1 Introduction

1.1 Motivation and problem set

Since the publication of the so called Bitcoin whitepaper by an unknown person or group of people using the pseudonym Satoshi Nakamoto, distributed ledger technology (DLT) gained a lot of attention within the past decade (Nakamoto, 2008).[1] Apart from cryptocurrencies, different fields of application are being researched and implemented across various industries (Heines and Gürpinar, 2021, p.98). Despite a promising outlook, to date there are still several challenges the technology faces: apart from technical scalability or discussions around energy-efficiency regarding certain consensus mechanisms, governance challenges are of utmost importance to overcome to foster application of DLT (Zachariadis et al., 2019, pp.2-3). DLT governance can be understood "as the means of achieving the direction, control, and coordination of stakeholders within the context of a given blockchain project to which they jointly contribute" (Pelt et al., 2021, p.21). It should be noted that governance issues are not only prevalent in the field of cryptocurrency networks, but also in the area of enterprise solutions, as will be shown below. The motivation and problem statement of the thesis are based on the following input:

1. Industry observation
The conducted research took place from April 2019 to December 2022. During this period the researcher was employed in two different research and development departments at a global operating logistics company. Within several joint research projects (see chapter 6), hurdles of applying DLT to enterprise use cases were identified as being less of a technical nature, but rather result from a lack of knowledge regarding sophisticated governance development approaches in an inter-organizational DLT context. This observation in practice, confirmed the topic to be of relevance and was the main motivation for the research conducted.

2. Grey literature
The observation described beforehand was supported by several grey literature publications, studies and surveys conducted by different institutions or consulting companies. For instance, the European Union Blockchain Observatory and Forum published a thematic report and highlighted the importance to address governance challenges for successful enterprise DLT solutions (Lyons, 2020, pp.17-22). The German Federal Ministry for Economic Affairs and

[1] Note that although the terms 'blockchain' and 'distributed ledger technology' are often used interchangeably, blockchain technology is a specific type of distributed ledger technology, which stores data in a cryptographically connected chain of blocks, whereas other forms of distributed ledger technology may apply other ways of storing data (Fertig and Schütz, 2019, p.27).

Energy published a so called Blockchain Strategy and funded respective research on DLT governance in the logistics sector (German-Federal-Ministry-for Economic-Affairs/Energy, 2019, p.11). The consulting company Capgemini published a report and called governance the weakest field regarding DLT enterprise adoption (Sudhir, 2018, p.6). Other examples highlighting the importance of governance for DLT enterprise solutions are the Global Enterprise Blockchain Benchmarking Study published by the Cambridge Centre for Alternative Finance (Rauchs et al., 2019, p.40) or a report on asset tokenisation published by the Organisation for Economic Co-operation and Development OECD (OECD, 2022, p.19). Despite the emphasis on the importance of the topic and the need for research, these reports lack recommendations for practitioners on how to build a respective governance for enterprise DLT solutions.

3. Academic literature

As will be shown later on by means of a systematic literature review, and similar to grey literature, academic literature points out research questions on how successful governance with regard to DLT-based enterprise solutions can be achieved (e.g., Rikken et al. (2021, p.80), Lacity (2018, p.202) or Beck et al. (2018, p.30)). However, it remains unclear how a step-by-step approach for the development of a governance for DLT-based enterprise solutions could look like (Brüning et al., 2022). It also remains unanswered which lessons learned can be transferred from other types of governance (e.g., IT governance or platform governance) (Ziolkowski et al., 2018, p.2).

4. Expert interviews

Last but not least, the topic of governance for enterprise DLT solutions was confirmed to be of importance by several (industry) experts, who were interviewed in the context of the conducted research. The following quotation is an exemplary extract from one of the interviews:

"So, I came to governance not because I started that way, but I came to governance because my artifact failed to launch. And that was one of my key learnings was, this stuff is hard. The technology was not actually the hard bit, it was really, governance is, is coined loosely to mean, you have got a lot of different people with different agendas. They have to make decisions together and they do not like it" (I 29, Pos. 18).

1.2 Research questions and goals

Following the previously described problem statement, the thesis aims to answer the overarching research question (RQ):

RQ: How can a governance for enterprise DLT solutions be developed?

This research question is divided into the following three subordinate research questions:

Before the question of a development process can be addressed, relevant components for enterprise DLT solution governance have to be identified first. Therefore, research question one asks:

RQ1: Which components have to be considered in terms of enterprise DLT solution governance?
In addition, it is of interest which design principles should be considered during governance development. "Design principles capture the knowledge gained about the process of building solutions for a given domain, and encompass knowledge about creating other instances that belong to this class" (Sein et al., 2011, p.45). Therefore, research question two is as follows:
RQ2: What are design principles of governance development for enterprise DLT solutions?
After the questions regarding components and design principles to be considered are answered, it is of interest how the different elements can be used within a systematic process, which guides practitioners and researchers during the development process itself. Thus, research question three asks:
RQ3: How can the development of a governance for enterprise DLT solutions be systematically supported?

As can be seen from the research questions, the thesis does not aim to develop a universally valid governance for enterprise DLT solutions. As various authors have already pointed out, not only with regard to IT governance, but also regarding DLT governance, it is not possible to develop a governance valid for every use case due to many dependencies (e.g., De Haes and Van Grembergen (2020, p.12), Atzori (2017, p.63) or Rikken et al. (2021, p.80)). In contrast, the thesis pursues the following goals for a specific context and project type:

1. The thesis aims to identify relevant **components** of a governance for enterprise DLT solutions.

2. The thesis aims to develop **design principles** to be considered for the process of governance development and for the artifact itself.

3. The thesis aims to develop a **method**, which provides systematic support for the process of governance development for enterprise DLT solutions.

Referring to the above-stated research questions and goals, it should be mentioned that partial results of this research have already been published by means of four different publications. These will be indicated within the respective chapters of the thesis and are briefly summarized below:

1. The first contribution contains the results of the conducted systematic literature review. It was presented at the 2021 online conference of the International Purchasing and Supply Education and Research Association (IPSERA). (Schwarzer (2021))

2. The second contribution was part of a joint research endeavor and discusses the topic of governance as one current and future research topic with regard to DLT in supply chain management. The publication was released as part of a lecture notes book series. (Gürpinar et al. (2022))

3. The third contribution deals with the question whether or not to join an enterprise DLT consortium. Here, governance is seen as one out five relevant evaluation dimensions from the perspective of an enterprise considering to participate in such already existing projects. (Schwarzer et al. (2022))

4. The fourth contribution is linked to one of the validation steps conducted (see chapter 8), as it describes a certain research project in the field of electronic transport documents for dangerous goods road transportation (Nikelowski et al. (2023)).

1.3 Scientific context

Referring to the above mentioned research questions, the goal of the thesis can be expressed in other words by stating that it is about "the development and communication of knowledge concerning both the management of information technology and the use of information technology for managerial and organizational purposes" (Zmud, 1995, p.xxi). This in turn is characteristic for **Information Systems (IS) Research** (Lee, 1999, p.xxxix). The IS research field "lies at the intersection of the interactions between the social and the technological" (Lee, 1999, p.xl). It is considered an applied research discipline (Peffers et al., 2006, p.84) and in the context of descriptive research it draws on theories from natural sciences and social sciences (Purao (2002, p.3), Peffers et al. (2006, p.84)). Ulrich and Hill (1976) describe the main goal of applied sciences, e.g., engineering or social sciences, being initiated by practical research interest and analyzing decision and action alternatives for human beings (Ulrich and Hill, 1976, p.305). But engineering and also other disciplines are not only interested in analyzing decision and action alternatives, but also in creating and designing artifacts, which was first argued by Simon (1969) in his book with the title 'The sciences of the artificial'. Design science (DS) originated from this perspective of artificial sciences, as it aims "to create things that serve human purposes" (March and Smith, 1995, p.253). Contrary to DS, natural sciences focus on the description and explanation of observed phenomena and social sciences deal with the exploration and description of human beings and actions (Dresch et al., 2015, p.1119). Table 1.1 provides an overview about main differences between these three approaches.

Table 1.1: Natural sciences, social sciences and design science

Characteristic	Natural Sciences	Social Sciences	Design Science
Areas or fields of study	Physics, chemistry, biology	Anthropology, economics, politics, sociology, history	Medicine, engineering, management
Scientific purposes	Description, explanation and justification of complex phenomena	Description and analysis of decision and action alternatives (human being and its actions)	Design and production of systems (Modification of existing situations). Practice-inspired problem solving.
Research goals	Explore, describe, explain and predict when possible	Explore, describe, explain and predict when possible	Design and prescribe. Research is oriented to problem solving

Source: Own table based on Dresch et al. (2015, p.1119) and Ulrich and Hill (1976, p.305)

DS together with natural (behavioral) science are denoted the two different main research paradigms of IS research, as "artificial phenomena can be both created and studied"

(March and Smith, 1995, p.253).[2] The two paradigms differ with regard to origin, underlying paradigm, research goals and objects studied / created, as shown in table 1.2.

Table 1.2: Design science research paradigms

Characteristic	Behavioral Science Research	Design Science Research
Origin	Natural science	Engineering, sciences of the artificial
Research paradigm	Problem understanding	Problem solving
Research goals	Development and justification of theories explaining or predicting organizational and human phenomena surrounding the analysis, design, implementation, management, and use of information systems.	Creation of innovations defining ideas, practices, technical capabilities, and products for an effective and efficient analysis, design, implementation, management, and use of information systems
Objects studied / created	Human-computer-interaction	IT artifact design

Source: Own table based on Stahl (2009, p.121), Hevner et al. (2004, p.76) and March and Smith (1995, p.253-255)

The thesis, with its practice-inspired research goal of artifact design (method and design principles), is located in the applied research field of IS, following the DS research paradigm. Subsequent chapters, i.e., chapter 3, 4 and 5 will draw on respective perspectives and methods to answer the main research questions. The next section will outline the structure of the thesis.

1.4 Structure of the thesis

The first chapter of the thesis describes the motivation and problem set, the research questions and goals, as well as the scientific context of the thesis. In chapter two, research-related topics, terms and concepts relevant for understanding subsequent chapters are introduced. These include: DLT, information technology (IT) governance and DLT governance. Chapter three discusses related literature and summarizes the conducted systematic literature review. Chapter four explains relevant theories for answering the above stated research questions and shows how the thesis makes a theoretical contribution. Chapter five illustrates the underlying research methods, which are applied for the development of the method and design principles. Chapter six describes the process of method and design principle construction in detail. Chapter seven contains the developed artifacts and chapter eight outlines the conducted practical validation steps together with the involved industry partner in the field of electronic transport documents. Chapter nine provides a critical appraisal of the conducted research and respective results, as well as a summary and an outlook with regard to future research.

[2] see also Hevner et al. (2004, p.76)