., 2020; Herschel and Clements, 2017).

Despite its importance, data storytelling poses significant challenges due to the complexity of the information being conveyed and the varied nature of the audiences (Bai et al., 2015; Boldosova, 2019). These challenges stress inquiries regarding how organizations can leverage data to improve decision-making, particularly through the integration of data storytelling within the data analytics process (Abbasi et al., 2016).

While previous research has explored different phases of the data storytelling process (Oberascher et al., 2023), we aim to explore more closely how data storytelling and BI&A are intertwined. Additionally, there is a gap in understanding the key elements essential for a comprehensive grasp of the phenomenon. Therefore, this paper aims to provide a refined conceptualization of data storytelling within BI&A and answer the following research question: *What are the key dimensions of data storytelling?*

To address this question, this research adopts a scoping review methodology, particularly suited for disseminating findings on data storytelling within Information Systems (IS) literature (Pare et al., 2015). This will offer a detailed synthesis of existing research on data storytelling while proposing a framework for embedding data storytelling into various operational facets, from data management to analytical processes.

Hence, this paper enhances comprehension and identifies practical data storytelling applications for effective decision-making. Studying data storytelling in BI&A is expected to significantly contribute to the IS field and expand the broader knowledge of data storytelling. By elucidating the various elements of data storytelling, this research provides novel insights into designing and implementing user-centric data analytics to support decision-making.

The remainder of the paper is organized as follows: the next section presents a comprehensive overview of existing literature on data storytelling and business intelligence, followed by the research method, the discussion and future research contributions to the field, and the conclusion.

2. Research Background

2.1. Data Storytelling

Data storytelling has its roots in journalism, where it was used to create narratives from databases for public sharing (Chokki et al., 2022). It has evolved from 'traditional storytelling,' characterized by in-person, persuasive oral narratives (Weissenfeld et al., 2017), into various forms, including digital and data storytelling. Digital storytelling uses multimedia tools

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like audio, video, images, and animations (Weissenfeld et al., 2017). It includes sub-categories such as transmedia storytelling, which integrates fiction into its narratives (Jenkins et al., 2016), and cross-media storytelling, which disseminates content across multiple media channels (Dena, 2016).

Data storytelling involves preparing and presenting insights from data analysis to an audience, telling a story grounded in data (Zhang & Lugmayr, 2019). It has been described with three phases: exploring data, making a story, and telling a story (Amini et al., 2018). It is an iterative process requiring both technical and business knowledge (Lee et al., 2015).

Multiple definitions have been proposed in the literature. Some authors define data storytelling as crafting narratives using data, emphasizing story communication (Chokki et al., 2020; Ojo & Heravi, 2018), while others focus on using visualizations to communicate results (Herschel & Clements, 2017). These approaches enhance the audience's understanding by providing context and increasing insights (Boy et al., 2015). However, it was noted that data storytelling lacks standardized definitions and measurement methods, leading to inconsistencies regarding its role in BI&A (Daradkeh, 2021). The absence of a conceptualization representing the value of the concept leads to mixed results and creates a fragmented understanding in academia, reducing research credibility and hindering future studies. Therefore, it is crucial to identify the key elements of the data storytelling process and provide a clearer conceptualization within BI&A.

2.2. Business Intelligence & Analytics

Business Intelligence (BI) involves transforming data into information and subsequently into knowledge to improve decision-making processes (Popovič et al., 2012). While BI focuses on past and present data, Business Analytics (BA) predominantly uses historical data to forecast future trends (Niu et al., 2021). BI and BA (B&A) enable the ability to leverage data to extract actionable insights. They have fostered the development of various technologies, tools, and processes to assist organizations in making better decisions and effectively communicating data insights (Chen et al., 2012). A common feature is using dashboards for visualizations of the analytic practices.

BI&A situates our literature review within a business context, emphasizing the important role of data as it is transformed into actionable insights. It involves data management, interpretation, and subsequent action, stressing the need for a deeper examination of analytic processes within organizations (Abbasi et al., 2016).

3. Research Method

This research adopts a scoping review approach to facilitate an in-depth examination of the subject, enabling conclusions to be drawn from existing academic research findings. To ensure that this review is conducted appropriately, the scoping review stages from Arksey and O'Malley (2005) were adapted to structure the study. Table 1 shows an overview of the different stages adopted.

Conducting a scoping literature review
Stage 1: identifying the research question
Stage 2: identifying relevant studies
Stage 3: study the selection
Stage 4: charting the data
Stage 5: collating, summarizing, and reporting the results

Table 1. Stages of the literature review

Stage 1: Identifying the Research Question

A prior lecture on data storytelling in BI&A was established to gain adequate knowledge on the topic. Throughout the lectures, potential research gaps were identified and deemed substantial for further investigation. Following this discovery, the research question was formulated. Our literature review focuses on data storytelling in BI&A. This review explored how data storytelling can be customized and applied in diverse domains to enhance decision-making processes. As the use of data increases daily, especially due to digitalization, it is essential to study its applications across different sectors and fields (Baesens et al., 2016).

Stage 2: Identifying Relevant Studies

To identify relevant studies, we focused on data storytelling and BI&A. The main keywords utilized were as follows: the concept of 'data storytelling' captured the phenomena of interpreting and sharing insights derived from data. The concept of 'business intelligence & analytics' positioned data storytelling within the realms of using data to increase efficiency and support organizational decision-making. To streamline the articles for this study, an additional concept of 'decision-making' was used to find studies that use data to act within their environment.

Substitutes for the main keywords were utilized to maximize the findings. To encapsulate aspects of data storytelling, we used storytelling, story, data narrative, data communication, data dissemination, dashboard, reporting, visualization, insight, leveraging data, data consumption, and data translation. To qualify the aspects of business intelligence, we used big data, analytics, business intelligence, decision-making, decision-making quality, data-driven decisions, and data analytics performance. To characterize 'decision-

making,' we used decision-making quality, data-driven decision, and data analytics performance.

Subject	Data storytelling in a business intelligence & analytics context
Research questions	What are the key dimensions of data storytelling?
Dates	From January 2000 to April 2024
Databanks	ABI/INFORM, Business Source Complete, AIS eLibrary
Search Criteria	Abstract, title, peer-reviewed, full text, English language, IS journals, conference papers in AIS library
Keywords (Data Storyte-lling)	storytelling, story, storytelling, data narrative, data communication, data dissemination, dashboard, reporting, visualization, insight, leveraging data, data consumption, data translation
Keywords (BI&A)	big data, analytics, business intelligence, decision-making, decision-making quality, data-driven decision, data analytics performance
Inclusion Criteria	(1) Subject must be about data storytelling (2) Storytelling within BI & Analytics

Table 2. Review protocol summary

We focused on three electronic databases for the article search—ABI/INFORM, Business Source Complete, and AIS eLibrary. ABI/INFORM was chosen for its comprehensive business sector database, and Business Source Complete was also selected to maximize the findings of scholarly business research. Within these databases, we concentrated on 11 renowned IS journals. Additionally, the AIS eLibrary was utilized to access conference papers in the IS field. The scope of our review was confined to full research papers and work-in-progress articles, all in English, peer-reviewed, and published between 2000 and 2024 inclusively. Our keyword search targeted abstracts and keywords, deliberately excluding full-text searches.

Stage 3: Study Selection

Our database queries are presented in Table 3. The three databases yielded 132 articles: 45 from the AIS eLibrary, 17 from Business Source Complete, and 12 from the ABI/INFORM database. A backward and forward search was also conducted, which added 58 articles; however, the forward search did not contribute any additional findings. In total, 24 duplicates were identified and removed from the original set. After this, 108 articles were screened based on their abstracts to assess relevance to the topic, resulting in the removal of 18 articles.

The remaining 90 articles were read in full and evaluated against the inclusion criteria to ensure they were suitable for the study. Following this screening, 62 articles were discarded, resulting in 28 articles.

Filtering Stage		Articles Count	
Database extract: 137			
AIS eLibrary: 45	Business Source Complete: 22	ABI/Inform: 12	Forward & Backward search: 58
Duplicate removal: 24			
Abstract reading: 108			
Full article reading: 90			
Inclusion criteria screening: 62			
Final article selection: 28			

Table 3. Article filtering process

Stages 4 & 5: Study Selection & Charting of the Data

The bibliometric analysis is based on two criteria: the journal distribution and publication year and the article type. The distribution by publication year is shown in Figure 1. Notably, publications peaked in 2015 for "Backward Search" articles, which accounted for four articles, signifying a heightened interest in data storytelling methodologies within that year.
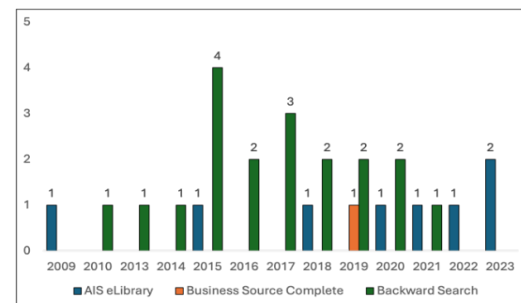

Figure 1. Number of articles per year

AIS eLibrary contributions were more evenly distributed over the years, with a slight increase in recent years, reflecting an ongoing engagement with data storytelling topics in academic research. The distribution highlights specific years where scholarly attention on data storytelling in business intelligence and analytics was particularly pronounced, underscoring the evolving nature of this research area. We can say that the topic of data storytelling is recent, as few papers were published before 2014.

4. Findings

4.1 Data Storytelling Conceptualization

Data storytelling has been approached both as a process and as a state in literature. To understand its conceptualization, we not only considered how authors define the term but also examined other essential elements of the process. The literature revealed a lack of uniformity, both in how the concept is defined and in how the process is understood.

Many of the articles that propose a framework fail to provide a clear definition of data storytelling. This lack of clarity extends beyond the framework proposals to other articles in our inclusion criteria. Authors sometimes use existing definitions within the articles selected, while others omit any explicit definition altogether. As shown in Table 4, this inconsistency contributes to the overall ambiguity surrounding the concept.

Authors	Definition	User-Centric Elements	Data-Centric Elements
Bai et al. (2015)	Storytelling is a natural way for people to present, interpret, and share information and knowledge.	audience	text, charts, images, interactive elements, narratives
Boldosova (2019)	This study defines 'deliberate storytelling' as the intentional use of stories or narratives spread by key organizational actors to other individuals in an organization for the achievement of specific organizational goals and outcomes.	manager, storyteller, audience	text, images, narratives
Boldosova & Luoto (2019)	Data storytelling is seen as a novel method of interpreting patterns and trends for improved decision-making.	sales analysts, company experts, business practitioners	text, charts, images, interactive elements, narratives
Boldosova (2020)	Storytelling is seen as a collective sensemaking and sense-giving process that occurs in interactions between customers and suppliers in which both parties contribute to the story development.	data scientists, data translators, sales professionals, clients, potential customers	text, charts, images, interactive elements, narratives
Boy et al. (2015)	Storytelling is seen as an aid to increase user engagement.	visualization designers, data journalists, public	text, narratives
Chen et al. (2020)	Storytelling is viewed as the design of a presentation of prepared content to be shown to an audience as storytelling.	analysts, public, business stakeholders	text, charts, images, interactive elements, narratives
Chokki et al. (2022)	Data storytelling is viewed as a process of translating data analysis into simple, logical stories that can be understood by a non-technical audience.	users with high/low data manipulation skills, data analysts, citizens, journalists	text, charts, interactive elements
Daradkeh (2021)	Data storytelling is seen as a way to effectively communicate analytical insights to support decision-making.	data analysts, data scientists, business analysts, decision-makers	text, charts, interactive elements, narratives
Echeverria et al. (2017)	Data storytelling is seen as a set of enhancements that could be applied to data visualizations to improve their communicative power.	educators, audience	text, charts, images, interactive elements, narratives
Elias et al. (2013)	Storytelling is seen as a means of passing on wisdom and culture.	bi analysts, decision makers, analysts, audience	text, charts, interactive elements, narratives
Figueiras (2014)	Storytelling is viewed as a way to convey information, cultural values, and experiences.	visualization creators, data journalists, audience	text, charts, images, interactive elements, narratives
Gagnon & Caya (2020)	Storytelling is seen as the creation of persuasive stories where analytical insights are organized as a guiding pathway, taking audiences to the source of data. It is a process seen to bring data to life to share a constructed narrative.	data scientists, business decision-makers, technical & non-technical audience	text, charts, images, interactive elements, narratives
Gunklach et al. (2023)	Data storytelling can be described as the process of preparing and presenting information appropriate to the target audience from the results of data analysis to motivate a decision.	analysts, data analysts, designers, business users	text, charts, images, interactive elements, narratives
Lee et al. (2015)	Storytelling is viewed as a process that involves transforming data into visually shared stories via three main components (exploring data, making a story, and telling a story).	data analyst, scripter, graphic designer, data journalist, general public	text, images, interactive elements, narratives
Ojo & Heravi (2018)	Data storytelling is seen as a structured approach comprising data, visuals, and narratives to communicate insights	data journalists, general public/specific group	text, charts, images, interactive elements
Ramm et al. (2021)	Storytelling is defined as a method of conveying information that facilitates the acquisition of insights and knowledge	analysts, scripters, editors, story creators, data scientists, audience	text, charts, images, interactive elements, narratives
Rodríguez et al. (2015)	They refer to storytelling as a process that allows us to pass experiences from human to human through many media: oral tradition, the printed word, visual images, radio, cinema, and television.	data journalists, general public	text, charts, images, interactive elements, narratives
Wende & Haghirian (2009)	Storytelling is viewed as a method to create meaning and understanding, serving as a useful tool for capturing the valuable tacit knowledge of organization members	project managers, developers, senior management, business users	text, charts, images, interactive elements, narratives

Table 4. Final list of selected articles providing "Data Storytelling" or "Storytelling" definition

Table 5 presents the list of papers without a clear definition but are essentially aligned with data storytelling in B&A context.

Authors	Definition	User-Centric Elements	Data-Centric Elements
Gutiérrez & Pérez (2016)	No definition is provided; however, it views it as a technique to improve the perception and interpretation of data.	data visualization experts, business users	text, charts, images, interactive elements, narrative
Herschel & Clements (2017)	No definition is provided; however, it is seen to provide the fundamental mechanism for putting data analysis in a meaningful context so that it can effectively inform decision-makers	analysts, decision-makers	text, charts, images, interactive elements
Lee et al. (2015)	Storytelling is viewed as a process that involves transforming data into visually shared stories via three main components (exploring data, making a story, and telling a story).	data analyst, scripter, graphic designer, data journalist, general public	text, images, interactive elements, narratives
Lin et al. (2018)	No definition is provided; however, storytelling is seen as a means to create compelling dashboard designs.	non-expert users, health care professionals, and managers	text, charts, images, interactive elements, narratives
Marjanovic (2016)	No definition is provided, however, storytelling is using visual stories as tools to help share knowledge and develop skills in exploring visual data.	data scientist, IT professionals	textual data, interactive elements
Segel & Heer (2010)	No definition is provided, however, this study views data as a means to convey information through a sequence of causally related events.	visualization designers, analysts, journalists, general public	text, charts, images, interactive elements, narratives
Tong et al. (2018)	No definition was provided; however, storytelling is viewed as a way of conveying information.	analysts, general audience	text, charts, images, interactive elements
Wang & Santhanam (2015)	No definition is provided, however, this study views storytelling as an interactive means that can influence an audience.	general public	narratives, interactive elements
Watson (2017)	No definition is provided; however, storytelling is viewed as a way to communicate a message by using visualizations.	bi or business analysts, data scientists, business managers	text, charts, images, interactive elements, narratives
Xu et al. (2023)	No definition is provided; however, data storytelling is seen as a means to facilitate data comprehension.	business analysts, data scientists, data managers, users, decision-makers	text, charts, images, interactive elements, narratives
Zhang & Lugmayr (2019)	No definition is provided; however, data storytelling is viewed as telling a story grounded in data.	visualization designers, general audience	text, charts, images, interactive elements, narratives

Table 5. Final list of selected articles providing elements of "Data Storytelling" or "Storytelling" without a definition

Furthermore, only few authors have attempted to conceptualize data storytelling, as shown in Table 6. There is inconsistency among these proposed conceptualizations, with the most apparent differences being in how the structure of the data storytelling process is viewed. For instance, while Lee et al. (2015) propose a framework consisting of three phases, Gutiérrez & Pérez (2016) view the process as having four stages. These discrepancies in conceptual frameworks indicate a lack of concordance within the field.

Additionally, our analysis reveals that several key elements of data storytelling are underemphasized in the literature. While some papers outline different types of elements necessary for identification in the literature, their importance is often assumed rather than explicitly elaborated upon. These omissions raise concerns about the validity and practical applicability of current frameworks and definitions within the literature. For a framework to be effectively adopted, it is essential to define its elements in detail and validate its robustness.

Authors	Conceptualization of data storytelling
Chokki et al. (2022)	Data storytelling as being composed of 6 stages: seeking answers, data collection, data processing, data visualization, story creation, and feedback collection. Data-centric or user-centric elements are not emphasized.
Gutiérrez & Pérez (2016)	Data storytelling includes a framework with 4 stages: explore and gain insight, create a story, share a story, and understand. Data-centric or user-centric elements are not emphasized.
Lee et al. (2015)	Data storytelling as comprised of 3 phases: data exploration, making a story, and telling a story. This framework emphasizes user-centric elements such as the presence of the audience, a 'scripter', the editor, and the presenter.
Zhang & Lugmayr (2019)	Data storytelling is oriented toward a user-centered view. There are no phases in the framework. It presents items such as data, story, visuals, and audience. It presents user-centric elements such as the presence of the audience, but no data-centric elements.

Table 6. Previous Conceptualization

Following the understanding of how data storytelling has been conceptualized, we analyzed the articles to understand the mechanisms of the data storytelling process. Previous research has highlighted the aim of using data storytelling, but it is also important to examine how the process itself works.

Lee et al. (2015) describe the storytelling process as comprising three stages: data exploration, making a story, and telling a story. Only 4 articles referred to these three stages of the data storytelling process (Chokki et al., 2022; Gutiérrez & Pérez 2016; Lee et al., 2015; Zhang & Lugmayr, 2019). The remaining articles focused either on making and/or telling a story phase. While these articles did not explicitly categorize themselves in these stages, their content indicated this focus.

The 'making a story' stage involves creating data stories, often visualizations or crafted narratives intended for public viewing. The 'telling a story' stage pertains to disseminating these stories or analyses to an audience.

4.2 Data-Centric Elements

The literature on data storytelling consistently identifies key characteristics of effective data stories, particularly the use of textual elements, charts, images, interactivity, and narratives (Bai et al., 2015; Daradkeh, 2021). Textual content is the core component in constructing and conveying complex data-driven stories (Elias et al., 2013; Lee et al., 2015), bridging the gap between raw data and audience comprehension. Indeed, textual elements provide context and coherence, they are seen to make complex information accessible (Boldosova, 2019) and relatable, thus enhancing audience engagement and actionability.

Another data-centric element found in the literature is the use of narratives in data storytelling. This technique makes complex data more comprehensible and engaging, and it is shared with an audience to capture their attention (Wende & Haghirian, 2009). Visual narratives have also been identified as an important feature to communicate insights (Marjanovic, 2016). Literature shows that items, such as textual elements, can be embedded in narratives (Rodríguez et al., 2015) and can be supported by visualization (Watson, 2017). Narratives are essential to the storytelling process, and it is recommended that they be molded and placed strategically according to visualization users (Figueiras, 2014).

Charts and images are prevalently utilized to visualize data trends and patterns effectively, supporting textual narratives by providing visual affirmations of discussed phenomena. Organizations use charts to visualize insights (Gunklach et al., 2023).

Interactive elements frequently deepen audience engagement, allowing dynamic data exploration, which is crucial for comprehensive understanding (Chen et al., 2020) and engagement (Segel & Heer, 2010). The consistent incorporation of these elements across studies emphasizes their effectiveness in enhancing the storytelling experience (Ojo & Heravi, 2018).

4.4 User-Centric Elements

Three types of stakeholders were identified in the process: data experts, storytellers, and the audience.

4.4.1 Data expert. Within the data storytelling process, a clear pattern emerges regarding the involvement of individuals with technical skills. These individuals, often responsible for creating dashboards, presentations, and other supporting materials, play a crucial role in integrating data into the analytics process (Gutiérrez & Pérez, 2016; Watson, 2017). The literature consistently recognizes data experts as specialists skilled in data manipulation and visualization (Chokki & Frenay, 2022; Chen et al., 2020). For instance, during the story creation phase, these experts must effectively interact with and customize dashboards (Lee et al., 2015), a necessity supported by numerous authors (Ramm et al., 2021; Tong et al., 2018; Ojo & Heravi, 2018; Wende & Haghirian, 2009).

Data experts are identified in various ways across studies. Tong et al. (2018) describe them as analysts who design and implement visualization tools, while Herschel and Clements (2017) refer to them as specialists using BI tools to create visualizations. Additionally, Zhang and Lugmayr (2019) highlight their role as visualization designers focused on user-centered storytelling. Lin et al. (2018) note that while technical capabilities are essential, other skill sets are also valuable at this stage.

Interestingly, Chokki et al. (2022) emphasize the inclusivity of data visualization tools, which cater to both technical and non-technical users. This allows a broader range of individuals to engage in data-driven activities, particularly during the story-making phase. Adopting self-service business intelligence tools challenges the assumption that traditional technical skills are always necessary for data storytelling (Xu et al., 2023), enabling individuals with non-technical backgrounds to engage with data visualizations actively and enhance their understanding over time.

Moreover, data experts encompass various roles beyond the technical realm. For example, educators

use storytelling to enhance learning (Echeverria et al., 2017), and journalists (referred to as scripters) create stories for public sharing (Lee et al., 2015). IT professionals also utilize data storytelling for knowledge transfer. While technical skill sets are frequently emphasized, these examples show that a diverse range of individuals can be considered data experts.

Overall, the data expert's involvement in the 'making a story' phase includes individuals with both technical and non-technical skills. Those with technical expertise manipulate data and manage its integration into the analytics process (Gutiérrez & Pérez, 2016; Watson, 2017). Various types of technical users contribute to creating stories in data storytelling. This highlights the relevance of skill sets in effectively implementing data storytelling.

4.4.2 Storytellers. Within the data storytelling process, particularly in the storytelling stage, the role of the storyteller is crucial for presenting the story to the audience (Ramm et al., 2021). The literature refers to this role in various terms. Watson (2017) describes these individuals as data interpreters who help explain visualizations during data storytelling. They can be analysts or data scientists with expertise in data. Similarly, Lee et al. (2015) refer to them as journalists, while Boldosova and Luoto (2019) identify them as experts with adequate business knowledge. A consistent point is that storytellers typically possess substantial knowledge of the topic around which the data storytelling revolves.

A storyteller can be a technical individual assigned additional tasks to share information with fellow business users (Watson, 2017). In studies using visualizations, data analysts often curate and present the data stories (Boy et al., 2015). IT professionals and project managers handle this task in business contexts for knowledge transfer (Wende & Haghirian, 2009). Other roles mentioned include data scientists and business analysts (Daradkeh, 2021), who take on this responsibility (Ramm et al., 2021; Segel & Heer, 2010).

The key trend is that storytellers usually have technical knowledge or expertise in data. This includes understanding the data, the business, and the audience to transfer knowledge effectively. For example, health educators or public officials share data stories in the health sector (Elias et al., 2013), and educators present information to students in the educational sector (Echeverria et al., 2017). Overall, storytellers must understand the organization, the available data, and, most importantly, the audience to transfer knowledge effectively. While the literature has not always explicitly discussed the utility of storytellers, it demonstrates their essential role in the process. This observation highlights a gap in the current literature regarding the general definition and requirements of a storyteller necessary for effective data storytelling.

The storyteller's role is primarily located in the 'telling a story' stage. Despite the lack of consistent emphasis in the literature, various articles reflect the inclusion of this role in the process, showing a trend that storytellers typically have expertise with data. They are often referred to as analysts (Chen et al., 2020; Chokki & Frenay, 2022; Daradkeh, 2021; Elias et al., 2013; Gunklach et al., 2023; Herschel & Clements, 2017; Ramm et al., 2021) or data scientists (Ramm et al., 2021).

While many storytellers possess technical skills, others have non-technical knowledge. Technical knowledge involves understanding data and the business context to carry out tasks effectively. For example, in the educational sector, educators present information to their students (Echeverria et al., 2017), and in a sales context, storytellers can be sales professionals (Boldosova, 2020). The key takeaway is that the individual presenting the story must understand the organization, the data, and the audience to transfer knowledge effectively.

4.4.3 The audience. Another critical stakeholder consistently appearing in the literature is the audience (Gagnon & Caya, 2020). Research consistently indicates that data storytelling always has a target audience, whether explicitly mentioned or not. For instance, Bai et al. (2015) emphasize user-centered design in data storytelling, highlighting the importance of adapting visual content based on user feedback to enhance communication effectiveness.

We found that the type of audience varies depending on the context. In a business setting, the target audience often includes managers, analysts, and decision-makers (Gunklach et al., 2023; Gutiérrez & Pérez, 2016; Wende & Haghirian, 2009; Xu et al., 2023). When data storytelling is used for knowledge transfer within organizations, business users again form the primary audience (Wende & Haghirian, 2009). In educational contexts, students are the target audience, with data storytelling aimed at improving learning outcomes (Echeverria et al., 2017). For data storytelling directed at dashboard users within organizations, these users are considered the audience (Ojo & Heravi, 2018). In the health sector, the general public and medical experts are both the target audience, benefiting from visualized data storytelling (Lin et al., 2018; Wang & Santhanam, 2015).

While having a specific target group allows for tailored data storytelling, general audiences can also be recipients. For example, Boy et al. (2015) studied

individual engagement with data visualizations without a specific target audience, making the general public their audience. Similarly, Lee et al. (2015) discuss storytelling in journalism, referring to a general audience without specifying a target group. This demonstrates the flexibility of data storytelling to cater to both specific and general audiences.

5. Discussion

5.1 Framework and Future Research

The insights found from this review have contributed to proposing an enhanced conceptualization of data storytelling as well as future research areas. Through our analysis, we have uncovered elements within the data storytelling process. As shown in Figure 2, this framework posits that data storytelling is the *process of making and telling a story through which business data is transformed into meaningful insights, supported by user-centric elements and enhanced with data-centric elements that cater to the audience's specific needs.* To ensure the success of this process, the identified key elements must be present, as detailed in the subsequent section.

Within these phases, as seen in the framework, key elements have been identified within the process: user-centric and data-centric elements. The data-centric elements include charts, images, textual elements, narratives, and interactivity. These elements are likely to influence the making of a story phase to a different level. The literature consistently highlights the significance of integrating these various elements in data storytelling for creating effective data stories that engage audiences and enhance understanding. As data storytelling evolves, focusing on these characteristics will likely continue promoting more sophisticated and user-friendly approaches to conveying complex information. Therefore, a *second area* for future research could explore the various combinations of data-centric elements and how the importance of each element varies according to various factors. For example, it would be interesting to look at how elements vary based on the analytical tasks, the context, or the data expert.
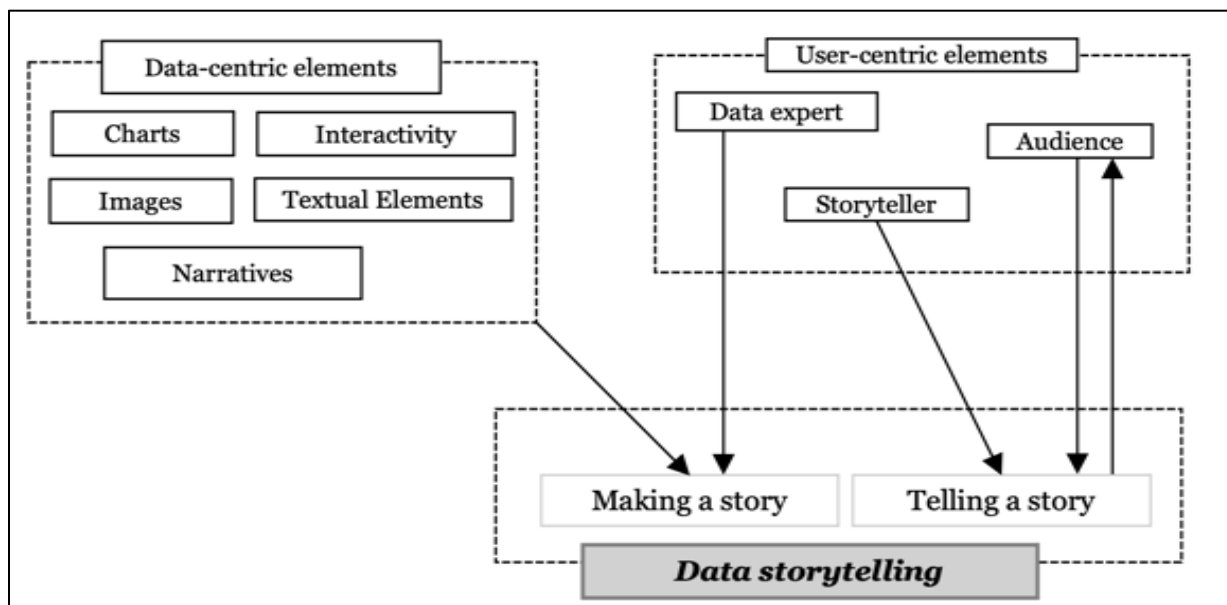

Figure 2. Data Storytelling Framework

The user-centric elements include three stakeholders identified in the process: the data expert, the storyteller, and the audience, each of which enters the process at different phases. Identifying the types of stakeholders involved in the data storytelling process is crucial, as their roles and contributions can significantly influence the process. Different stakeholders, such as data analysts, business managers, and end-users, play distinct roles in each phase of the data storytelling process. Thus, a *third area* for research could focus on recognizing these roles that help tailor the data storytelling process to meet the needs and expectations of the audience. This focused examination would contribute to a more nuanced understanding of how data storytelling can be strategically implemented to drive better organizational decision-making and communication.

Additionally, every article meeting our inclusion criteria emphasized the involvement of data experts. This significant observation underscores the necessity of identifying such individuals as stakeholders in the data storytelling process. While these data experts play a crucial role, it is important to note that the studies primarily focus on describing their responsibilities rather than highlighting their importance to the process.

A *fourth area* for future research is related to the audience. As shown in our framework, the audience influences and is influenced by the 'telling a story' phase, as it is the recipient of the data stories or narratives and can interact with the storyteller (Lin et al., 2018). However, the literature on data storytelling often overlooks the role of the audience, treating it as a given rather than a point of emphasis. More specifically, the audience is implicitly assumed to be a constant participant in the storytelling process, even though it is not explicitly addressed in all the studies.

This oversight might be explained by the inherent goals of data storytelling, which are typically focused on conveying specific objectives to an intended audience. Consequently, while critical, the inclusion of the audience is not extensively discussed, possibly because it is considered an obvious element of any storytelling process. Therefore, future research could investigate how the telling phase is adapted based on the audience. For example, it is argued that not all audiences are equal in their abilities to understand data analytics outputs and insights, which will necessitate different types of storytelling (Lee et al., 2015). People's willingness to embrace a data-driven approach to decision-making can vary extensively both within and across organizations (Phillips-Wren et al., 2015) Recognizing and understanding the audience is essential for the effectiveness of data storytelling, as it ensures that the message is appropriately conveyed and comprehended.

6. Conclusion

This paper sheds light on the complexities and nuances of data storytelling, providing a refined conceptualization that bridges theoretical and practical perspectives. As the field of data storytelling continues to evolve, our findings and proposed framework pave the way for further research and development, ultimately enhancing the effectiveness of data storytelling in BI&A. This study not only advances academic understanding but also offers valuable insights and practical tools for professionals, contributing to more informed and effective decision-making processes in a data-driven environment.

As it pertains to contributions, this paper advances the conceptualization of data storytelling through a comprehensive framework that integrates both data-centric and user-centric elements within the field of BI&A. By conducting a rigorous scoping review, this study not only identifies and addresses conceptual inconsistencies in the existing literature but also proposes a standardized framework that elucidates the stages and essential elements of data storytelling. This framework enhances the academic understanding of data storytelling by providing a structured approach to guide future research and empirical validation.

Moreover, the study contributes practically by offering BI&A practitioner's actionable insights and guidelines for effectively implementing data storytelling in organizational settings to enhance decision-making processes. By emphasizing the pivotal roles of data experts, storytellers, and the audience within the data storytelling process, this research promotes a more nuanced understanding of how these stakeholders interact and contribute to the effectiveness of data-driven narratives.

Furthermore, identifying underemphasized elements in current literature, such as the iterative nature of data storytelling and the varying importance of data-centric elements across different contexts, opens up new avenues for further exploration and empirical research. Overall, this paper serves as a foundational resource that not only enriches the academic discourse on data storytelling but also supports practitioners in leveraging data storytelling as a strategic tool for communication and decision support in diverse organizational contexts.

7. References

Abbasi, A., Sarker, S., & Chiang, R. (2016). Big Data Research in Information Systems: Toward an Inclusive Research Agenda. *Journal of the Association for Information Systems*, *17*(2), I–XXXII.

Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology*, *8*(1), 19–32.

Baesens, B., Bapna, R., Marsden, J. R., Vanthienen, J., & Zhao, J. L. (2016). Transformational Issues of Big Data and Analytics in Networked Business. *MIS Quarterly*, *40*(4), 807–818.

Bai, X., White, D., & Sundaram, D. (2015). Towards a Flexible User-Centred Visual Presentation Approach. *PACIS 2015 Proceedings, 10.*

Boldosova, V. (2020). Telling stories that sell: The role of storytelling and big data analytics in smart service sales. *Industrial Marketing Management*, *86*, 122–134.

Boldosova, V. (2019). Deliberate storytelling in big data analytics adoption. *Information Systems Journal*, 29(6), 1126–1152.

Boldosova, V., & Luoto, S. (2019). Storytelling, business analytics, and big data interpretation: Literature review and

theoretical propositions. *Management Research Review*, *43*(2), 204–222.

Boy, J., Detienne, F., & Fekete, J.-D. (2015). Storytelling in Information Visualizations: Does it Engage Users to Explore Data? *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, 1449–1458.

Chen, H., Chiang, R. H. L., & Storey, V. C. (2012). Business Intelligence and Analytics: From Big Data to Big Impact. *MIS Quarterly*, 36(4), 1165–1188.

Chen, S., Li, J., Andrienko, G., Andrienko, N., Wang, Y., Nguyen, P. H., & Turkay, C. (2020). Supporting Story Synthesis: Bridging the Gap between Visual Analytics and Storytelling. *IEEE Transactions on Visualization and Computer Graphics*, *26*(7), 2499–2516.

Chokki, A. P., Frenay, B., & Vanderose, B. (2022). Open Data Explorer: An End-to-end Tool for Data Storytelling using Open Data. *AMCIS 2022 Proceedings, 10*.

Daradkeh, M. K. (2021). An Empirical Examination of the Relationship Between Data Storytelling Competency and Business Performance: The Mediating Role of Decision-Making Quality. *Journal of Organizational and End User Computing*, *33*(5), 42–73.

Dena, C. (2004). The current state of cross media storytelling: Preliminary observations for future design. In *Proceedings of the European Information Systems Technologies, 15.*

Echeverria, V., Martinez-Maldonado, R., & Buckingham Shum, S. (2017). Towards data storytelling to support teaching and learning. *Proceedings of the 29th Australian Conference on Computer-Human Interaction*, 347–351.

Elias, M., Aufaure, M.-A., & Bezerianos, A. (2013). Storytelling in Visual Analytics Tools for Business Intelligence. *Human-Computer Interaction – INTERACT 2013,* 280-297.

Figueiras, A. (2014). Narrative Visualization: A Case Study of How to Incorporate Narrative Elements in Existing Visualizations. *2014 18th International Conference on Information Visualisation*, 46–52.

Gagnon, E., & Caya, O. (2020). Bridging the Gap between Insights and Action: The Role of Analytical Storytelling. *AMCIS 2020 Proceedings*, 11.

Gunklach, J., Jacob, K., & Michalczyk, S. (2023a). Beyond Dashboards? Designing Data Stories for Effective Use in Business Intelligence and Analytics. *ECIS 2023 Proceedings, 19.*

Gutiérrez, A., & Pérez, C. B. (2016). Data visualization process through storytelling technique in Business Intelligence. *Avances En Interacción Humano-Computadora*, *1*(1), 49–52.

Herschel, R. T., & Clements, N. (2017). The Importance of Storytelling in Business Intelligence: *International Journal of Business Intelligence Research*, *8*(1), 26–39.

Jenkins, H., Purushotma, R., Weigel, M., Clinton, K., & Robison, A. J. (2009). Confronting the challenges of participatory culture: Media education for the 21st century. *The MIT Press.* 70.

Lee, B., Riche, N. H., Isenberg, P., & Carpendale, S. (2015). More Than Telling a Story: Transforming Data into Visually Shared Stories. *IEEE Computer Graphics and Applications*, *35*(5), 84–90.

Liberatore, M. J., & Luo, W. (2010). The Analytics Movement: Implications for Operations Research. *Interfaces*, *40*(4), 313–324.

Lin, C.-Y., Liang, F.-W., Li, S.-T., & Lu, T.-H. (2018). 5S Dashboard Design Principles for Self-Service Business Intelligence Tool User. *Journal of Big Data Research*, *1*(1), 5–19.

Marjanovic, O. (2016). Empowering Business Users to Explore Visual Data Through Boundary Objects and Storytelling. *49th Hawaii International Conference on System Sciences*, 5032–5041.

Niu, Y., Ying, L., Yang, J., Bao, M., & Sivaparthipan, C. B. (2021). Organizational business intelligence and decision making using big data analytics. *Information Processing & Management*, 58(6).

Ojo, A., & Heravi, B. (2018). Patterns in Award Winning Data Storytelling: Story Types, Enabling Tools and Competences. *Digital Journalism*, *6*(6), 693–718.

Paré, G., Trudel, M.-C., Jaana, M., & Kitsiou, S. (2015). Synthesizing information systems knowledge: A typology of literature reviews. *Information & Management*, *52*(2), 183–199.

Phillips-Wren, G., Iyer, L. S., Kulkarni, U., & Ariyachandra, T. (2015). Business analytics in the context of big data: A roadmap for research. *Communications of the Association for Information Systems*, 37, 448-472.

Popovič, A., Hackney, R., Coelho, P. S., & Jaklič, J. (2012). Towards business intelligence systems success: Effects of maturity and culture on analytical decision making. *Decision Support Systems*, *54*(1), 729–739.

Ramm, S., Kopf, E.-M., Dinter, B., & Hönigsberg, S. (2021). What Makes a Good Story—The Use and Acceptance of Storytelling in Business Intelligence. *Proceedings of the 54th Hawaii International Conference on System Sciences,* 5706-5715.

Rodríguez, M. T., Nunes, S., & Devezas, T. (2015). Telling Stories with Data Visualization. *Proceedings of the 2015 Workshop on Narrative & Hypertext - NHT '15*, 7–11.

Segel, E., & Heer, J. (2010). Narrative Visualization: Telling Stories with Data. *IEEE Transactions on Visualization and Computer Graphics*, *16*(6), 1139–1148.

Tong, C., Roberts, R., Borgo, R., Walton, S., Laramee, R., Wegba, K., Lu, A., Wang, Y., Qu, H., Luo, Q., & Ma, X. (2018). Storytelling and Visualization: An Extended Survey. *Information*, *9*(3), 65.

Wang, D., & Santhanam, R. (2015). Visual Storytelling: Impact of Data visualization on citizens' health behaviours. *MWAIS 2015 Proceedings,5.*

Watson, H. J. (2014). Data visualization, data interpreters, and storytelling. Communications of the Association for Information Systems, 34(1), 40-48.

Weissenfeld, K., Abramova, O., & Krasnova, H. (2017). Understanding storytelling in the context of information systems, *AMCIS 2017 Proceedings,* 10.

Wende, E., & Haghirian, P. (2009) Storytelling as a tool for knowledge transfer in the IT industry. *ECIS 2009 Proceedings,* 12.

Xu, J., Naseer, H., Maynard, S. B., & Filippou, J. (2023). Managing and Making Sense of Data to Drive Digital Transformation: A Case Study. *ICIS 2023 Proceedings*, 17.

Zhang, Y., & Lugmayr, A. (2019). Designing a User-Centered Interactive Data-Storytelling Framework. *Proceedings of the 31st Australian Conference on Human-Computer-Interaction*, 428–432.