
# Structuration analysis of collaboration in Big Data Analytics work practices in organizations.

A Masters Dissertation presented to the

Department of Information Systems

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by

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in partial fulfilment of the requirements for the course

Information Systems Masters

(INF5005W)

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It took a lot of hard work and dedication for me to earn this degree, and it's a tribute to the efforts of my wife, my family, my friends, and the mentors who supported me. Thank you so much for your support; You've given me a lot of inspiration, and I thank God for you.

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## Abstract

**Background**: Big Data's emergence has presented organizations with numerous opportunities, such as Big Data Analytics (BDA), which generates insight across multiple departments, interrelated business domains, and organizational levels and provides an opportunity for collaboration.

**Problem Statement**: Organizations face challenges in adopting collaboration across departments for leveraging Big Data due to structural practices in BDA work practices, making it a difficult concept to implement for fostering innovation and long-term competitiveness.

**Research Purpose**: Little is known about the influence of structural practices on collaboration in BDA work practices in organizations. The purpose of this study explores how structures enable and constrain collaboration in BDA work practices.

**Methodology**: The study adopted an interpretivist research philosophy. A qualitative research strategy was employed, using semi-structured interviews for data collection, among 12 (twelve) IT and Analytics professionals. Guided by the initial proposed conceptual framework, grounded theory methodology techniques were adopted to analyze the data, using the NVivo software.

**Findings**: The study identified structural practices in both formal and informal collaboration in BDA work practices. For the formal collaboration, the structures include BDA platform services enacted in practice, BDA capabilities enacted in practice, and governance and management enacted in practice. For the informal collaboration, the structures include ad-hoc BDA platform services enacted in practice, social capabilities enacted in practice, and social contracts and informal sessions enacted in practice. The practical enactment of these structures leads to both intended and unintended consequences, resulting in either enabling or constraining collaboration in BDA work practices.

**Research Contribution**: The study provided an understanding of the structures that enable and constrain collaboration in BDA work practices in organizations. Practitioners in BDA domains can leverage this understanding in their collaboration implementation and assessment. The findings can assist in understanding and defining fit-for-purpose collaboration. Also, a revised conceptual framework and a

causal loop diagram presenting the dynamic interplay of collaboration and the structures were presented, with theoretical propositions.

**Key Words:** Collaboration, Big Data, BDA, Work Practices, BDA Work Practices, Structures, Organizations

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## Abbreviations

| Abbreviations | Description |
|---|---|
| **BDA** | Big Data Analytics |
| **IT** | Information Technology |
| **IoT** | Internet of Things |
| **EiRC** | Ethics in Research Committee |
| **UCT** | University of Cape Town |
| **POPI** | Protection of Personal Information |
| **COVID-19** | Coronavirus disease |
| **B-DAD** | Big – Data, Analytics, and Decisions |

*Table 1: Abbreviations*

# 1. Introduction

## 1.1 Background

Big Data has presented organizations with many opportunities, and many organizations have strived to leverage its insight (Ghasemaghaei and Calic, 2019). Thus, concepts such as Big Data Analytics (BDA) have emerged (Dubey, Gunasekaran, Childe, Roubaud, Wamba, Giannakis, and Foropon, 2019). BDA is described as “methods and tools for gathering, processing, and analyzing large amounts of trace data, enabling organizations to generate valuable insights by compiling their” clients' internet data trail into a comprehensive report of an individual's day-to-day life (Lehrer, Wieneke, Vom Brocke, Jung and Seidel 2018; p. 425). Some of the opportunities presented by big data include BDA work practices such as insight generation, product development, product promotion, and a variety of other work (descriptive analytics, predictive analytics, prescriptive analytics, and diagnostic analytics) activities and practices (Youssra and Sara, 2018; Ghasemaghaei and Calic, 2019; Reddicharla et al., 2019; Komalavalli and Laroiya, 2019; Lepenioti, Bousdekis, Apostolou, and Mentzas, 2020; Pidsley, 2022). These types of work practices occur across different departments, interrelated business domains, and organizational levels (Günther, Mehrizi, Huysman, and Feldberg, 2017; Grover, Chiang, Liang, and Zhang, 2018; France and Ghose, 2019). As such, they present an opportunity for collaboration among the different stakeholders and professionals performing these work practices.

According to Bjørn and Ngwenyama (2009), collaborative work practices are influenced by structures such as lifeworld (everyday life experiences) structure, organizational structures, and work process structures. In addition, Pham (2019) argues that collaboration is influenced by structural, technological, socio-cultural, and personal factors. Organizations adopt ways of working collaboratively with professionals, based on their practices that are informed by their everyday work activities (Hurme, 2005). When ways of working become routine, the collaborating professional consciously and unconsciously ratifies rules, resources, and meaning

systems in their work practices; this is referred to as structure, and it can either constrain or benefit (enable) both social and technical work systems (McPhee and Canary, 2016; Kabanda and Brown, 2017; Dremel, 2017; Bernardi, 2017). Structures are also referred to as “traces in mind”, which can constrain or enable professional’s interactions (Kabanda and Brown, 2017; p. 120). The literature has identified both the barriers to collaboration in BDA work practices in organizations, as well as the benefits and opportunities for collaboration (Akhtar, Khan, RaoNicholson, and Zhang, 2019; Dhlamini, Brown, and Oosterwyk, 2021). In addition, organizations stand to benefit from professional’s collaboration in BDA work practices. However, for effective collaboration “big data analytics requires the trinity of analytical, technological, and business capabilities and domain knowledge” (Dremel, 2017; p. 6). It is therefore critical to comprehend the issue of collaboration in BDA work practices and structures (i.e., ratified rules, resources, and meaning systems).

## 1.2 Problem Statement

Even with the potential of value creation that BDA can offer through the insights it produces, the process of value creation is a continuous and collaborative effort of sense-making (Dremel, Wulf, Engel, and Mikalef, 2020). Although collaboration fosters innovation and gives prospects for long-term competitiveness, organizations continue to struggle to embrace collaboration across departments and associations in order to process, access, and gain insights from Big Data (Akhtar et al., 2019; Pham and Williamson, 2020; Dremel et al., 2020). This could be because collaboration is a difficult concept to implement and various factors come into play when collaborating (Kinsella-Meier and Gala, 2016; De Koker, 2019). According to Bjørn and Ngwenyama (2009), the challenges of collaboration may be influenced by rules, resources, and meaning systems established in a lifeworld, an organization, and work processes. Such rules, resources, and meaning systems may include ratified cultural rules, resources, and meaning systems that influence collaboration in an organization (Bolman and Deal, 2017; De Koker, 2019). These ratified rules, resources, and meaning systems have an influence on and are reproduced by BDA work practices (Kache and Seuring, 2017). Hagen (2021) asserts these claims, arguing that a

thorough understanding of such structural influence is required. To this end, little is known about the structural influence on collaboration in BDA work practices in organizations. Developing such understanding is important for practitioners.

## 1.3 Importance of the Study

Collaboration has significant value in an organization's work practices. Similarly, even in leveraging BDA for establishing an organization's competitive advantage, and business value creation (Eggers and Hein, 2020). The collaborating departments in organizations can have more resources than when they work in silos (Berends and Sydow, 2020). Thus, it enables organizations to effectively make use of their valuable and reusable resources (Lenz et al., 2018). A structuration theory analysis of collaboration in BDA work practices in organizations will help to cement such a quest by providing insight into how structures enable and constrain collaboration in BDA work practices in organizations.

## 1.4 Research Questions

The study aims to answer this main research question

- How do structures enable and constrain collaboration in BDA work practices in organizations?

The following sub-questions are also posed

- What structures enable or constrain collaboration in BDA work practices in organizations?
- How do structures enable collaborative BDA work practices in organizations?
- How do structures constrain collaborative BDA work practices in organizations?
- How do structures and collaboration interact in BDA work practices in organizations?

In answering the stated questions, the following section presents the research objectives.

## 1.5 Research Objectives

The following are the objectives of the study

- To understand what structures, enable or constrain collaboration in BDA work practices in organizations.
- To understand how structures enable collaboration in BDA work practices in organizations.
- To understand how structures constrain collaboration in BDA work practices in organizations.
- To understand how structures and collaboration interact in BDA work practices in organizations.

## 1.6 Thesis Overview

This paper includes the following chapters:

Chapter 1: An introduction that discusses the study's background, a problem statement, study importance, research questions, and objectives,

Chapter 2: This chapter discusses the literature review on big data, big data analytics, BDA contribution to business value, big data capabilities, work practices, and collaboration in BDA work practices.

Chapter 3: This chapter presents the theoretical basis of the study with the developed conceptual framework.

Chapter 4: This chapter presents the research design and methodology of the study.

Chapter 5: This chapter presents and reports the research findings.

Chapter 6: The chapter discusses conceptual development and theoretical elaboration.

Chapter 7: The chapter presents the conclusion of the study. This chapter is followed by a list of references and appendices.

# 2. Literature Review

## 2.1 Introduction

This chapter presents a literature review of the core concepts of the study from the information systems domain. A hermeneutic framework was employed to assist in conducting the literature review. The hermeneutic framework is “a process of developing understanding that is iterative in nature” (Boell and Cecez-Kecmanovic, 2014; p. 257). It enables the researcher to engage the literature by interpreting the text, thus, developing an understanding and meaning of the literature (Baghizadeh, Cecez-Kecmanovic, and Schlagwein, 2020).

Following the hermeneutic framework depicted in Figure 1, the literature review was based on prior knowledge of collaboration, big data, BDA, and work practices. Several published papers from various sources were reviewed. The keywords used to search the literature were collaboration, big data, BDA, and work practices. The search led to a review of other papers from other sources, providing an in-depth understanding of the subject's past and current literature. This process was repeated iteratively while critically analyzing and interpreting the literature.

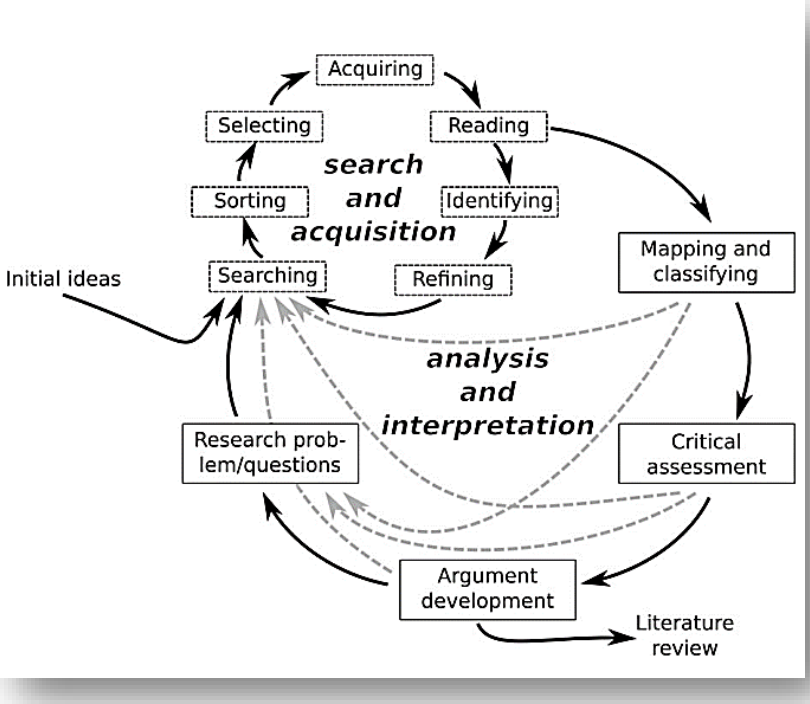


*Figure 1: A hermeneutic framework for the literature review process consisting of two major hermeneutic circles (Boell and Cecez-Kecmanovic, 2014)*

The literature review developed an understanding of concepts related to big data, BDA, BDA contribution to business value, work practices, and collaboration in BDA work practice through the hermeneutic framework process. The reviewed literature also addressed the notion of big data analytics capabilities as a collaboration enabler (Mikalef, Krogstie, Pappas, and Pavlou, 2020). The chapter further discusses the benefits and challenges related to collaboration in BDA work practices in organizations.

## 2.2 Big Data

Big data is viewed as the "new oil" that enables information and data-driven organizations (Jin, Wah, Cheng, and Wang, 2015). Providing organizations with an opportunity for innovation (Lehrer et al., 2018). In the earlier literature, big data is defined as “the information assets characterised by such high volume, velocity and

variety to require specific technology and analytical methods for its transformation into value" (De Mauro, Greco, and Grimaldi, 2016; p. 122). However, more recent literature adds variability, veracity, and visualization to the characteristics of big data (Grover et al., 2018; Mikalef, Pappas, Krogstie, and Giannakos, 2018a; Lehrer et al., 2018; Walker and Brown, 2019). With such data, highly specialized technologies are required (Sun, Hall, and Cegielski, 2020). The definition of big data is comprised of four fundamental concepts: technology, information/data, methods, and value. Table 2 below describes each of these concepts. Additionally, the concepts are essential for the collaboration of professionals who work with big data.

| ***Big Data Concepts*** | **Description** |
|---|---|
| *Information/data* | The generation of information from multiple sources (Liu et al., 2020) |
| *Technology* | The data-specific technologies and infrastructure for extracting meaningful insights, sourcing, storage, event recognition and prediction, behavior recognition and prediction, rule-based action, and visualization (Günther et al., 2017; Grover et al., 2018; Lehrer et al., 2018) |
| *Methods* | The methods for big data analytics (De Mauro et al., 2014) |
| *Value* | The impact of big data on decision-making (Elgendy and Elragal, 2014; Wang, 2017; Grover et al., 2018; Shabbir and Gardezi, 2020) |

*Table 2: Big Data Concepts*

The next section present BDA and its methods or techniques for leveraging big data.

## 2.3 Big Data Analytics

The techniques for generating insights from big data, which aid in facilitating improved decision-making, are fundamental to the concept of BDA (Rajaraman, 2016; Aboelmaged and Mouakket, 2020). The techniques include descriptive analytics, diagnostic analytics, prescriptive analytics, and predictive analytics (Kaur and Phutela 2018; Ghasemaghaei and Calic, 2019; Reddicharla et al., 2019; Komalavalli and Laroiya, 2019; Lepenioti, Bousdekis, Apostolou, and Mentzas, 2020; Brooke, 2022;

Pidsley, 2022). With BDA, advanced technologies are integrated with these techniques to generate insights and enable better decision-making (Chen, Preston, and Swink, 2015). These techniques are described in detail in Table 3 below. In addition, the techniques present an opportunity for collaboration in the different departments, for example for customer services purposes (Jalali and Park, 2018).

| ***BDA Techniques*** | **Description** |
|---|---|
| *Descriptive analytics* | The technique uses categorization, illustration, characterization, consolidation, and organization to understand historical and current events in order to inform decision-making (Evans and Lindner, 2012; Ajah and Nweke, 2019). |
| *Predictive analytics* | The technique is an advanced one that builds on descriptive analytics and makes use of data mining, machine learning, and artificial intelligence techniques to make future predictions (Kaur and Phutela, 2018; Ajah and Nweke, 2019; Lepenioti, Bousdekis, Apostolou, and Mentzas, 2020). |
| *Prescriptive analytics* | The technique utilizes the outcomes of both descriptive and predictive analytics to improve business decision-making (Kaur and Phutela, 2018; Ajah and Nweke, 2019; Lepenioti et al., 2020). |
| *Diagnostic analytics* | The technique seeks to answer the question of why an event occurred by investigating the cause of the event (Youssra and Sara, 2018). |

*Table 3: BDA Techniques*

The next section describes how BDA enhances organizational business value.

## 2.4 BDA Contribution to Business Value

Organizations have adopted and used big data and analytics to gain a competitive advantage by generating value from data and informing their decision-making capabilities (Elgendy and Elragal, 2014; Wang, 2017; Grover et al., 2018; Shabbir and Gardezi, 2020). The purpose of big data collection has often been associated with assisting in decision-making (Janssen et al., 2017). Analytics professionals use big

data to gain insights for various purposes by applying various techniques, solutions, practices, and tools (Elgendy and Elragal, 2014, Lehrer et al., 2018). Thus, contributing to business value realization. Frameworks such like Big – Data, Analytics, and Decisions (B-DAD) have been applied to understand among other concepts, big data storage management, processing, analytics, visualizations, and evaluations methods and tools for the purpose of decision-making (Elgendy and Elragal, 2014). These concepts, which are aimed at maximizing business value, can be implemented as a work practice in various departments within an organization (Günther et al., 2017; Grover et al., 2018; France and Ghose, 2019). Figure 2 depicts the interrelated value realization targets and work practices aimed at increasing BDA business value realization. Even more, the work practices can extend to include but not limited to, business process improvement, product and service innovation, marketing and sales, customer experience and market enhancement, organization performance improvement, work practices improvement, improved decision making, and business image and reputation improvements (LaValle et al., 2011; Grover et al., 2018; Wang, Kung, and Byrd, 2018; France and Ghose, 2019; Chakravaram, Srinivas, and Ratnakaram, 2019; Walls and Barnard, 2020; Elia, Polimeno, Solazzo and Passiante, 2020; Moseneke and Brown, 2022). Thus, emphasizing the importance of collaboration. For example, an organization with these multifaceted undertakings and established BDA capabilities can leverage collaboration even in their business unit's individual business process (Kock, 2005; Mikalef et al., 2018a; Mikalef et al., 2020).

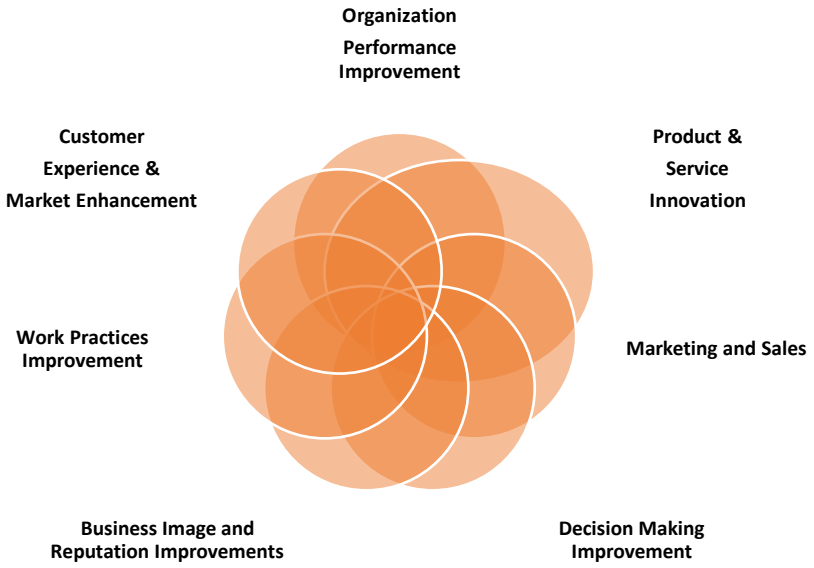


*Figure 2: Big Data Analytics Value Realization Targets and Work Practices (extended from Grover et al., 2018).*

It has been argued that collaboration in BDA work practices could enable an organization's competitive advantage (Akhtar et al., 2019). BDA goes through a chain of collaborative practices (Janssen et al., 2017). Such practices involve data collection, data preparation, data analysis, and decision-making (Janssen et al., 2017). Wang (2017) affirms this by highlighting some of the major steps in BDA, such as data acquisition, cleansing, integration, and analysis. Grover et al. (2018) built from the Information technology (IT) value model to further examine how organizations can collaboratively leverage their BDA capabilities in their work practices to support value creation needs. Value-creation consists of bringing together different BDA resources collaboratively (Grover et al., 2018). In leveraging BDA for value-creation and decision-making, organizations must appreciate its BDA capabilities in their work practices (Mikalef et al., 2018a; Mikalef et al., 2020).

## 2.5 Big Data Analytics Capabilities

To develop BDA capability, an organization must consider its resources, which can be classified as tangible, intangible, and human resources (Gupta and George, 2016).

Mikalef et al. (2018a) agree, noting that BDA capability is centered on big data and an organization's resources. The tangible resources are those related to physical and financial resources, the intangible resources are those related to organizational culture and organizational learning, and the human resources are those related to employees' skills and knowledge (Mikalef et al., 2020). In addition, unique organizational processes are dynamic capabilities that should be considered when developing BDA capabilities (Chen et al., 2015). Moseneke and Brown (2022) classified BDA capabilities into the following categories; (1) Strategic Alignment – which refers to the alignment of BDA work practices and BDA resources with an organization's strategy to enable competitive advantage; (2) Governance - which refers to the management of an organization's data in order to enable the generation of business value; (3) Human Expertise – refers to managerial, technical and soft skills; (4) Culture – refers to an organization-wide data-driven culture; (5) Investment and Time - refers to the financial and time investments required for BDA project implementation, and (6) Technology – refers to big data-specific technologies and infrastructure. These categories are contained in Gupta and George (2016)'s classification of BDA resources that contribute to BDA capability, as shown in Figure 3.

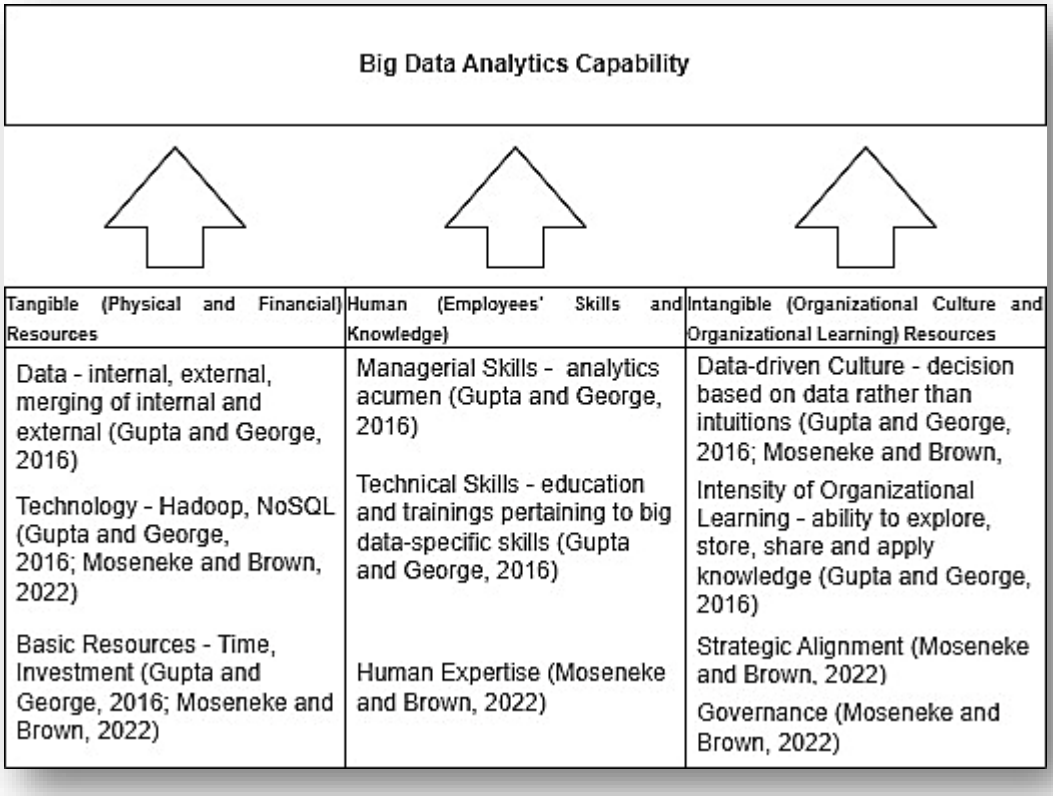


*Figure 3: BDA resources classification (Gupta and George, 2016; Mikalef et al., 2020; Moseneke and Brown 2022) – extended from Gupta and George (2016).*

BDA capability is an organization's ability to integrate and leverage its capabilities and resources with BDA-specific resources (Mikalef et al., 2018a). Thus, collaboration is an attribute of BDA capabilities and is enabled by it (Mikalef et al., 2020). Technical and social skills are essential resources for every big data-related work practice in organizations (Gupta and George, 2016). For example, human expertise is a significant resource in BDA work practices, and it is related to human resources (Mikalef et al., 2018a; Moseneke and Brown, 2022). Such human expertise can be thought of as technical and social skills. The social skills are linked to interpersonal skills (soft skills), among other things, whereas the technical skills are linked to BDA-specific skills and business knowledge (domain knowledge) (Mikalef et al., 2018a; Mikalef, Giannakos, Pappas and Krogstie, 2018b; Moseneke and Brown, 2022). Both social and technical skills are important resources for effective collaboration in BDA work practices (Mikalef et al., 2018a; Mikalef et al., 2018b). This enables and simplifies

communication because collaborating professionals in BDA work practices will have a shared understanding (Kaya, 2019).

## 2.6 Work Practices

Daily work activities are likely to produce some form of practice (Feldman and Orlikowski, 2011). A practice is “a defined activity or a set of activities that a variety of firms might execute” (Bromiley and Rau, 2014; p. 1249). Orlikowski and Scott (2008; p. 466) suggest that “work practices are constituted by an array of sociomaterial agencies, for example, space, devices, standards, categories, algorithms, expert judgements, physical mechanisms, and so on”. Also, continuous activities and practices produce a social life/system (Pham, 2019). Thus, it can also influence changes and be inscribed in the systems and technologies (Ngwenyama, 1998). This could mean that also collaborative work activities and work practices may influence change in systems and technologies.

The various work activities and practices performed by BDA professionals are influenced by the professional’s role, level of knowledge, and the nature of the data with which they work, which either enable or constrain their work practices (Ola and Sedig, 2014; Günther et al., 2017; Pham, 2019). Günther et al. (2017) classified the BDA work practices as inductive and deductive work practices, and algorithmic and human-based intelligence work practices. The deductive work practice pertains to first formulating a hypothesis and then analyzing the data to achieve understanding, whereas the inductive work practice relates to exploratory data analysis, seeking understanding from the uncovered insight (Moseneke and Brown 2022). Additionally, the algorithmic work practice involves using models and technologies to interpret the data, whereas the human-based intelligence work practice involves someone with experience making sense of the data (Moseneke and Brown 2022). These BDA work practices are employed in the “analytical model development, data sharing, data collection, data curation, data cleansing, reporting, requirements analysis, and data analysis” (Dhlamini et al., 2021; p. 88). Also, these work practices could be interdisciplinary (France and Ghose, 2019; Grover et al., 2018). Thus, an opportunity

for collaboration is created. This is also evident from what the practice theory suggests: an action that occurs in a certain context is critical to the production of social life, and relations of the mutual constitution are capable of establishing collaboration (Feldman and Orlikowski, 2011). According to Moung Yin Chan, Lo and Ng (2020), context influences social dynamics. The nature of the context may be a barrier to collaborative work practices (Pham, 2019; Dhlamini et al., 2021).

## 2.7 Collaboration in BDA Work Practices

Collaboration takes up different levels and stages as it evolves. The levels include networking, cooperation, coordination, coalition, and collaboration (Frey, Lohmeier, Lee, Tollefson, 2006). The stages include formation, storming, norming, performing, and transforming (Tuckman and Jensen, 1977; Woodland and Hutton, 2012). Collaboration can be thought of as "the partnership of alliance members in the performance of a specific work or task in the frameworks of one project" (Halynska, 2017; p. 1470). It is also argued that it is "a process through which parties who see different aspects of the problem can constructively explore their differences and search for solutions that go beyond their limited vision of what is possible" (Wood and Gray, 1991, p.4). This process can be formal or informal (Kaya, 2019; Dhlamini et al., 2021). For example, formal collaboration is contractual, whereas informal collaboration is ad hoc and enabled by social contracts (Dhlamini et al., 2021).

According to Akhtar et al. (2019), collaboration in BDA is employed for data sharing and innovation, among other things. Collaboration in BDA work practices in an organization can be inter-departmental, cross-functional, and interprofessional (Woodland and Hutton, 2012; De Koker, 2019; Dhlamini et al., 2021). In addition, it is enabled by multiple factors including technologies, processes, a clear mandate, self-interest, and social connections (Kaya, 2019; Schwade, 2021). According to Hernández (2019), collaboration is made possible by mechanisms for conflict resolution, coordination, mutual support, and communication at work.

Challenges in the different BDA work practices exacerbate the barriers to collaboration. This is also because of the nature of big data and the complexity associated with it, such as its heterogeneity, completeness, source, knowledge and skills, and processing complexity (Wang, 2017). The complexity of the processes, methods, and tools associated with BDA work practices, and resources challenges, present barriers that influence collaborative work practices (Elgendy and Elragal, 2016; Wang, 2017; Gotta, Elliot, and Preset, 2018; Kulkarni et al., 2020; Mehta, Pandit, and Kulkarni, 2020; Dhlamini et al., 2021).

De Koker (2019) notes that with collaboration different factors could influence how collaborative work practice takes place. The factors can be understood by looking at the different levels and stages of collaboration. Figure 4 depicts the levels and stages of collaboration, as well as the barriers to collaboration found at each level and stage. Dhlamini et al. (2021) identified seven collaboration barriers in BDA work practice: (1) work activity barriers – this barrier is influenced by difficulties in shared understanding, interest, objectives, goals, time, trust, and failure to recognize the value, importance, and benefit of collaboration, (2) context barriers – this barrier is influenced by organizational structure and culture challenges, (3) team barriers – this barrier is influenced by challenges in capacity, collaborative relationships, communication, knowledge sharing, and team composition, (4) process barriers – this barrier is influenced by challenges in governance, standards, and work processes, (5) technological barriers – this barrier is influenced by challenges in analytics technologies and tools, as well as collaborative platform technologies, (6) individual barriers – this barrier is influenced by resource constraints, as well as challenges in professionals' competency, knowledge, and skills, and (7) capability barriers – This barrier is influenced by challenges in BDA maturity and knowledge across the organization. Other barriers include data barriers – which relate to data-specific characteristics challenges, and management barriers – which relate to ethics, governance, privacy, and security challenges (Malaka and Brown, 2015; Sivarajah, Kamal, Irani, and Weerakkody, 2017). Hagen (2021) and Hagen, Pély, and Hess, (2022) identified similar barriers to collaboration in BDA work practice, but further classified them as structural social capital challenges – this relates to the organizational hierarchy structure and power structures; relational social capital

challenges – are a by-product of the influence of change, mindset, language, and a lack of social skills; and cognitive social capital challenges – relates to mutual and shared understanding. On the other hand, Claridge (2018) argues that structural social capital – relates to a social structure (i.e., roles, rules, precedents, procedures, and network ties and configurations), cognitive social capital – relates to shared understanding (i.e., shared language, codes, narratives, values, attitudes, beliefs, goals, purpose, and vision), and relational social capital – relates to nature and quality of relationships (i.e., trust and trustworthiness, norms and sanctions, obligation and expectations, identity and identification). Although relational social capital is intangible, structural social capital is noticeable and tangible (Claridge, 2018).

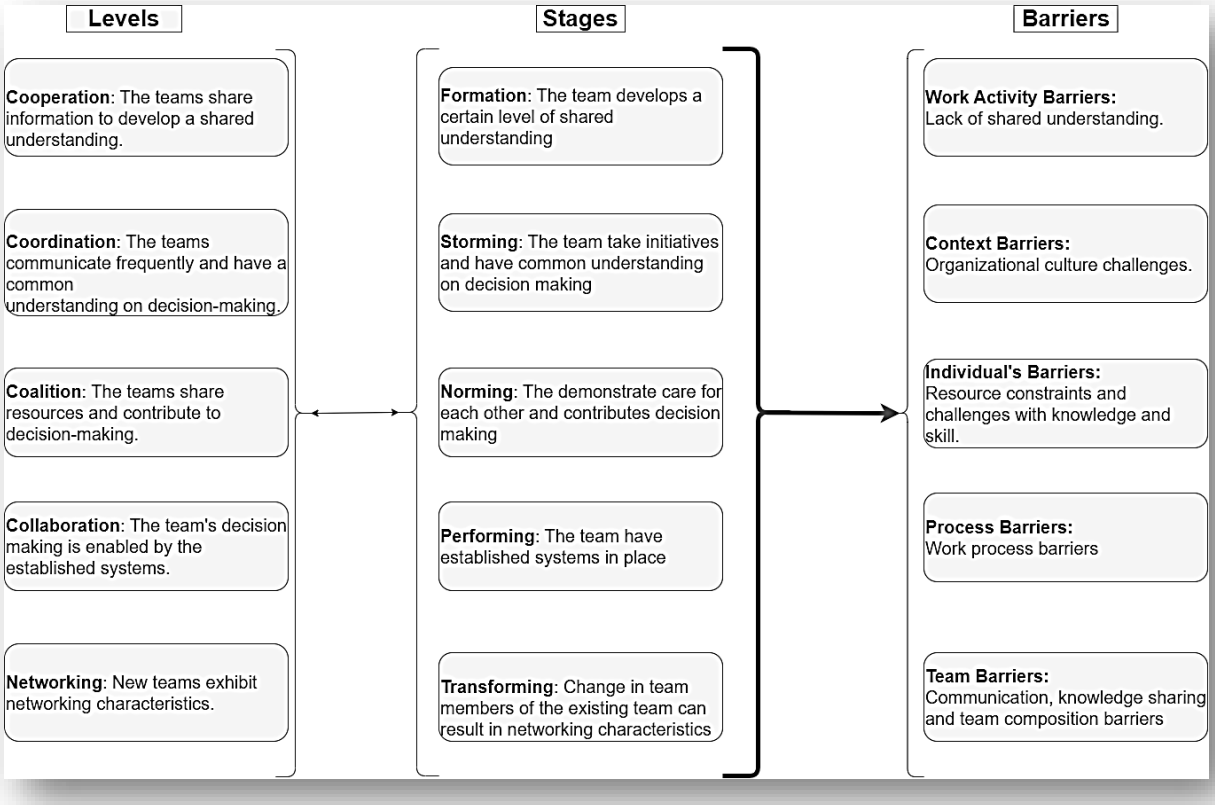


*Figure 4: Collaboration Levels and Stages with associated barriers (Frey, Lohmeier, Lee, Tollefson, 2006; Woodland and Hutton, 2012; Dhlamini et al., 2021).*

In contrast, Kaya (2019) identified enablers of formal and informal intra-organizational collaboration. However, the challenges of collaboration enablers can impede it. Figure

5 extends a model to assess barriers to collaboration in BDA work practices in organizations, as proposed by Dhlamini et al. (2021).

| Work Activity Barriers | Process Barriers | Team Barriers |
|---|---|---|
| Shared understanding, interest, objectives, goals barriers<br>Time and trust barriers<br>Failure to recognize the value, importance, and benefit of collaboration | Governance barriers<br>Standards barriers<br>Work processes barriers | Capacity barriers<br>Collaborative relationships barriers<br>Communication barriers<br>Knowledge sharing barriers<br>Team composition barriers |
| **Data Barriers** | **Context Barriers** | **Management Barriers** |
| Data characteristics barriers | Organizational structure challenges<br>Organizational culture challenges | Ethics challenges,<br>Governance challenges<br>Privacy challenges<br>Security challenges |
| **Technological Barriers** | **Individual Barriers** | **Capability Barriers** |
| Analytics technologies and tools barriers<br>Collaborative platform technologies barriers | Resource constraints<br>Challenges in professionals' competency, knowledge, and skills | BDA maturity barriers<br>BDA knowledge barriers |

*Figure 5: A model for assessing barriers to collaboration in big data analytics work in organizations (extended from Dhlamini et al., 2021).*

## 2.8 Chapter Summary

This chapter reviewed the literature on big data, BDA, and how BDA has been leveraged, as well as the value it provides to organizations. This was followed by a discussion on the BDA capabilities leveraged in organizations and capabilities fundamental to collaboration. The definition of work practice was contextualized in

relation to the study. The literature review further discussed collaborative BDA work practices and concluded by presenting the challenges of collaboration in BDA work practices.

Despite the potential benefits of big data for innovation, decision-making, and contribution to business value, specialized technologies are necessary to realize these benefits. However, these technologies come with their own set of challenges, as is the case with BDA and BDA techniques. Developing and establishing BDA capabilities requires consideration of tangible and intangible resources as well as human resources, including strategic alignment, governance, culture, time, investment, and technology (Moseneke and Brown, 2022). Shared understanding among collaborating professionals in their BDA work practices can only be established by first establishing these capabilities. Collaborative work practices can enable or constrain change in systems and technologies, influenced by factors such as the professional's role, level of knowledge, and nature of the data with which they work (Ola and Sedig, 2014; Günther et al., 2017; Pham, 2019). Collaboration can occur at different levels and stages, both formal and informal, and can be influenced by various factors that are structural in nature (Tuckman and Jensen, 1977; Frey et al., 2006; Woodland and Hutton, 2012; Hagen, 2021; Hagen et al., 2022). However, little is known about the underlying structures that enable or constrain collaboration in BDA work practices. The literature notes factors such as processes, methods, tools, and resources, as well as structural social capital, relational social capital, and cognitive social capital (Dhlamini et al., 2021; Hagen, 2021; Hagen et al., 2022). In summary, Figure 6 depicts the factors that influence collaboration in BDA work practices in organizations.

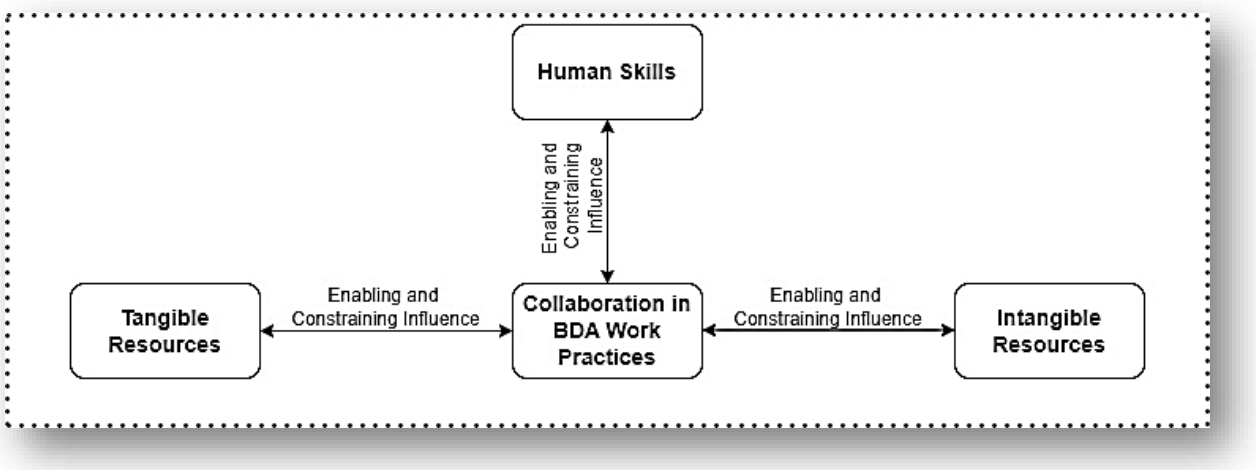


*Figure 6: Factors that Influence Collaboration in BDA Work Practices in Organizations.*

Even though collaboration and BDA work practices have been widely studied and various frameworks have been used to study them, it is important to develop an understanding of the structuration theory analysis for these concepts. The next chapter will focus on developing a theoretical basis for collaboration in BDA work practices through the lens of structuration theory.

# 3. Theoretical Basis

## 3.1 Introduction

This chapter presents structuration theory as the theory underpinning this study. The chapter provides a detailed overview of how structuration theory has been used in information systems. This is followed by presenting structuration theory in the context of collaboration in BDA work practices in organizations. Following that, a conceptual framework is presented.

## 3.2 Structuration Theory

Giddens's structuration theory seeks to analyze and conceptualize the relationship between individuals and social practices in a society (Gidden, 1984; Ma, 2010; Jones and Karsten, 2008). The key premise of structuration theory is the argument of structure and agency, which is addressed in the duality of structure (Walsham and Han, 1993). Lyytinen and Ngwenyama (1992; p. 21) affirm this, stating that "structuration theory views agency and structure as a duality in which human agents draw upon understandings of interpretive schemes, norms, and power during social activities, and in so doing, produce and reproduce social structure". Rerup and Feldman (2011; p. 578) define interpretive schemes as "a set of shared assumptions, values, and frames of reference that give meaning to everyday activities and guide how organization members think and act". In addition, the interpretive schemes refer to the lenses through which a social world is seen and understood, the facilities refer to the means of leveraging resources, and social norms refer to an individual's ethical issues/matters (Kabanda and Brown, 2017). To explain what facilities and norms are, Orlikowski (2000) uses the example of a knowledge worker leveraging their knowledge and facilities (resources) available to them in their practices, which are informed by sets of habits or norms (rules and processes). According to Walsham and Han (1993), human agents use interpretive schemes in their communication interactions, facilities in their power interactions, and norms in their sanctioning interactions. As a result,

structures of signification, domination, and legitimation are produced and reproduced (Walsham and Han, 1993).

Structure's duality states that a structure is both a means of interaction used in the production and reproduction of social activity, as well as the outcome of structures that it repeatedly produces and reproduces (Walsham and Han, 1993; McPhee and Canary, 2016; Moung Yin Chan et al., 2020). Structures refer to the rules, resources, and meaning systems in a social system that are ratified and used in a work activity or practice (McPhee and Canary, 2016). Walsham and Han (1993; p. 193) noted this viewpoint, claiming that structures are "rules and resources that exist only as memory traces in human minds". Furthermore, structures can also be thought of as the "traces in the mind" that enable or constrain an individual's interaction in a society, whether consciously or unconsciously (Kabanda and Brown, 2017; p. 120). Thus, social rules, resources, and meaning systems (structures) are both an enabler and a constraint of social activity (Lyytinen and Ngwenyama, 1992). Taking consciousness and emancipation, as an illustration, it is necessary to "understand its dialect opposite" (Ratner, 2014; p. 539). Social activities reproduce and give rise to social rules resources, and meaning systems (Lyytinen and Ngwenyama, 1992).

Structures can be understood through the three dimensions of structures, which are fundamental elements of social interaction (Lyytinen and Ngwenyama, 1992). Moung Yin Chan et al. (2020) argue that the structuration theory dimensions are key to analyzing the evolution of social rules, resources, and meaning systems. As illustrated in Figure 7, the dimensions include signification enacted through interpretive schemes, domination enacted through facilities, and legitimation enacted through norms (Jones and Karsten, 2008; Moung Yin Chan et al., 2020). Structuration theory has been employed in various disciplines, including information systems.

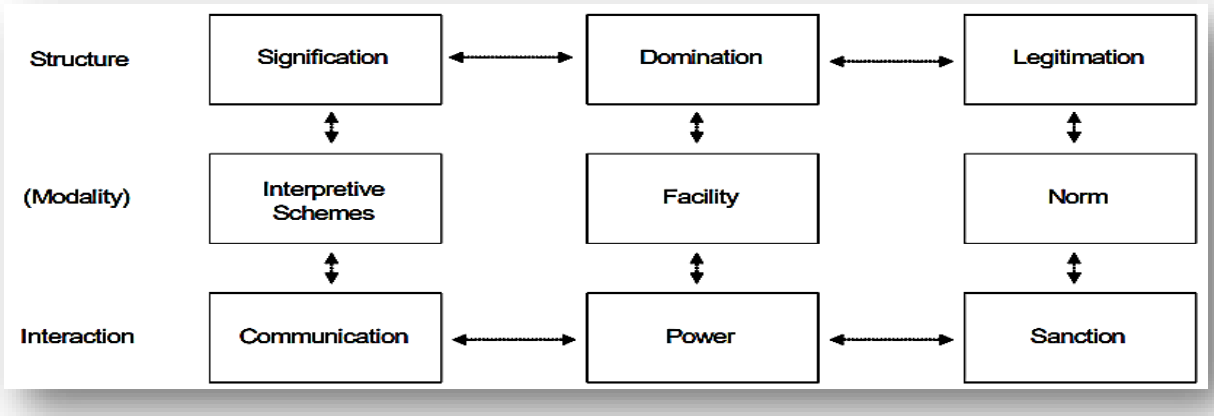


*Figure 7: Structuration theory: Analytical dimensions of duality of structure (Giddens 1984, as cited by Jones and Karsten, 2008).*

### 3.3 Structuration Theory in Information Systems

Structural influence on information systems can be analyzed by understanding both the sets of rules and resources drawn upon by the individuals when interacting with the information systems/technologies (Lyytinen and Ngwenyama, 1992). According to Moung Yin Chan et al. (2020), other theories that study structures, such as structuralism, are unsuitable for considering structure and agency interactions because they focus on the structure of the organization. With structuralism, the structure becomes the priority, overlooking the duality of structures (Moung Yin Chan et al., 2020).

In information systems, structuration theory has been used to conceptualize social action and structures (Jones and Karsten, 2008). Information system studies concentrate on conceptualizing social action as well as the rules, resources, and meaning systems in specific technological systems (Walsham and Han, 1993). Kabanda and Brown (2017) add that structuration theory allows the conceptualization of the information system as a social system. Some theories, like actor-network theory, claim to help in understanding the interaction in a social system between actors (human and non-human) cooperating in a heterogeneous network and the influence of such interaction (London and Pablo, 2017; Cabral, 2017). However, it does not

address the structure and agency debate. For example, actor-network theory views technology as an independent actor, while structuration theory views technology as a resource among other resources that actors employ in a social system (Greenhalgh and Stones, 2010). Thus, it might be beneficial to study collaboration in BDA work practices through the lens of structuration theory.

## 3.4 Collaboration and Structural Interactions

Professionals collaborate and interact with structures differently and on different levels in their work practices. The type of collaboration can be informal and formal, and the levels at which it takes place can be on a “macro” and “micro” level (Kaya, 2019). Klee, Janson, and Leimeister (2021) state that the opportunity for multidisciplinary collaboration in BDA work practices presents complex structural interactions. Andersson, Hedström, and Karlsson (2022) add that such work practices constitute structures.

Poirier, Forgues, and Staub-French (2016) state that collaboration is constituted by entities, structures, processes, actors, artifacts, and context. Collaboration occurs in a specific social setting as an act of interaction between multiple actors, where participants draw on different rules and resources, thus influencing their social environment (Poirier et al., 2016). This is central to what structuration theory suggests, where people's interaction produces and reproduces intended and unintended consequences (Pham, 2019). Yan, Steller, Watanabe, and Popp (2018) affirm this, suggesting that participants are dependent on ratified rules, resources, and meaning systems (structures) to exercise their power and influence. Akhtar et al. (2019) add that collaboration in BDA work practices provides collaborating parties with an opportunity to exercise their power to influence structures. This may be because of structures constraining and enabling collaboration, that can take place in the formal and informal interactions of professionals.

### 3.4.1 Informal Collaboration Structures

Informal collaboration is ad hoc and enabled by social contracts adopted by professionals participating in BDA work practices (Dhlamini et al., 2021). Shared artifacts, social networks, information broadcasting channels, and open communication channels are some of the factors that enable informal collaboration in BDA work practices (Patel, Pettitt, and Wilson, 2012; Sungur, Dorn, Dustdar, and Leymann, 2015). Affirming these factors Kaya (2019) also adds trust, self-interest, common goal, and expectations as enabling factors to informal collaboration. Virtual technology platforms and distributed geographic settings (autonomous and decentralized practice) also add to the factors that influence collaboration (Cross, Borgatti, and Parker, 2002; Bernardi, 2017; Morrison-Smith and Ruiz, 2020). These factors reflect structural social capital (Hagen, 2021; Hagen et al., 2022). These factors are fundamental to the interacting professionals in BDA work practices. Thus, the challenges around these same factors can potentially impede collaboration in BDA work practices, be it informal or formal (Dhlamini et al., 2021, Hagen, 2021).

### 3.4.2 Formal Collaboration Structures

To encourage trust, formal contractual agreements are often adopted among collaborating professionals, thus, enabling collaboration (De Koker, 2019). Other factors that enable formal collaboration in BDA work practices include organizational strategy, organization design, centralization, inter-departmental dependencies, and processes (Kaya, 2019; De Koker, 2019). The organizational structure is the underlying enabling factor for formal collaboration in organizational design, and its attributes include "tasks, processes, policies, culture and norms, power relations, trust, learning, and participation incentives" (Patel et al., 2012; p.4). Like the informal collaboration structures, these factors are important to the collaborating professionals in BDA work practices. Hence, challenges around them can also impede collaboration in BDA work practices (Dhlamini et al., 2021; Hagen, 2021).

### 3.4.3 Collaboration in BDA Work Practices

The ratified rules, resources, and meaning systems (structures) that influence professional's interactions relate to legitimation (norms), domination (facilities), and signification (interpretive schemes) (Poirier et al., 2016; Pham, 2019; Pham and Williamson, 2020). Such structures are important in understanding actions and interactions (Moung Yin Chan et al., 2020). First, regarding structures of legitimation (norms and sanctions structures), little is said in the literature on how it positively or negatively influences interactions in BDA work practices. Other scholars only mention that the enactment of processes can enable and constrain collaboration in BDA work practices (Kache and Seuring, 2017; Mehta et al., 2020). Second, regarding structures of domination (resources and power structures), Pham and Williamson (2020) and Dremel (2017) only mention that a variety of factors, such as the exercise of individual power, influence collaboration and the success of BDA work practices. However, the literature makes less mention of such unique domination structures that enable and constrain collaborative practices in BDA work practices. Except that BDA, as a practice, can do away with power enactment because it necessitates a variety of resources and skill sets (Van Rijmenam, 2019). Last, barriers to collaboration in BDA work practices associated with signification structures (interpretive schemes and communication) constrain collaboration, for example, a lack of shared understanding and vision ratified as interpretive schemes in collaboration practices (Kache and Seuring, 2017; De Koker, 2019; Dhlamini et al., 2021).

Though it is evident that structures may enable and constrain collaboration in BDA work practices, still not much is known about how the structures enable and constrain collaboration in BDA work practices. Kaya (2019) only emphasizes the negative influence of geographical proximity on collaboration, but much of what is noted is the various structures that enable informal and formal collaboration, as well as the interdependence of such factors. Günther et al. (2017) also emphasized the importance of investigating big data societal influences and interactions with organizational actions, such as the need for collaboration in BDA work practices. Such

investigations may yield insights into how structural influences and interactions enable and constrain organizational actions.

The behavior of the professionals performing the work practices is also ever-changing and unpredictable (Introna, 1996). The interaction between the multiple actors (human and non-human) in BDA work practices can be looked at in the context of interactions. Also, the work practices are influenced by the structure's occurrence order and their interactions (Fricker, Kotnik, and Piskorec, 2019). Thus, the occurrence of each interaction is unique. Making the double involvement of structures in collaboration in work practices complex, as the interactions are constantly changing.

Since collaboration in BDA work practices can be an ever-changing dynamic interaction between BDA work practices and professionals, the social reality is constantly produced and reproduced (Introna, 1996). The collaboration processes are constantly shaped and reshaped because of interactions with collaboration rules, resources, and meaning systems (Yan et al., 2018). Similarly, the conduct of their work practices is likely to be shaped and reshaped by the interaction of the work practices and the BDA rules, resources, and meaning systems (Yan et al., 2018). It seems there is a dynamic interaction during the collaboration of professionals, thus creating their own social reality (London and Pablo, 2017). Table 4 summarizes collaboration structures enacted as interpretive schemes, facilities, and norms that can influence collaboration in BDA work practices.

| Modalities | Themes | References |
|---|---|---|
| Interpretive schemes | Context, Organizational culture, Shared Understanding, Interest, Language, Location, Objectives, and Goals. | (Cross et al., 2002; Patel et al., 2012; Poirier et al., 2016; Bernardi, 2017; De Koker, 2019; Kaya, 2019; Hagen, 2021; Dhlamini et al., 2021) |
| Facilities | Technology and Tools, Teams, Capacity, Interpersonal Relationships, Skills, Resources, Knowledge, Time, and Capabilities | (Patel et al., 2012; Poirier et al., 2016; Mikalef et al., 2018a; Mikalef et al., 2018b; De Koker, 2019; Akhtar et al., 2019 Hagen, 2021; Dhlamini et al., 2021; Moseneke and Brown, 2022) |
| Norms | Processes, Governance, Standards, and Work Practices. | (Patel et al., 2012; Poirier et al., 2016; Hagen, 2021; Dhlamini et al., 2021) |

*Table 4: Summary of collaboration structures*

### 3.4.4 Collaboration Interpretive Schemes, Facilities, and Norms Interplay

During the collaboration of professionals in work practices, it is evident that norms, routines, and practices are ratified (Zuzul, 2019). Zuzul (2019) adds that though important, the sets of norms, routines, and practices are often not the same among collaborating professionals. Boundary objects are enacted as interpretive schemes that "build common ground, and facilitate knowledge integration" (Zuzul, 2019; p. 740). Such interpretive schemes, social or technical, ratify systems structures (Walsham and Han, 1993). Significantly influencing the collaboration of professionals in work practices. Also, the ratification of structures gives meaning to the cause and effect of an activity or behavior (Konlechner, Müller, Güttel, Koprax, and Link, 2016).

Though standards, procedures, and policies are generally implemented through sanctions, when ratified in a social setting such as collaboration in work practices, they are authoritative and power-based (Adiema, 2019; Andersson et al., 2022). This could

be since standards, procedures, and policies are often enforced. They can be viewed as resources that are also necessary for interoperability (Girard, 2018). As a result, enabling data sharing and promoting trust among interacting entities, as well as demonstrating their dynamic interactions with collaboration in work practices (Girard, 2018). On the other hand, policies, standards, and procedures are enacted in practice as a norm to ensure data security during collaboration in BDA work practices (Merhi and Bregu, 2020). As a norm professionals follow sets of standards and leverage technologies among other resources when performing their work practices.

## 3.5 Technologies and Structural Interactions

Technologies impose rules, resources, and norms when enacted in social practice (Orlikowski, 2000). Professionals use BDA technologies and collaborative technologies for various BDA work practices.

### 3.5.1 Big Data Analytics Technologies Structures

Big data can be thought of as having structural and functional dimensions (Daniel, 2019). The structural dimension is informed by the nature of the data sources, such as social media, network sensors, mobile devices, etc. (Daniel, 2019). These data sources influence the big data infrastructure, such as the data storage infrastructure (Grover et al., 2018). The functional dimension informs big data technologies (Daniel, 2019). As noted, big data presents opportunities for leveraging data insight by adopting big data technologies such as advanced analytics technologies (Günther et al., 2017). Such advanced analytics technologies support different kinds of analytics practices like data mining, machine learning, event processing, etc (De Moura, Ceotto, and Gonzalez, 2017).

Big data technologies are resources that analytics professionals use to carry out their work practices (Pham, 2019). The nature of these resources may influence their practices. For example, technology can be imposing on a professional's day-to-day activities (Nunu, 2019). The big data infrastructures embody the expert's expertise, knowledge, and assumptions of those who built them (Williamson, 2019). Williamson (2018) affirms this, stating that big data infrastructures can be influenced by political, economic, and social events. As a result, it has an impact on professional work. For instance, the way information is presented in big data technology influences how professionals perform their work (Moung Yin Chan et al., 2020). Because of such influences, changes in big data technologies may be implemented (Leonardi, 2011). Thus, big data infrastructure has interactions with social structures. Orlikowski (2000) affirms this, suggesting that the structures in the infrastructures and technologies are enacted by the users of the technologies in their work practices. Infrastructures can be understood not as just built structures, but as "a thoroughly heterogeneous and interpenetrating 'assemblage' of technological objects, standards, values, administrative procedures, and organizational work, all of which involve myriad people, institutions, technologies, policies, legalities, and financial arrangements to build, repair, maintain, and reconstruct" (Williamson, 2018; p. 5). Modeling the resources and rules embodied by infrastructures. Big data infrastructures have an impact on data production, as well as how it is consumed and used (Williamson, 2019). Also, the use of big data infrastructure influences the evolution of the big data infrastructure (Williamson, 2019).

Factors such as the user's experience, the complexity of tasks at hand, skills, adequate and relevant resources, and capabilities, influence the usage of big data technologies (Wang, Kung, and Byrd, 2018; Ghasemaghaei, 2019; Ghasemaghaei, 2020). Also, Ghasemaghaei (2019) states that structural and psychological constraints influence big data technologies during their use. This may be true with the use of big data technologies in the collaboration of professionals in their BDA work practices.

### 3.5.2 Collaborative Technologies Structures

The technology support structure that enables collaboration is essential in the modern way of working (Patel et al., 2012). Such technologies and tools can support various collaboration capabilities. The capabilities include training functions, support functions, knowledge management, open data repository, work facilitation and coordination (management), and communication (Patel et al., 2012; Marivate and Combrink, 2020; Dhlamini et al., 2021). These collaborative technology capabilities better support virtual ways of working (Morrison-Smith and Ruiz, 2020). That is for both formal and informal collaborative work. In addition to these technological capabilities that support virtual ways of working are social networks capabilities (Li, Chen, Zhang, and Fu, 2012; Khanyile and Coetzee, 2018). Social network capabilities are important for enabling communication. Communication is central to an organization's collaborative technologies (Bjørn and Ngwenyama, 2009). It supports work processes through various messaging capabilities, such as email, instant messaging, audio conferencing, and electronic presentation (dashboard) (Bjørn and Ngwenyama, 2009; Khanyile and Coetzee, 2018; Marivate and Combrink, 2020).

Integrated collaborative technology systems usually embody a user-based interaction model, its goal is “to provide a general-purpose framework that enables collaboration systems and their support tools to interact and share information without each having advance knowledge of the others’ existence” (Port and Kaiser, 1998; p. 81). This practice enables a federated platform with different toolsets (Jacobsen, Benedict, Foster, and Ward, 2015). Thus, enabling data sharing and management. The advancement of technology has enabled organizations to leverage a “federated IoT-based collaboration platform” to collaborate and share data (Innerbichler, Gonul, Damjanovic-Behrendt, Mandler, and Strohmeier, 2017; p. 1). This type of structure, like a collaborative BDA platform, necessitates governance for data security and protection (Dhalmini et al., 2021). Thus, enabling collaborating professionals to perform analysis services effectively (Park, Nguyen, and Won, 2015).

## 3.6 Proposed Conceptual Framework

Structuration theory has previously been used to investigate the interrelationship between social structures and information professionals' day-to-day work practices (Pham, 2019). The information work practices that professionals do daily are socially structured in addition to being culturally and organizationally structured (Ma, 2010). BDA work practices can also be thought of as social activities, enabled and constrained by ratified rules, resources, and meaning systems (structures) that are constantly formed and reproduced by human mechanisms (Lyytinen and Ngwenyama, 1992; Van Rijmenam, 2019). The mechanisms include an individual's knowledge and capabilities (social and technical capabilities), which individuals can use to influence the domains of social activities they interact with (Lyytinen and Ngwenyama, 1992). Thus, BDA as a domain of social interaction is influenced by both social and technical structures. Using structuration theory in a study is a useful way of investigating collaborative work practices (Jones and Karsten, 2008).

According to Bernardi (2017; p. 947), "structuration theory is still a useful perspective for studying the linkage between IT materiality and socio-organizational processes". As previously stated, BDA technologies (IT materiality) have an impact on domains of social activity such as BDA work practices (socio-organizational processes) with which professionals interact. Building on Bernardi's conceptualization, the proposed conceptual framework seeks to provide a lens to the structuration analysis of collaboration in BDA work practices in organizations. The framework provides an understanding that when BDA technologies and collaborative technologies are interacted with, they impose structures (rules, resources, and meaning systems) enacted in BDA work practices and social systems. Thus, influencing their mutual interactions. BDA professionals' action triggers and interaction needs stimulate the ways in which modalities (BDA technologies, collaborative technologies, and the BDA work practice social system) produce and reproduce structures. Consequently, such structures may enable or constrain their collaboration in BDA work practices. Figure 8 conceptualizes the structuration of collaboration in BDA work practices in organizations.

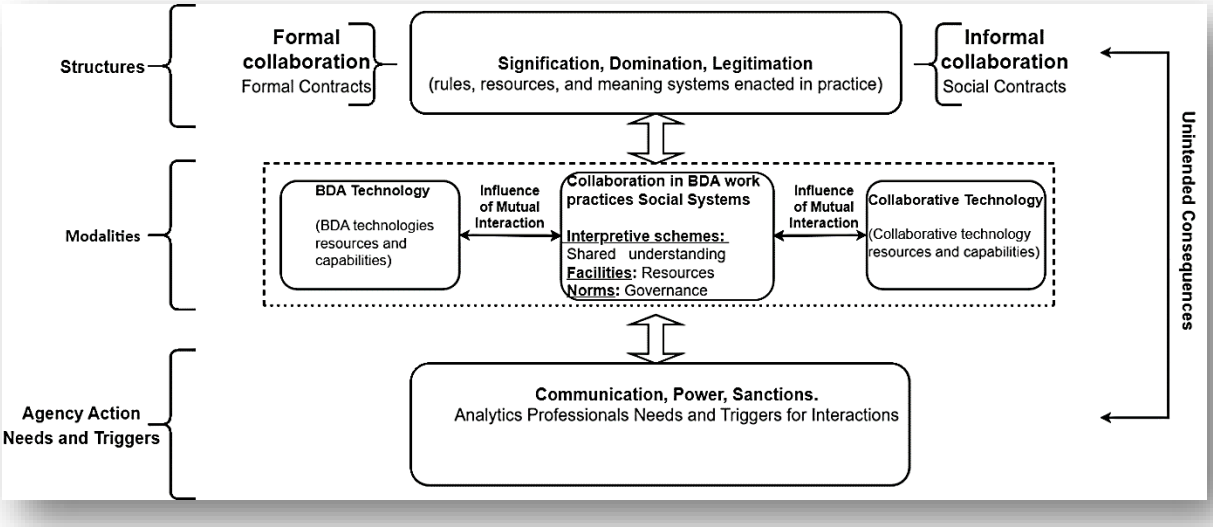


*Figure 8: Conceptual Framework: Structuration of collaboration in BDA work practices in organizations (Giddens, 1984; Lyytinen and Ngwenyama, 1992; Orlikowski, 2000; Bernardi, 2017; Kabanda and Brown, 2017).*

## 3.7 Chapter Summary

This chapter sought to discuss the theory underpinning this study. The chapter presented structuration theory as the theory underpinning this study and reviewed information systems literature to present an understanding of how the theory has been applied in the information system field. This is followed by a literature review of BDA collaborative work practices in relation to structuration theory. The chapter concludes by presenting a proposed conceptual framework.

# 4. Research Design and Methodology

## 4.1 Introduction

The purpose of this chapter is to detail the research methodology the researcher has adopted for the study. The research methodology aims to provide a systematic method for knowledge discovery (Creswell & Robinson, 2007). The study adopted a qualitative research strategy using semi-structured interviews for data collection. In addition, the study employed grounded theory methodology techniques to further assist in analyzing the data (Matavire and Brown, 2013).

A research study needs first to assume a philosophical stance. This is because a study is informed by the research philosophy adopted. According to Saunders, Lewis, and Thornhill (2016; p. 568), a qualitative study is “often associated with an interpretivist philosophy because researchers need to make sense of the subjective and socially constructed meanings expressed by those who take part in research about the phenomenon being studied”.

This chapter includes the following sections: the introduction, the research philosophical stance, the approach to theory, the research purpose, the research strategy, the target population, the sample population, the data collection procedure, the data analysis procedure, ethical considerations, and the summary to the chapter.

## 4.2 Philosophy

Though it is argued that research can begin at any stage of research methodology, some scholars emphasize the importance of first identifying the ontological stance (Mack, 2010). This is because research is best done by outlining the relationship between the ontological stance and the epistemological stance (Mack, 2010).

Bhattacherjee (2012) argues that both ontological assumptions and epistemological assumptions shape a social phenomenon study. Also, Mack (2010) argues that the adopted ontological stance should inform the epistemological stance, therefore, informing the methodology. Thus, it is also important to understand the two opposing stances of objectivism and subjectivism (Levers, 2013). According to Saunders et al. (2016; p. 124), “research philosophy refers to a system of beliefs and assumptions about the development of knowledge”, and each assumption relates to two opposing extremes (objectivist and subjectivist). The following subsections will discuss the research philosophy assumptions.

### 4.2.1 Ontology

Ontology is the study of the nature and structure of ‘things’ that have the quality or state of being real and are not dependent on something else for their existence (Guarino, Oberle and Staab, 2009; Al-Saadi, 2014). The ‘things’ can refer to social entities (Al-Saadi, 2014).

Concerning the ontological assumption, objectivism embraces realism and believes that there is a single true social reality that can be experienced (Saunders et al., 2016). Subjectivism embraces that social realities are produced from an individual’s perceptions, presumptions, interpretations, understanding, and interactions (Al-Saadi, 2014; Saunders et al., 2016; Janeþková, 2003).

This study sought to understand the interaction of structures and collaboration in BDA work practices from a social theory, assuming that social interaction influences collaboration in BDA work practices in organizations. Thus, the study adopted a subjective ontological perspective.

### 4.2.2 Epistemology

Making sense, assumptions about the quality or essence of knowledge, and how knowledge can be conveyed are all part of epistemology (Saunders et al., 2016; Goertz and Mahoney, 2012; Al-Saadi, 2014). According to Mack (2010), a positivist paradigm assume that knowledge is objective. Meanwhile, an interpretivist paradigm emphasizes a researcher's ability to study the meaning and subjective interpretation of social reality (Mack, 2010). Furthermore, an interpretivist paradigm maintains that knowledge is obtained through interaction and experience (Mack, 2010). To better understand the fundamentals of the proposed subject, the study adopted an interpretivist epistemological assumption.

## 4.3 Approach to Theory

Though research can adopt multiple approaches, the research approach should be informed by the researcher's ontological stance and epistemological stance (Bhattacherjee, 2012; Johnston, 2014). A deductive research approach seeks to test the adopted theory (Saunders et al., 2016). Conversely, an inductive research approach does not seek to test the adopted theory. However, with an inductive study, an adopted theory may be used as a sensitizing device to guide the research data collection and analysis of research data (Bowen, 2006). In addition, Bowen (2006) argues that researchers use sensitizing devices as interpretive devices. It is advised that structuration theory should be used as a sensitizing device (Pham, 2019).

The developed conceptual framework in this study, served as a guide while remaining open to new themes that emerged as the coding progressed (Bernardi, 2017). An inductive approach was adopted for this study.

## 4.4 The Research Purpose

The purpose of this study was to investigate the interaction of structures and collaboration in BDA work practices in organizations, using a conceptual framework. Further seeking to understand how structures enable and constrain BDA work practices. According to Stebbins (2001), an exploratory study seeks first to study, examine, and analyze the subject, then familiarize and methodologically explore it. Also, Stebbins (2001) states that the objective of an exploratory study is to drive generalization and explain the subject under study inductively. Thus, the purpose of this research was classified as exploratory.

## 4.5 The Strategy of the Study

There are various research strategies associated with a qualitative study (Saunders et al., 2016). Also, a research strategy aims to develop the researcher's data collection and analysis plan, ultimately answering research questions (Bilau, Witt, and Lill, 2018).

This study employed a qualitative research strategy using semi-structured interviews. This approach allowed data to be socially constructed, co-produced by both the interviewer and interviewee, allowing for the creation of insights based on the interviewee's perspectives and the interviewer's interpretation (Saunders et al., 2016). For a phenomenon that does not have a developed theory or framework, such as collaborative BDA work practices, it is recommended to use techniques that allow for the exploration of the research question, such as qualitative interview techniques (Britten, 1995).

## 4.6 Target population

To enhance heterogeneity, the targeted population of the study included IT and Analytics professionals involved in BDA work practices in their personal capacity, regardless of their organizational affiliation. The research target population is not in a specific organization.

## 4.7 Sample population

To avoid any bias, the snowball sampling approach was used to define the study sample (Ishak, Bakar, and Yazid, 2014). This was also done to guarantee that only knowledgeable professionals are interviewed. Because snowball is a multistage technique, the first participant(s) interviewed determined who will be the next participant(s) (Ishak et al., 2014). To ensure that the Protection of Personal Information (POPI) Act is upheld, the researcher sought to be introduced to each participant. The POPI Act is South Africa's data protection legislation, whose goal is to safeguard personal data processed by both public and private sectors (Republic of South Africa Goverment Gazette, 2013). Primarily, the LinkedIn platform was used to reach out to potential participants.

The concept of saturation, although unclear as to how it is achieved, has been identified as a technique for determining the adequate sample size in qualitative interview research methods (Constantinou, Georgiou, and Perdikogianni, 2017). The aim of the researcher was to leverage this concept in order to determine the appropriate sample size. As a result, informed by the concept of saturation, this study was conducted among twelve (12) professionals involved in BDA work practices..

## 4.8 Respondents Profile

Table 5 below depicts the demographics of the participants who responded to the study.

| Participant | Sector | Role | Years of experience |
|---|---|---|---|
| **POT0102** | Financial Services | Product Owner | 7 years |
| **DEW0202** | Financial Services | Data Engineer | 10 years |
| **LDB0303** | Tech Consulting | Technology Lead | 10 years |
| **DAS0403** | Financial Services | Data Analyst | 5 years |
| **TAJ0503** | Financial Services | Tech Architecture | 25 years |
| **DEW0603** | Financial Services | Data Engineer | 1 year |
| **BAC0703** | Financial Services | Solution Architecture | 15 years |
| **SAI0803** | Financial Services | Solution Architecture | 4 years |
| **TSG0903** | Financial Services | Technical Specialist | 10 years |
| **DEG1004** | Financial Services | Data Engineer | 1 year |
| **DSE1104** | Telecommunication | Data Scientist | 16 years |
| **POK1204** | Tech Consulting | Product Owner | 5 years |

*Table 5: Respondent's profile*

## 4.9 Data Collection Procedure

Data was collected through conducting qualitative semi-structured interviews. The conceptual framework guided the data collection. Interview questions used for data collection were developed guided by the conceptual model, as a sensitizing device, formulated from the reviewed literature (Bowen, 2006). The interview questions are included in Appendix A. To uphold COVID-19 regulations, the researcher leveraged Microsoft Teams to conduct the interviews and data collection. The researcher also made use of a notebook to take notes during the interview session. The interview sessions were scheduled and lasted between 30 to 60 minutes. Interview sessions were scheduled with participants at a time convenient to them. Each interview session was recorded and later transcribed, then followed by analysis.

## 4.10 Data Analysis Procedure

Grounded theory methodology aims to derive theory inductively from qualitative data collection and analysis without extensive knowledge of the literature (Bowen 2006,

Gioia, Corley, and Hamilton, 2013). However, to maintain balance, the methodology also employs the literature as a sensitizing concept (Bowen 2006, Gioia, Corley, and Hamilton, 2013). This study aimed to achieve this objective, utilizing grounded theory techniques that involve open coding, axial coding, and selective coding (Urquhart, Lehmann, and Myers, 2010; Walker and Myrick, 2006; Hoddy, 2019).

The open coding stage follows the transcripts (text) inductive analysis approach of inductively analyzing text to gain meaning, thus constructing codes by identifying constructs and concepts (Glaser & Strauss, 1967; Walker and Myrick, 2006; Thomas, 2006; Bernardi, 2017). In addition, the stage involves describing and labeling basic conceptual constructs (concepts) with almost no categorization refinement (Holton, 2007; Urquhart et al., 2010). The stage involves painting an image through words, it pays less emphasis on the refinement of codes categories (Strauss and Corbin, 1998). Gioia et al. (2013) relate this stage to the first-order analysis.

The axial coding approach, seek to identify similarities and resemblance in codes and group the similar codes into an abstract conceptual category (Adolph, Kruchten and Hall, 2012; Gioia et al., 2013; Scott and Medaugh, 2017; Bernardi, 2017). Gioia et al. (2013) relate this stage to the second-order analysis.

The selective coding stage involves “deciding on the central category that all major categories can link to” (Stol, Ralph, and Fitzgerald, 2016; p. 123). The aim is to develop the categories, their properties, and their theoretical connections (Walker and Myrick, 2006; Holton, 2007). This stage is related to Gioia et al. (2013) stage of the development of aggregate dimensions. It is followed by theoretical coding which involves the formulation of theory (Urquhart et al., 2010). It is a systematic approach to integrating conceptual categories (Holton, 2007). It can be thought of as a process of high-level abstraction (Strauss and Corbin, 1998). Thus, “integrating the data around a central theme” (Walker and Myrick, 2006; p. 556). The themes are the ultimate outcome of the analysis (Thomas, 2006).

Using the NVivo software the researcher critically analyzed the transcribed participant's response to identifying emerging codes. The process of identifying codes involved constant reference to the transcribed participant's response, familiarizing and getting acquainted with the collected data, and reassessing the codes (Braun and Clarke, 2006; Heydarian, 2016). The whole process eventually led to the development of a codebook. As suggested by Heydarian (2016), the codebook was reviewed and refined throughout the analysis process. The emerging codes were grouped into categories with a little attempt of refining the categories (Gioia et al., 2013). This was followed by the process of identifying similarities and resemblances in codes and grouping the similar codes into major categories (Adolph et al., 2012; Gioia et al., 2013; Scott and Medaugh, 2017; Bernardi, 2017). The major categories were aggregated into themes with different dimensions resembling core concepts that can be used to establish theory (Gioia et al., 2013; Andrade, 2009). Throughout the process, the themes were reviewed and revised. The researcher generated a report from the concepts of theoretical interest (Heydarian, 2016; Mortensen, 2020).

## 4.11 Ethics and Confidentiality

When conducting interpretive research there are four main areas of ethical concerns to note, it includes, "harm to participants, lack of informed consent, invasion of privacy, and deception" (Walsham, 2006; p. 327). In addressing these concerns, the researcher sought ethics approval from the University of Cape Town (UCT) Ethics in Research Committee (EiRC). Also, the researcher requested the consent of each participant. Each participant was informed of the purpose of the research and any other factor the participant should take note of. This includes informing the participant that participation is voluntary, that they can withdraw participation at any point, and that they are not obligated to answer questions they are uncomfortable answering. In ensuring that there is no potential harm to the participant, the participant's rights were always treated with respect. The data collected and all other information related to the research were treated with high confidentiality and privacy.

Though the participant's identity has been kept confidential by means of using pseudo names, the challenges related to anonymity required the researcher to pay attention to ensuring that it is not easy to trace back from the report, who the participant is. A good example is in a case where the participant is a CEO of a company, the researcher needed to ensure that the reader of the report cannot make an informed guess of who the participant might be (Walsham, 2006). Another ethical consideration is the researcher's honesty during the interview. According to (Walsham, 2006), it is unethical for a researcher to ask questions about something else when they are aware that they intend to learn about something else. Furthermore, Walsham (2006) argues that in writing the report the researcher must uphold honesty. The research findings presented in Chapter 5 were reported with honesty.

## 4.12 Chapter Summary

This chapter outlined the research design and method the researcher adopted in facilitating the study. In addition, the researcher outlined their philosophical stance, approach to theory, strategy, data collection procedure, and data analysis procedure.

# 5 Research Findings

## 5.1 Introduction

This study aimed to answer the research questions; what are the structures that enable or constrain collaboration in BDA work practices in organizations and how do structures enable and constrain collaboration in BDA work practices in organizations?

In answering these research questions, a structuration analysis of collaboration in BDA work practices in organizations is investigated. Thus, also investigates how structures and collaboration interact in BDA work practices in organizations by exploring structures that influence formal and informal collaboration. Using the developed conceptual framework as a sensitizing device, data was collected through semi-structured interviews, transcribed, and cycled through the data to note the emerged codes, categories, and themes.

In the first-order analysis, various codes were described with little categorization. The codes that shared similarities were categorized as communication triggers, authority triggers, sanction triggers, interpretive schemes, facilities, and norms in the second-order analysis. The categories were aggregated in formal and informal collaboration dimensions as signification structures (e.g., BDA platform services enacted in practice, ad-hoc BDA platform services enacted in practice), domination structures (e.g., BDA Capabilities enacted in practice, social capabilities enacted in practice), and legitimation structures (e.g., BDA governance enacted in practice, social contracts, and informal sessions enacted in practice). Table 6 below depicts the data structure of the research findings.

| *1st Order* | 2nd Order | Aggregate Dimension |
|---|---|---|
| *Big data platform services. Communication and collaborative activities. Platform. Infrastructure implementation. Productionalizing practices. Business strategy practices. Insight-sharing practices. Proof of concept development practices. Process improvement practices. Problem-solving practices. Establishing Shared understanding and objectives practices. Stakeholder engagement activities. Infrastructure* | Formal communication triggers. | Formal Signification Structures |
| | Formal Interpretive schemes. | |
| *Governance practices. Agreements. IT infrastructure. Access control. Federated data practice. Management. Governance practices. Agreements practices. Access control practices. Federated data practice. Management practices. Temporal complexity. Subject matter expert culture. Geographic settings. Technical capabilities. Social capabilities. Employee roles. Technical capabilities challenges. Social capabilities challenges.* | Formal power triggers, | Formal Domination Structures |
| | Formal facilities | |
| *Governance. Processes and standards. Governance challenges. Processes and standards challenges. Governance. Technologies. Work Practices. Governance challenges. Technologies challenges. Work Practices challenges.* | Formal sanction triggers | Formal Legitimation Structures |
| | Formal norms | |
| *Productionalizing practices. Project management practices. Work activities nature. Work environment culture. Tribal knowledge. Interpersonal relations. Knowledge sharing. Problem-solving. Requirement analysis. Work environment culture challenges.* | Informal communication triggers. | Informal Signification Structures |
| | Informal Interpretive schemes. | |
| | Informal power triggers. | |

| *1st Order* | 2nd Order | Aggregate Dimension |
|---|---|---|
| *Professional's individual knowledge. Time challenges. Soft skills. Individuals' knowledge. Collaborative technologies. Employee roles. Social technology capabilities.* | Informal facilities | Informal Domination Structures |
| *Informal meeting practices. Processes challenges. Social sessions. Technical sessions. Collaborating Platforms Preferences. Data Security and Non-Disclosure Agreements Practices.* | Informal sanction triggers<br>Informal norms | Informal Domination Structures |

*Table 6 Data Structure of the 1st-order Terms and 2nd-order Themes and Aggregate Dimensions (Gioia et al., 2013)*

The following section presents findings that detail the nature of collaboration in BDA work practices in an organization. The section will be followed by a detailed section on structuration analysis in BDA work practices in organizations and a chapter summary. Figure 9 below provides a visual guide to the next sections of this chapter.

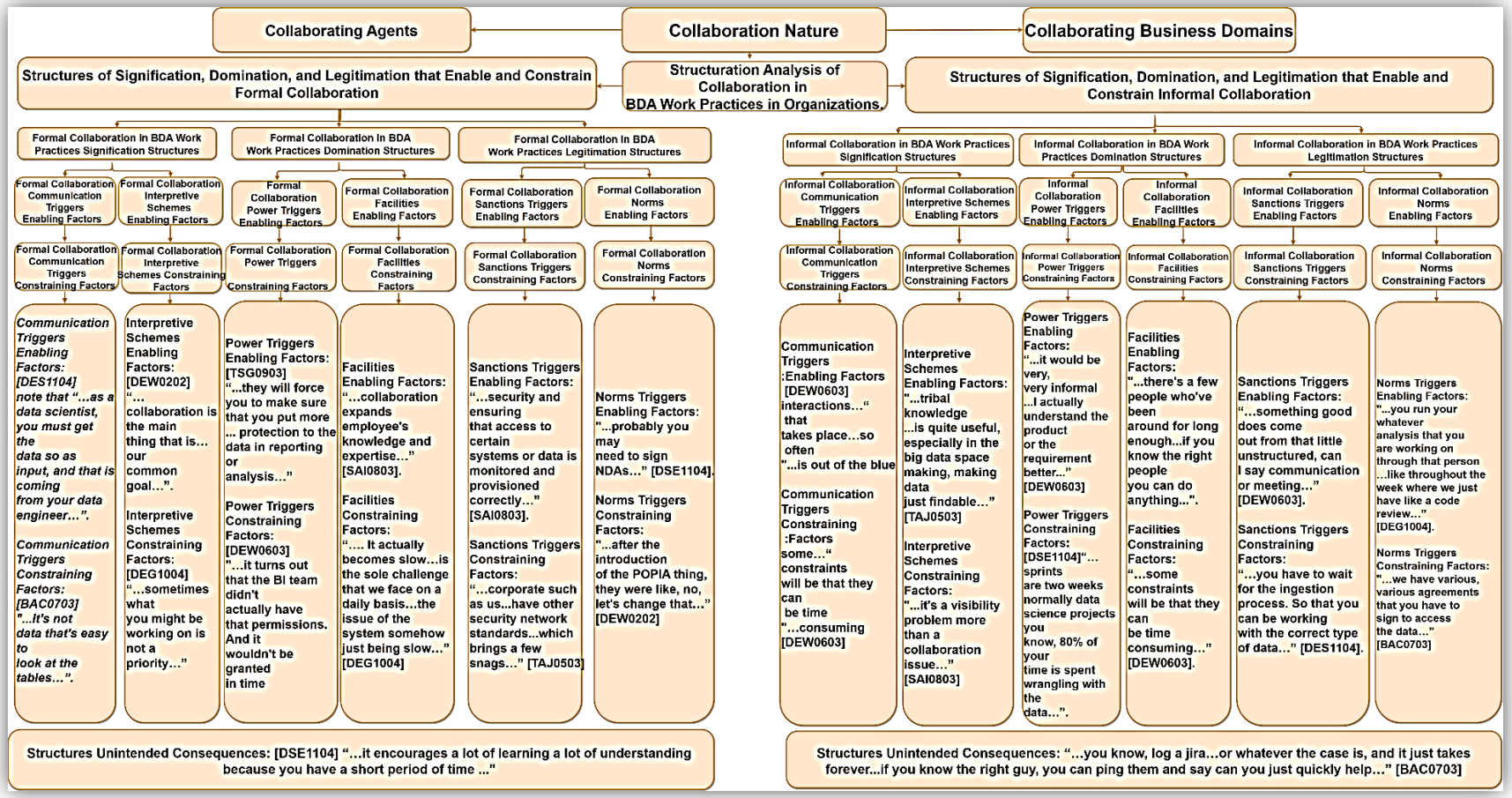


*Figure 9: Chapter Five Visual Guide.*

## 5.2 Collaboration Nature

### 5.2.1 Collaborating Agents

Most of the participants note that the nature of collaboration that BDA professionals adopt as human agents or actors that draw upon understandings of interpretive schemes, norms, and power during social activities is influenced by the nature of their work practices and the task at hand. Both formal and informal collaboration happens across different collaboration settings. Such collaboration is further enabled by online collaborative technologies that have been adopted. Collaboration practices such as forums are facilitated through *"…communication that happens within that chat platform…" [SAI0803].* Such practice is further enabled by *"…instant messaging, instant chatting…" [SAI0803].*

[DEW0603] note that in facilitating formal collaboration *"…data scientists and the quantitative analysts…they get their hands on that data…after an agreement has been put in place… that is put together in terms of a formalized document that needs to be ratified before…"*

Collaboration among BDA professionals in their work practices can be an interdepartmental, inter-organizational, inter-teams, inter-discipline, and interprofessional type of collaboration. One of the professionals noted that in their collaboration in BDA work practices, there is "...*integration with one of the big insurance companies…" [DEW0202].* Another professional affirms interdepartmental collaboration.

> *"…I was assigned a particular task to work on, for one of the department…" [DAS0403]*

The professionals in their collaboration in BDA work practices *"…would have the different teams…that collaborate together…" [SAI0803].*

With interprofessional collaboration, for example [DSE1104] note that *"…you have to be interacting with product owners, you have to be interacting with SMEs, you have to be interacting with business analyst with the with data owners, different data owners. And you so as as data scientists, we have to be cooperating. Some projects might be interplay between two different data scientists sitting in different place…"*

### 5.2.2 Collaborating Business Domains

The BDA work practices in organizations happen across the business domains to aid their defined functions and capabilities. The business domain functions include among others, sales, and marketing, human resources, risk, regulatory, finance, investments, wealth, etc. One professional noted that *"…the guys who are doing wealth will have their own data, the guys who are doing investments will have their own data, and so forth and so forth. And then they'll have their own tech and whatever, inside the team…" [POT0102]*

Another professional noted that *"…the marketing department is the one that's always forcing, like they want things to be done their own way…" [DEW0202]*

Furthermore, collaboration would initially be in *"…my team regulatory reporting…then the bigger department which is risk treasury and finance…" [SAI0803].*

## 5.3 Structuration Analysis of Collaboration in BDA Work Practices in Organizations.

### 5.3.1 Structures of Signification, Domination, and Legitimation that Enable and Constrain Formal Collaboration

When formal practices, rules, resources, and meaning systems are enacted in BDA work practice they reproduce and give rise to structures of signification, domination, and legitimation. Table 7: below summarise the detailed research findings of formal collaboration practices, rules, resources, and meaning systems enacted in BDA work practice.

| ***Structures, Modalities, and Agency Action, Needs and Triggers*** | **Themes and Responses** |
|---|---|
| ***Signification Structure*** | BDA platform services enacted in practice |
| *Action and Triggers* | **Communication triggers (enabling):**<br>Big data platform services. Communication and collaborative activities. Platform. Infrastructure implementation. Productionalizing practices. Business strategy practices. Insight-sharing practices. Proof of concept development practices. Process improvement practices. Problem-solving practices. Establishing Shared understanding and objectives practices. Stakeholder engagement activities. |
| | **Communication triggers (constraining):**<br>Infrastructure |
| *Sample Responses* | *"…as a platform team, you are responsible for a certain level of upkeep and maintenance…" [TAJ0503]*<br>*"…One of the challenges, I think, is that there is just so much of…like historical mainframe stuff…it's not data that's easy to look at the tables…" [BAC0703]* |
| *Modalities* | **Interpretive schemes (enabling):**<br>Shared understanding and assumptions. Shared values. Shared infrastructure and technologies. Shared strategy and objective. |
| | **Interpretive schemes (constraining):**<br>Shared understanding and assumptions. Challenges. Shared values Challenges. Shared strategy and objective Challenges. |
| *Sample Responses* | *"…collaboration is the main thing that is…our common goal…" [DEW0202]*<br>*"…sometimes what you might be working on is not a priority…" [DEG1004]* |
| ***Domination Structure*** | **BDA Capabilities enacted in practice** |
| *Action and Triggers* | **Power triggers (enabling):**<br>Governance. Agreements. IT infrastructure. Access control. Federated data practice. Management |
| | **Power triggers (constraining):**<br>Governance practices. Agreements practices. Access control practices. Federated data practice. Management practices. Temporal complexity. Subject matter expert culture. Geographic settings. |
| *Sample Responses* | *"…we need the project manager or whoever, or your manager to give approval regarding you accessing specific data…" [TSG0903]*<br>*"…certain knowledge is sitting with certain key people. And if they are not there, you cannot proceed with the work that you want to do. But those issues are broader, are broader and structural…" [DSE1104]* |
| *Modalities* | **Facilities (enabling):**<br>Technical capabilities. Social capabilities. Employee roles |
| | **Facilities (constraining):**<br>Technical capabilities challenges. Social capabilities challenges. |
| *Sample Responses* | *"…in that supervisory structure, we ensure that people are mentored…" [LDB0303]*<br>*"…you have information that data that's being generated on a particular system that can't be integrated with your with the new the new infrastructure…" [SAI0803].* |

| ***Structures, Modalities, and Agency Action, Needs and Triggers*** | **Themes and Responses** |
|---|---|
| ***Legitimation Structure*** | **BDA governance** and **management enacted in practice** |
| *Action and Triggers* | **Sanction triggers (enabling):**<br>Governance. Processes and standards. |
| | **Sanction triggers (constraining):**<br>Governance challenges. Processes and standards challenges. |
| *Sample Responses* | *"…making sure that you continuously align with the with the client...where you have things like your morning stand ups…" [LDB0303]"*<br>*"…on the coding standards, yes, we differ, because we've got our own ways that we need to follow…" [DEW0202]* |
| *Modalities* | **Norms (enabling):**<br>Governance. Technologies. Work Practices |
| | **Norms (constraining):**<br>Governance challenges. Technologies challenges. Work Practices challenges. |
| *Sample Responses* | *"…you may be exposed to certain classified information, for instance, that should by nature shouldn't be shared with a wider audience of people. And yeah, in those cases, probably you may need to sign NDAs…" [DSE1104]*<br>*"…we have very few initiatives or projects I would say that cut across multiple teams…" [SAI0803]* |
| ***Unintended Consequences*** | **Collaboration in BDA work enacted in practice** |
| *Action and Triggers* | Knowledge retention activities triggered by consultancy enactment |
| *Modalities* | Collaboration value recognition challenges. Resources challenges. Challenges with Formal processes |
| *Sample Responses* | *"…you have a short period of time say you have to solve a problem in in two weeks because a sprint is two weeks…you have to assimilate quite a lot and understand so that you can implement a sound product…" [DSE1104].*<br>*"…you follow your sort of traditional SDLC, where you got a dev and acceptance, pre prod and production, and you've got to go to change control boards to sign up production changes…that slows you down…" [BAC0703].* |

*Table 7: Research findings summary of formal collaboration practices, rules, resources, and meaning systems enacted in BDA work practice.*

#### *5.3.1.1 Formal Collaboration in BDA Work Practices Signification Structures*

##### 5.3.1.1.1 Formal Collaboration Communication Triggers

The communication triggers in BDA work practices include collaboration activities resulting from the need for big data platform services, infrastructure, productionalizing, business strategy, insight sharing, process improvement, problem-solving, shared understanding and objectives, and stakeholder engagement that is enacted in practice.

##### 5.3.1.1.1.1 Formal Collaboration Communication Triggers Enabling Factors

*Big Data Platform Services Activities*

Almost all participants highlighted the need for "BDA platform services" as a trigger and enabler for communication and interaction. Enacted in practice are BDA platform services activities of data sourcing, data warehousing, data analysis, and reporting, data quality, and data platform. Most of the participants indicated that data-sourcing activities are central to triggering communication. For example [DEG1004] note that *"…sometimes we have to source for data…the process usually starts from outside what we call tenants…if the data that we're trying to source comes from like a different source from what we have, we have to stage it…".* In addition, [DES1104] note that *"…as a data scientist, you must get the data so as input, and that is coming from your data engineer…".*

The necessity of communication is also demonstrated by the stakeholder engagement activities that occur during data processing. [DEW0603] noted that

> *"…with the communications of the BI manager.… we add an SSIs package to the job…this job does run on a scheduling tool…apart from the initial injection, that just pushes the data off to a SQL table…".*

Additionally, in the service of data storage activities, which happens where technologies and tools are required. [TAJ0503] explained that

> *"…all these replicas and are for certain purpose...you might have four or five data repositories with four or five tools...already 16 permutations of various things that can talk to each other…".*

Participants noted that even with data sourcing and ingestion activities there is a need for communication with other teams. As noted by [SAI0803] stating that

*"… 99% of the time we are not the producers of the information that are required. There is definitely some other team that this data needs to be extracted from or caught from…".*

One participant noted that the requirement for big data platform services such as data visualization leads to communication being triggered and extending to the end user. In some of the BDA work practices [BAC0703] note that

*"…you started to nurture insights, create your cubes, and your dashboards that you can make available for consumption to end users…".*

Among other big data platform services, data processing enables collaboration, as it is a function that happens across teams. As noted by [DEW0603] that they

*"…incorporated another section or other BI departments workflow into my own as well, in that we include an SSIS job with the collaboration…so that it can actually kick off immediately to the end consumer...".*

It has been noted that professional collaboration will enable predictive analytics and data modeling as a big data platform service. For example [BAC0703] note that

*"...It certainly influences our modelling...we are using predictive analytics....SAP HANA as well has its own predictive analytics as well. I can't say it derives collaboration. But also collaboration enables it...".*

The requirement for a data lake and data mart further enables collaboration. As noted by [SAI0803], regarding

*"…the data Mart and the lake. If you have this one system where everybody is landing all the... all the data and there it becomes a one stop shop where everybody can come and just request or get what they need…"*

### *Productionalizing Activities*

Few participants note that productionalizing enacted in practice enables the need for communication in the interaction of professionals in BDA work practices in organizations. Productionalizing includes among other things requirements for time to market, environment setup, and support.

Enacted in practice the environmental configurations enable interactions among professionals. As noted,

> "*…the data scientists on the supplier side they send us raw files, we mearlly set up the environment to and send this data off…" [DEW0603].*

Communication is evident when professionals ensure they meet time to market, as they coordinate dates and timelines. As noted,

> *"…sometimes we coordinate dates and timelines there…development teams are delivering building solutions have requirements for new features, and specific timelines…" [TAJ0503].*

Interactions are noted in ensuring successful productionalizing professionals are responsible for the upkeep and maintenance of their solutions and environment. As noted, *"…they log request related to report dashboard, or whatever BI solution that they are using, if there are something that needs to be fixed, one of the developers in the team have to look on that, if there is a new application or BI solution that needs to be build, someone have to take that and work on that piece of work…" [TAJ0503].* [TAJ0503] further notes that *"…as a platform team, you are responsible for a certain level of upkeep and maintenance…".*

### *Business Strategy Activities*

Few participants noted business strategy activities as a trigger and an enabler for communication and interaction in BDA work practices in organizations. Enacted in practices are business strategy activities for leveraging data insights to gain business value and decision-making, revenue generation, competitive advantage, planning, training, data quality, and customer services.

There is often a need for communicating business strategy that informs the delivery of specific business capabilities. As noted,

> *"…there would be business strategy that informs which deliverables and which business capability is needed for the company…" [TAJ0503].*

The business capabilities include the insights generated from the data, which get passed through to other business stakeholders, and further translated to business value by means of revenue generation. As noted,

> *"…we do have processes to formalize those insights…that kind of collaboration gives us really, really good insights…that are making money for the business …people often get our BI you've got graphs and reports…that's really nice …when you seeing it directly showing business value, and those insights being used…" [BAC0703].*

Such insights are further used for business decision-making. As noted, *"…business get the report and analysis which will assist them to improve the business or to avoid certain risk.... because remember, at the end of the day, the data is meant for business decisions…" [TSG0903].*

The desire for organizations to remain in competitive advantage with competitors fuels the need for collaboration and planning. As noted, *"…the main thing that drives*

*collaboration is the desire or the need to remain competitive…once you start to integrate all this information together, then a more a bigger picture, or a more clearer picture starts to form…the easier it is and it will be for those who make strategic decisions, to do their work and to do their planning and make sure that you know, we were taking the company in the in the right direction…" [SAI0803].*

This makes data quality and training essential to the BDA professionals in doing their work and when collaborating. As noted, *"…there's a small aspect of the technical side, where we lacking when we're doing our things, then they'll organize…vouchers to write AWS…" [DEW0202].* [POT0102] further notes that *"…there will always be someone who does data quality assurance…".*

Thus, customer service is strengthened. As noted, there is a need to *"…understand your customer and the problem that you're solving…" [DES1104].* [TSG0903] further notes that *"…at the end of the day, you have to go to business, present their results, discuss the results…"*

### *Insights Sharing Activities*

Few participants noted that insight sharing enacted in practice enables communication and collaboration of professionals in BDA work practices in organizations. Such insight sharing is triggered by the need for information and knowledge sharing.

Professionals engage in various activities for knowledge sharing, such activities take different forms but with the intention to further enable collaboration. As noted,

> *"...there is a knowledge sharing sessions...you get to demonstrate something of value that you've done to the team...that it's an enabler...there opportunities that can be unlocked is another business might be trying might have the same problem that you've already solved for, and therefore they can leverage your solution..." [DSE1104].*

### *Process Improvement Activities*

Only a few participants noted that process improvement activities enacted in practice enable communication and collaboration of professionals in BDA work practices in organizations.

To further enable effective communication and collaboration, there is a need for process improvement by automating some of the processes. As noted, *"…we then make sure we productionlize it in the best way possible and avoid back and forth between business and us and avoid human interaction…" [POT0102].* [SAI0803] add that the *"…processes allows them to automate things that they would ordinarily have done in the past manually…".*

### *Problem Solving Activities*

Most of the participants noted that problem-solving activities enacted in practice enable communication and collaboration of professionals in BDA work practices in organizations. The problem-solving practices include among others, calculations, solution and design, innovative activities, introducing effective ways of work, proof of concepts, and script execution.

Professionals collaborate in problem-solving to introduce effective ways of performing specific tasks and solving customers' challenges. As noted,

> *"…you want to translate the customers problem or challenges, and properly have that solution to then at the end become something that is then implemented…" [LDB0303].*

Introducing effective ways of working, enables them in solving “technical problems”. As noted, *“…we sort of quite good at solving the technical problems…” [BAC0703].* The technical problems include among other things scripts execution and calculations. [DEW0603] note that *“…the analytical work comes in, when you actually lighting out that...PySpark script service. So that does require a bit of thinking force…”.* [BAC0703] add that *“...you starting to take data from different sources from different teams and trying to make some sense out of it...if you want to look at actuarial calculations...”.*

Some other problem-solving initiatives are innovative activities and building proof of concepts. In the problem-solving interaction if a solution is *“…feasible, and then we move on to creating a POC for them proof of concept to see that it works. So that's like the formal way in which some piece of work or collaboration will begin…” [SAI0803].* [TAJ0503] adds that they *“…would be innovative…its exploration…”.*

### *Establishing Shared Understanding and Objectives*

Almost all participants agree that establishing shared understanding and objectives enables communication and collaboration of professionals in BDA work practices in organizations. Enacted in practice, business requirements and working together establish shared understanding and objective.

Business requirements for BDA work come from various channels and are meant to address specific business needs and business cases. As noted,

> *“…those usually come as requests from different areas within the within less larger team or the technology team, or it comes from the business teams that we service…the other thing is to continue to produce classic business cases or to produce newer initiatives and projects…” [SAI0803].*

Defined business requirements ensure that collaborating professionals in BDA work practices work together with a clear common goal that addresses customers’ needs.

[TSG0903] noted that they *"…have to go and collect requirements and everything…".* As noted by [LDB0303], *"…it helps with clarifying exactly what the customer wants, making sure that we manage expectations…"*

*Stakeholder Engagement Activities*

Though it is evident from all participants that there is various stakeholder engagement for almost every initiative in the collaboration of BDA professionals, only a few participants emphasized that stakeholder engagement enacted in practice enables communication. The need for consultancy and engagement with project managers, other professionals, and teams trigger communication during collaboration in BDA work practices in organizations.

Not only is the need for stakeholder engagement a need to engage with specific roles such as project managers, but different arms of the business also based on their needs, for example contracting specific skill sets for specific capabilities in solving a specific problem. As noted, *"…that data science resources are pretty much used in consulting basis...they are loaned to the business all the different arms of the business...you literally bring that capability as a data scientist to leverage or solve a specific problem…" [DSE1104].* [TSG0903] add that there is a *"…need the project manager or whoever, or your manager to give approval regarding you accessing specific data…"*

#### 5.3.1.1.1.2 Formal Collaboration Communication Triggers Constraining Factors

*Infrastructure Challenges*

Only a few participants stated that the need for infrastructure enacted in practice enables communication in BDA work practices. However, legacy infrastructure can

render collaboration in BDA work practices in organizations ineffective, thus, contributing as a constraint. As noted by [BAC0703]

> *"…I don't think we are as good at saying...here is my data, here is your data, how can we share it and use it more effectively? One of the challenges, I think, is that there is just so much of…like historical mainframe stuff…it's not data that's easy to look at the tables…".*

Though almost all participants stated that shared understanding is an enabler for collaboration and triggers communication, the lack of shared understanding can constrain collaboration in BDA work practices. [DSE1104] note that

> *"…If you don't understand, you may struggle to convey. So, the assumption always is a data scientist is a good data scientist... they understand the technicalities…".*

#### 5.3.1.1.2 Formal Collaboration Interpretive Schemes

The enactment of shared understanding and assumptions, shared values, shared infrastructure and technologies, and shared strategy and objective in BDA work practices influences mutual interactions, thus, contributes to enabling or constraining collaboration in BDA work practices in organizations.

##### 5.3.1.1.2.1 Formal Collaboration Interpretive Schemes Enabling Factors

*Shared Understanding and Assumptions*

Almost all participants indicated that shared understanding and assumptions enacted in practice influence mutual interaction and enable collaboration in BDA work practices in organizations. The need for expertise and tools, business requirements, and

common goals are all examples of how shared understanding and assumptions influence mutual interactions.

Participants stated that the common goal of getting work done makes collaboration in BDA work practices of value, thus, enabling it. [DAS0403] noted that *"…you get use to working with people not just working for the sake of working, but working within an aim of getting something out…".* In addition, [BAC0703] claims that *"…shared understanding, definitely can be better. But I also think tied to that is shared goals…"* Similarly [DEW0202] notes that *"…collaboration is the main thing that is…our common goal…".*

Some participants noted that there is an understanding of the "need to collaborate" in BDA work practices in organizations, because of the need for expertise and tools. As noted,

> *"…there's always a need to collaborate with someone else…you can write your SQL statement, but at the end of the day, you need to collaborate…with the data scientists code from the Python code from the data scientists…encouraging or forcing us to do more collaboration when it come to tools or on the technical side of things…" [DEW0202].*

The mutual interaction in leveraging different expertise positively influences shared understanding, thus, enabling collaboration. As noted,

> *"…collaboration then is so important because each person is bringing in a piece of knowledge…" [POK1204].*

In addition, the complexity of the tasks in BDA work practices forces professionals to collaborate as it is not easy to have an "end-to-end" understanding. As noted,

*"…there's no way one person can understand end to end. It's, it's almost impossible to completely understand it and that's why you need people to communicate and collaborate…" [POK1204].*

The set guidelines and principles further influence shared understanding, thus, enabling collaboration. As noted,

*"…there is a lot of architectural principles in how you deploy and use tools. But again...they should, and they are architectural guidelines that says, Look, this is how you use these tools…" [TAJ0503].*

Business requirements specifications are often a basis for creating shared understanding, thus enabling collaboration. It has been noted that business requirements enacted in BDA work practices form a basis for solution development and delivery, proof of concept specification, and use case specification. This can be noted from the participant's comments like: *"…you can't just deliver anything that doesn't conform to what the business analyst want…" [DEW0202]; "…you can actually get whatever the requirement is, or whatever the objective is, you can actually get it into production…" [DEW0603]; "…you want to translate the customers problem or challenges, and properly have that solution to then at the end become something that is then implemented..." [LDB0303].*

Furthermore, the use of templates in documenting business requirements encourages shared understanding among collaborating professionals. As noted,

*"…business requirements can actually make more sense to other people. So yeah, I think the approach of using templates actually helps a lot..." [DEG1004].*

Common goal influence on collaborating professionals has been noted to be implemented through working together among other factors. As noted,

*"…that influences collaboration a lot...each person got his own piece of work that he has to do. But all those pieces once they are combined, together, they sort of achieve the common goal that is needed…" [DEW0202].*

### *Shared Values*

Most of the participants indicated that shared values enacted in practice influence mutual interaction and enable collaboration in BDA work practices in organizations. This is through the enactment of a common working culture, the organization's culture and structure, communication, problem-solving, knowledge sharing, interpersonal relationships, and trust.

Participants noted the shared culture of working together as one of the shared values, and central to enabling collaboration in BDA work practices in organizations. For example, [DAS0403] notes that

> *"…the people who you are working with, they're always willing to assist…that enables you to accomplish even more…because you have support. But at the same time, you also learn because it's not only about me getting help from other people, but to also learn that I'll have to be able to assist others...".*

In addition, the organization's culture and structure are also an enabler of collaboration. This can be noted from the participant's comments like: *"…the organization is built such that you have to collaborate…" [LDB0303]. "…corporate culture would influence the way we collaborate…" [TAJ0503]*

One participant noted communication as one of the shared values that also enable collaboration in BDA work practices in organizations. *"…communication skills are really important they allow you to…motivates the reason for why you....put forward your case…"* [SAI0803]. In turn, the enabled collaboration serves as a "communication bridge". This was noted by one participant, answering how collaboration is influenced.

> *"…being part of the technical staff and all the salespeople are not technical, it is a bit tough at times. And it's mainly a communication bridge…" [DEW0603].*

Fundamental to shared values, problem-solving is central to enabling collaboration in BDA work practices in organizations. One participant noted that problem-solving involves asking questions in order to solve the task at hand, thus, enabling collaboration. [SAI0803] noted that,

> *"…you have to go out…ask questions...that whole problem solving process that really requires you to just step outside of your space...reach out to others...".*

Organizations embrace trust as one of their shared values. One participant noted that trust is fundamental in enabling collaboration.

> *"…both parties at the end of the day… they're going to be performing a function, one of those parties itself…trust actually goes both ways, between maybe technical or non technical stakeholders as well…" [DEW0603].*

### *Shared Strategy and Objectives*

Few of the participants indicated that shared strategy and objectives influence collaboration in BDA work practices in organizations. Shared strategy and objectives enacted in practice influence mutual interaction through the need for data-specific objectives, performance, skills, project work delivery, and business value objectives. The data-specific objective includes big data platforms and data literacy.

Data is sourced from various distributed enterprise technology systems. This nature of data sourcing enables collaboration from integrated data sources. A big part of an organization's analytics work practices is implementing "golden sources" such as data marts and data lakes as technology platforms, which has an influence on the nature of collaboration by enabling federated and centralized data platforms. As noted,

> *"…big part of those analytics, your work practices is making sure that you know, you're using the golden source… this data lake or this data mart is central to the entire organization…" [SAI0803].*

The need for data literacy is often triggered by the need to establish a shared understanding. Data literacy and big data platform are an enabler of collaboration in BDA work practices in organizations. An enabler of collaboration in BDA work practices noted by most of the participants is the importance of professionals knowing their data, the kind of data that is available, how to find the data, and the technologies that enable these functions. This can be noted from the participant's comments like: *"…this also talks to data citizens you want almost everyone... and data literacy, you want everybody in the organization to understand the value of data…" [LDB0303]. "...if we had better ways of doing data discovery...big constraint is people just don't know what's available..." [BAC0703].*

To ensure productivity, organizations ensure that professionals perform in their work practices. Most of the participants state that collaboration becomes important in BDA work practices for ensuring that participants perform. Thus, further enabling collaboration and the BDA work practice. This can be noted from the participant's comments such as: *"…collaboration becomes very important, because everybody in that value chain needs to play their part." [LDB0303]. "…personal development plays a big role. Because once you begin to collaborate, you are usually if introduced into things…So they push you to learn new things" [SAI0803].*

Having a relevant and right skill set as an organization-wide strategy and objective, have an influence on collaboration in BDA work practices. As noted,

> *"…it's very important to also when you have people with the right skill, put them in the right places…for example, safe encourages like cross collaboration…" [POK1204].*

Specific to project work delivery organizations have work "backlog" to ensure that objectives are met, which further enables collaboration. For example, [POK1204] noted that

*"…we're delivering against and these are the objectives...that's basically how we communicate through the team, what the objectives are from the bigger scale to take them all the way down to these other tasks and then team backlog…".*

Central to an organization's shared strategy and objectives is adding business value, which further influences collaboration as it encourages discussions even on the executive board level. [BAC0703] noted that,

*"…depending on the importance of the insights, you know, at different levels, you know, some of the insights wouldn't surprise me if you end up with board level discussions…I'm sure they have some very long discussions and their board meetings around those insights…".*

Organizations invest in technology as their shared strategy and objective, some of the technologies include open-source resources, which further enable collaboration even with external parties. For example, [DES1104] notes that

*"…with machine learning there's a lot of open source capability that is has been leveraged within machine learning most of the tool sets, they come from the open source community and you know, how much collaboration is in the open source community…".*

### *Shared Infrastructure and Technologies*

Few of the participants indicated that shared infrastructure and technologies influence collaboration in BDA work practices. Shared infrastructure and technologies enacted in practice influence mutual interactions by enabling collaboration in BDA work practices in organizations.

Leveraging shared infrastructure involves mainly activities of data platform services. The data platform service includes integrated technology systems processes, data sourcing, and insights generation. The technology architecture of a BDA platform service intends to create an integrated and shared platform service, thus, enabling shared understanding and collaboration. This can be noted from the participant's comments: *"…when you look at Informatica the tool was made specifically for ETL…now when you go and check databases and everything, you will see that they go distributed databases or environments…that when you access you don't access on one system, you can read it from different from blits, and then the performance will be improved…which also assist you at the end of the day to get you to collaborate…" [TAJ0503]. "…we have a BI platform. And we have a shared data lake containing all of the sort of formally managed business data…" [BAC0703]. "And then sometimes there are certain things that you can perform or inter relationship between systems where there's an open interrelationship…you can even if you're in this system can access such data that is sitting on the other one...." [DEW0202].*

How collaboration is further enabled happens through the infrastructure that allows teams to build on top of it. As noted from [SAI0803],

> *"…we have a platform that's built in house, which allows several teams within the, within the company to build out their own business processes…".*

#### 5.3.1.1.2.2 Formal Collaboration Interpretive Schemes Constraining Factors

*Shared Understanding and Assumptions Challenges*

Not having similar or the same priorities constrain effective collaboration. Much less participant state that due to capacity and priorities not being aligned among collaborating professionals, collaboration in BDA work practices gets constrained. This can be noted from the participant's comments like: *"...that process involves a truckload of people. And those people are all busy...It's a day for the security guy to pick it up on his priority list..." [BAC0703]. "…sometimes what you might be working on is not a priority…" [DEG1004]*

### *Shared Values Challenges*

Fewer participants highlighted that environmental culture could constrain collaboration. One participant noted that in creating a collaboration culture the senior members need to advocate for it.

> *"…I really do believe that those in senior positions are the biggest drivers of the culture…if you want to create a collaboration culture within your team, then you need to have those in senior positions, or more experienced, you know, advocating for that or being the ones to demonstrate that…" [SAI0803].*

While other environments "fosters silos", with a lack of visibility of what other teams are working on. As noted, *"…in an environment that fosters silos…you cannot show it to anybody. It tends to kill motivation…some places, they might say, do your model, but just give me a report of the key actionable insights. In some places, they might say, I actually want to see your model itself. In some places, they might say no, do your model just give me an output in an Excel format…" [DSE1104].* [SAI0803] add that *"…the biggest challenge… is that we don't know what your neighbour is doing on the other side...it's a visibility problem more than a collaboration issue…". [BAC0703] also noted that, "…we need collaboration, we need to do it…but I keep hitting a brick wall because nobody's got the willpower…".*

### *Shared Strategy and Objectives Challenges*

Fewer participants highlighted the lack of data literacy as a contributor to collaboration in BDA work practice constraining factors. Enacted in practice, data literacy and the understanding of the value of data influence professional's interaction, thus, either enabling or constraining collaboration in their BDA work practices. One participant noted that one "big constraint" is people not knowing and understanding the data they have.

*"…there's very few people who've got enough understanding...if we had better ways of doing data discovery...big constraint is people just don't know what's available..." [BAC0703].*

#### *5.3.1.2 Formal Collaboration in BDA Work Practices Domination Structures*

##### 5.3.1.2.1 Formal Collaboration Power Triggers

The power and authority triggers in BDA work practices include collaboration activities resulting from the need for governance, agreements, temporal complexity, IT infrastructure, access control, federated data practice, geographic settings, management, and subject matter expert culture that is enacted in practice.

###### 5.3.1.2.1.1 Formal Collaboration Power Triggers Enabling Factors

*Governance Practices*

Few participants note that governance enacted in practice is enforced through company practices, rules, and norms. Such enforcement occurs because of the need for code review and standardized processes when professionals collaborate in BDA work practices in organizations. The company practices, rules, and norms include components of enforcing authority and power. Governance authority necessitates the introduction of ways of working. [DEW0202] note that,

*"…the only thing that is governing us is the procedures, rules and procedures…it's because of the rules that we need to collaborate in order to achieve…you know, okay. In the Data Analytics, you know, ABCs...is not allowed…because of the certain types of rules available within the combine that have been outlined...".*

Standards and procedures are put in place during the collaboration of professionals to enforce standard ways of performing work. [POT0102] note that *"…when we have*

*collaboration with business, all those things are enabling to also help us make better data standard procedures…".* The introduction of templates is an example of the standards and procedures that are put in place to further enable collaboration and encourage shared understanding. As [DEW0202] notes, *"…they've introduced something called templates…that's when I can say, everyone, we are on the same page, because they've developed templates where if a developer, right, sometimes you, you capture more information that you want to process…".* [DEW0603] add that, *"…it's a one size fits all document, in that you have to specify first of all, what the purpose is of this data set that you're now sending off to us…".*

The same applies in addressing security and privacy, there are standards and procedures enforced on practitioners. As [TSG0903] notes,

> *"…you can access the data which is confidential but also they will force you to make sure that you put more ... protection to the data in reporting or analysis…"*

One participant noted that collaboration in BDA work practices is enabled by the need for code review. When code review is enacted in practice triggers components of enforcing authority and power. As [DEW0202] notes,

> *"… those logical or predefined steps on patents are the ones that are helping to reduce human error…but if let's say you give me your code, 130 lines of code…I can be like, Ah, this is too much code…the logic was predefined steps and all that, then we are forced to follow the rules…where the need for human intervention and all that, then you're forced to sort of collaborate with other people…"*

### *Agreements Practices*

Only a few participants noted the practice of enforcing agreements as an enabler for collaboration, to ensure data sharing security measures are put in place. When agreements are enacted in practice trigger components of enforcing authority and power in the collaboration of professionals in BDA work practices in organizations.

To ensure control measures are observed collaborating organizations and professionals sign agreements that are enforced, further enabling formal interactions. As [BAC0703] notes, *"…I guess you need to sign these agreements and follow these processes…a very bureaucratic, big corporate way of thinking, but we have to do it because it's, you know, things like customer data or medical data or employee salary, data, that sort of stuff…".* [DEW0603] add that, *"…an agreement has been put in place with their company as well as mine…that is put together in terms of a formalized document that needs to be ratified before..."*

### *Federated Data Practice*

Few participants highlighted the practice of federated "data capability" as an enabler for collaboration. The federated data capability enacted in practice triggers components of enforcing authority and power in the collaboration of professionals in BDA work practices in organizations.

Federated and centralized data platforms enforce control measures and guidelines that are enforced on collaborating professionals in BDA work practices. This can be noted from the participant's comments like: *"…this data lake or this data mart is central to the entire organization…" [SAI0803]. "…More and more the people are also talking about a federated kind of data capabilities, right...there is this idea, and…is, at the moment, deployed a singular data Lake...you'd like to think that there is a lot of architectural principles...architectural guidelines that says, Look, this is how you use these tools…" [TAJ0503].*

### *Access Control Practices*

Few participants agree that the need for access enforces collaboration, as a result, enabling collaboration in BDA work practices. Professionals are forced to collaborate due to the level of access they have to certain technologies enforced by access

policies in place. Access control enacted in practice triggers components of enforcing authority and power in the collaboration of professionals in BDA work practices in organizations.

Access levels differ across the collaborating professionals, it is often allocated according to the level of seniority. Such arrangements enforce collaboration with those that have more access. As [TSG0903] notes,

> *"…we need the project manager or whoever, or your manager to give approval regarding you accessing specific data…".*

The formal nature of gaining access also enforces formal collaboration in BDA work practices, as professionals are forced to follow the formal channels. As [SAI0803] notes, *"…have formal, formal ways of requesting access to a particular system particular…".* [BAC0703] adds that *"…very often have to go to positions like to sign something off...you know, if the head of architecture sign something off…I do find those are only used when necessary…".*

### *Management Practices*

Few participants stated that management and those in leadership enable collaboration in BDA work practices as visionaries. Management activities enacted in practices triggers components of enforcing authority and power in the collaboration of professionals in BDA work practices in organizations. One of the participants note that

> *"…a big driver for this professionals to want to collaborate is to is to achieve I think, the, the vision that's coming from I'll say higher up…" [SAI0803].*

In an effort to provide guidance and support, management structures that enforce effective engagement are implemented, thus, enabling collaboration. *As [LDB0303] notes,*

> *"…in that supervisory structure, we ensure that people are mentored…So that we able to continuously grow skills, that way that helps enhance not only our*

*delivery capability, but it helps people to also understand each other's strengths and weaknesses…".*

*Information Technology Infrastructure Usage*

Most of the participant claim that collaboration in BDA work practices is often enforced through the tools, processes, and technologies the professionals use to accomplish their work. IT infrastructure enacted in practice triggers components of enforcing authority and power in the collaboration of professionals in BDA work practices in organizations. As [LDB0303] notes,

*"…we find that leveraging tools and processes that are in place, in this particular case actually helps the cause and actually enforces collaboration…".*

Though a wiki might offer informal collaborative capabilities, the introduction of a wiki encourages collaboration. Organizations incorporate into the wiki templates which enforce ways of collaborating. As [BAC0703] notes,

*"…there's a template for this template for that…it makes the documentation start to look very, very similar. And in those templates, we've got best practice examples…example diagrams, you know, take this diagram and modify to be your diagram...We've also bought some addons for the wiki to encourage collaboration…".*

#### 5.3.1.2.1.2 Formal Collaboration Power Triggers Constraining Factors

*Temporal Complexity*

One participant noted that temporal complexity (capacity and time) is a factor that constrains collaboration in BDA work practice. Temporal complexity factors enacted

in practice trigger enforcement of authority and power in the collaboration of professionals in BDA work practices in organizations.

The time frame constraints impede effective collaboration, thus, influencing how collaboration takes place. As noted by one of the participants:

> *"…I would need to perform that function on thier behalf…a once off file from another supplier that we've never worked with before… it turns out that the BI team didn't actually have that permissions. And it wouldn't be granted in time to get this file out as soon as it lands because the time frame we were working with was quite short..." [DEW0603].*

The time frame constraints have the potential to even influence priorities. As noted by one of the participants:

> *"…there's also the politics of what's important priority of the work that needs to be you know, needs to be completed…" [POK1204]*

As consequence, time frame constraints such as limited time can lead to certain collaboration activities not taking place.

### *Management Practices*

Few of the participants noted the constraints to collaboration in BDA work practices associated with management enacted in practices, as a trigger to the enforcement of authority and power.

Management's failure to create a culture of teamwork can exacerbate collaboration challenges in BDA work practices. As noted by one of the participants:

> *"…instead of even like trying a little bit to see how they can actually resolve a certain problem. They'll be waiting for somebody else to take care of it because they're like, I don't earn enough for this…" [POK1204]*

Other cultural aspects that are not encouraged by management also have the potential to further impede collaboration in BDA work practices. Such cultural aspects might include open communication. As noted by one of the participants:

> *"…the way you present yourself and shut other...discussion there on…when somebody's got a different, different opinion, and you, it's not going to be effective…" [TAJ0503].*

Senior stakeholders in the teams set the tone for collaboration culture, thus, negative collaboration culture can influence collaboration's effectiveness. As noted by one of the participants:

> *"…the manager or the product owner, or the subject matter experts, they set the tone of how the teams work…" [DSE1104].*

As consequence, management-enacted practices influence how collaboration is perceived, either constraining or enabling it. Senior stakeholders and those in managerial positions influence the culture of collaboration.

### *Geographic Setting*

One participant highlighted that a geographic setting contributes to constraints to collaboration in BDA work practices. The participant stated that this can be due to language barriers. Geographic settings enacted in practice trigger enforcement of authority and power in the collaboration of professionals in BDA work practices in organizations.

Geographic location can influence collaboration, considering factors such as language and specific country legislations. Where language is an issue, collaboration can be difficult. As noted by one of the participants:

> *"…we find multidisciplinarity teams, not just in the sense that they're coming from different areas of the business, or they address different components of the value chain of that BDA project. But also, because they may be coming from different geographies as well. And that something that may be called one*

*thing here, maybe something else there. And you can easily miss each other, even in interpreting things, work cultures, and so forth…" [LDB0303]*

### *Subject Matter Expert Culture*

Few of the participants noted the constraints to collaboration in BDA work practices associated with subject matter expert culture enacted in practice, as a trigger to components of enforcing authority and power.

The culture of subject matter experts exacerbates collaboration and how it occurs because knowledge is sitting with certain individuals. The collaborating professionals are forced to collaborate with the SME, as a result, they may not be able to proceed with their work due to the SME's unavailability. As noted by some of the participants: *"…we do get circumstances where there are silos. People certain knowledge is sitting with certain key people. And if they are not there, you cannot proceed with the work that you want to do. But those issues are broader, are broader and structural…" [DSE1104]. "…be it your senior software engineer, or your BI manager, only the data engineering department can actually handle such a thing…" [DEW0603].*

Though unintended, the culture of subject matter experts in the collaboration of professionals on BDA work practices influences delivery time and capacity (temporal complexity). As noted by one of the participants:

*"…because he is so busy actually, everyone goes to him because I will say is the one who understand that application or the BI as a whole more than anyone else…" [DAS0403]*

### *Governance Practices*

Few of the participants noted the constraints to collaboration in BDA work practices associated with company practices rules/norms enacted in practice as triggers to components of enforcing authority and power.

Though non-disclosure agreements are implemented as control measures, such measures constrain effective collaboration as there are rules that need to be observed before proceeding. Some of the constraints to collaboration are predefined step by step which professionals are forced to follow. As noted by some of the participants: *"…the logical was predefined steps and all that, then we are forced to follow the rules…" [DEW0202]. "…you're constrained by the NDA, you cannot share with a wider company…" [DSE1104].*

### *Access Control Practices*

Most of the participants noted the constraints to collaboration in BDA work practices associated with access control enacted in practice which triggers the enforcement of authority.

The collaborating professionals are impeded and delayed as a result of permissions and access levels. The collaborating professionals often have to wait for relevant access to be granted or for the required step in the process to be actioned. As noted by some of the participants: *"…if it so happens that you need access to specific things, that's where you get to escalated to you know, your managers…" [DEG1004]. "…somewhere somehow you have to get some, some approvals from the senior people that you can be able to do that…" [DEW0202].*

#### 5.3.1.2.2 Formal Collaboration Facilities

Technical capabilities, social capabilities, and employee roles when enacted in BDA work practices influence mutual interaction, thus, either enabling or constraining collaboration in BDA work practices in organizations.

##### 5.3.1.2.2.1 Formal Collaboration Facilities Enabling Factors

*Social capabilities*

Most of the participants noted that social capabilities enacted in practice influence mutual interaction, thus, enabling collaboration in BDA work practices in organizations. This is through the enactment of knowledge, soft skills, and time and capacity as resources or means professionals leverage to enable collaboration.

Knowledgeable professionals leverage their knowledge power and means to further enable collaboration in BDA work practices. Other attributes of knowledge that have been highlighted include domain knowledge, individual knowledge, and expertise. The need for professionals to have domain knowledge among other expertise triggers the need for collaboration. As noted by some of the participants: *"…collaboration expands employee's knowledge and expertise…" [SAI0803]. "…people understand the space within which we operate…" [LDB0303]*

To enable collaboration in BDA work practices, organizations intentionally allocate capacity and time. As noted by one of the participants:

> *"…is to make sure that you have like specific resources, which is specifically set aside for the purpose of your process or for your project... to make sure that when you need assistance whatsoever, you get it to get it as fast as possible…" [TSG0903]*

In addition, collaboration is enabled through a professional's willingness to learn and the ability to solicit information. As noted by some of the participants: *"…they need is*

*also just being able to learn quickly and on the fly…" [POK1204]. "…your ability to ask the right questions…" [DES1104]*

### *Technical capabilities*

Most of the participants note that technical capabilities enacted in practice influence mutual interaction by enabling collaboration in BDA work practices in organizations. This is through the enactment of technology infrastructure and technical skills as resources or means professionals leverage to enable collaboration.

Organizations employ various tools and technologies in their infrastructure to enable their BDA work practices objectives, thus, also enabling collaboration. Such tools and technologies vary from more formal tools (traditional licensed enterprise tools and technologies) to informal tools (open-source tools and technologies). The adopted tools are meant to serve various purposes. As noted by one of the participants:

> *"…we are more likely to try and use more open source technologies, but efficient open source technologies but also because requires the stability, that's like very important we make sure that in that we can still use for example, Microsoft services where required and a bit sensitive on you know, like the costs of such you know, like propriety like licenses...because of the nature of the work, we want to use the latest and greatest...we want to be able to say okay, how can we implement this…" [POK1204]*

The BDA technology infrastructure enables collaboration in BDA work practices across collaborating departments. As noted by one of the participants:

> *"…that Pyspark script service it contains both a loading as well as pushing in it… that's where the ETL process...put the data into a structure…from there that's basically my analytics where is done…we add an SSIs package to the job…this job does run on a scheduling tool …so now we incorporated another section or other BI departments, workflow into my own as well, in that we include an SSIs job with the collaboration, of course, so that it can actually kick*

*off immediately to the end consumer and obviously get out to marketing customers first…" [DEW0603].*

The BDA technology infrastructure is integrated, which further enables interprofessional and inter-team collaboration. As noted by one of the participants:

*"…one example…where we using and pulling data as row in whatsoever from your Oracle SAP Hana and then manipulating it using Informatica ETL. One loading into HDFS and then from there, we'll pull it again. Push it to Teradata, where the front end people develop reports and whatsoever will access the data from...all these technologies work together at the end of the day, so you have to collaborate with other team…" [TSG0903].*

Organizations adopt infrastructure that supports "one stop shop" which can further enable collaboration in BDA work practices. As noted by one of the participants:

*"…this data lake or this data mart is central to the entire organization…you have this one system where everybody is landing…all the data and there it becomes a one stop shop where everybody can come and just request or get what they need…" [SAI0803]*

In addition, organizations adopt various collaborative technologies to facilitate collaboration in BDA work practices. As noted by some of the participants: *"…Microsoft teams players played a big role in terms of how easier it becomes to communicate with different colleagues…" [SAI0803]. "…some team collaboration tool such as Mirro, where you start tracking dependencies and from that comes a consolidated plan…" [TAJ0503]. "…we use JIRA to track tasks, our backlog…we work with a lot of international clients and we rely heavily on platforms like Slack as well, to communicate…" [POK1204]*

Because the nature of work with BDA in organizations involves "a formal enterprise Big Data capability" interactions also happen on a more formal platform. As noted by one of the participants:

*"...this is a formal enterprise Big Data capability…you will then collaborate around formal request management tools…" [TAJ0503]*

Collaborating professionals in BDA work practices leverage their skills to enable their collaboration and perform their work. Also, the nature of work with BDA requires versatile skill sets, which enables effective collaboration. As noted by some of the participants: *"…we sort of quite good at solving the technical problems…" [BAC0703]. "…In order for the team to then collaborate to like, solve the issue. Everybody would need to know the same programming language…" [POK1204]. "…big data currently it wants or force us technical people to ...to know as much as possible different kinds of technologies…depending on the environment…you must be open to using different tools…" [TSG0903]. "…you need to have programming skills, you need to have an understanding of data. You need curiosity. You need to have mathematic skills. You need to have statistics skills…" [DSE1104].*

### *Employee Roles*

Employee roles are fundamental and the core resources for enabling collaboration in BDA work practices. The role of a mediator is among the roles that are dominant in influencing mutual interaction, thus, enabling collaboration in BDA work practices. As noted by some of the participants: *"… that's part of collaboration as well, because there's this mediator…" [DEW0202]. "…we have got clear roles and responsibilities for each level…" [LDB0303]. "…in that supervisory structure, we ensure that people are mentored…" [LDB0303].*

The nature of work and the level of seniority influence mutual interactions. Thus, collaboration is enabled through the need for a more senior role to perform specific work that it can only be done by such a role. As noted by one of the participants:

> *"…the lead data engineer would then perform…that's set up for such large files with sensitive data in it. It can only be done by data engineering team…" [DEW0603]*

#### 5.3.1.2.2.2 Formal Collaboration Facilities Constraining Factors

*Social capabilities*

Few of the participants noted that social capabilities enacted in practice influence mutual interaction by constraining collaboration in BDA work practices in organizations. This is because of the enactment of knowledge, time, and capacity as resources or means professionals leverage, consequently constraining collaboration.

Temporal complexity contributes to collaboration constraints, it has been noted that collaboration for the purpose of access and permission granting can be time-consuming due to capacity challenges and human error. As noted by one of the participants:

> *"…the security guys, they need to create the role…that process involves a truckload of people. And those people are all busy…it's manual, and it's time consuming, and it's error prone and things go wrong…" [BAC0703].*

In addition to the temporal complexities, hard deadlines are another factor in collaboration constraints. As noted by one of the participants:

> *"…we have hard deadlines…you don't have another week or a day to figure out how to fix it…to be able to collaborate a lot better…" [POK1204].*

Spatial boundaries add to the temporal complexities that constrain collaboration in BDA work practices. As noted by one of the participants:

> *"...work hours also some people right now, for them, they're just coming on board, they've just come on board, you think of people in Chicago, still early mornings for them, for argument's sake…" [LDB0303].*

Collaborating professionals often must have multifaceted skills, however, to supplement their skill sets domain knowledge is necessary. Thus, a lack of domain knowledge constrains collaboration. As noted by one of the participants:

> *"…that in itself, as well puts in a level of complexity…if you're doing a piece of analytics to try and get predictability, do you understand? Do you have domain knowledge..." [POK1204].*

### *Technical capabilities*

Few of the participants note that technical capabilities enacted in practice influence mutual interaction by constraining collaboration in BDA work practices in organizations. This is because of the enactment of infrastructure and technical skills as resources or means professionals leverage to constrain collaboration.

Organizations continue to grabble with legacy technology systems which present challenges when integrating with new technologies, which also negatively influence collaboration in BDA work practices. This is further exacerbated by the maturity of new technologies. As noted by some of the participants: *"…you have information that data that's being generated on a particular system that can't be can't be integrated with your with the new the new infrastructure…" [SAI0803]. "…there's a lot of new open source technology, new technologies being developed at various levels of maturity Some of them, a lot of them are hyped up. Some of them live up to it, some of them actually, it's hyped up, but it's for a niche use case. So when you try and deploy it wider, it's maybe not as easy as for your use case, you know, which puts a bit of strain on a platform team…" [TAJ0503]*

Infrastructure scalability is another factor that contributes to collaboration constraints. As noted by one of the participants:

> *"…we have a lot of players…trying to make use of the data. We have different types of data coming in almost every second of the day. It actually becomes slow…is the sole challenge that we face on a daily basis…the issue of the system somehow just being slow…" [DEG1004]*

Access control policies in the technologies in use contribute to the factors that constrain collaboration. As noted by one of the participants:

> *"…we do collaborate and be able to use the card data in conjunction with the client data, but there are some restricted policies for inter- interchangeability within the data..." [DEW0202]*

Professionals may become discouraged from working together and even performing their jobs if they have misaligned skills. The professional's failure to perform because of their misaligned skill sets worsens collaboration constraints. As noted by some of the participants: *"…you just hired a data scientist, and they come in to do dashboards on Power BI…they want to do exciting work…" [LDB0303]. "…if you don't understand what, or you don't have skill in that specific technology, therefore, even the questions which like you are going to ask or the stuff you're going to do on that technology, it will be a problem…" [TSG0903].*

#### *5.3.1.3 Formal Collaboration in BDA Work Practices Legitimation Structures*

#### 5.3.1.3.1 Formal Collaboration Sanctions Triggers

The sanctions in BDA work practice are triggered by collaborative activities resulting from the need for governance (policies and regulations), processes, and standards that are enacted in practice.

##### 5.3.1.3.1.1 Formal Collaboration Sanctions Triggers Enabling Factors

##### *Governance*

Most of the participants noted that "governance enacted in BDA work practices" enables collaboration. The need for governance practices is triggered by factors that involve rules and laws that are enacted in practice, thereby enabling collaboration.

Among other factors that involve governance are security practices. Though security measures can potentially impede progress, few participants noted that the enforcement of collaboration by such security measures enables collaboration. As noted by some of the participants: *"...we formed a very tight and like hierarchy in terms of who can do what or we can make what changes…nobody can just go into the system and be like, oh, I want to change this…because we need to be able to protect*

*our environments...they have to wait for somebody..." [POK1204]. "…we can set up the security we now need to go to the IM guys..." [BAC0703].*

As a security measure practice, data privacy and masking measures are put in place during the collaboration of professionals in BDA work practices, to ensure the secure sharing of data. As noted by some of the participants: *"…security and ensuring that access to certain systems or data is monitored and provisioned correctly…" [SAI0803]. "…Privacy has been one of those…where we've seen that if you don't get your data right and your people on board, you can easily have loopholes…" [LDB0303].*

Another participant noted that collaboration is enabled by having agreements in place, such as "data sharing usage agreement" as part of data governance. As noted by one of the participants:

> *"...we have various, various agreements that you have to sign to access the data...they create a...data sharing usage agreement, which is basically a contract between them..." [BAC0703].*

As part of data governance, organizations adopted a strategy of data as a central function. One participant noted that the strategy of data as a central function supports various business units. The introduction of a data lake and data mart is another centralized function that enables collaboration. As noted by one of the participants: *"…the strategy is to build this digital data lead bank...they put data as a central function, and then data support of this business organization...so there is collaboration with the other parts of the business..." [POT0102]. "…it becomes very rule driven, you can do that. But I think it's quite a big undertaking to start describing a data lake or Big Data platform like that…" [TAJ0503].*

The need for licensing as a governance practice, and upgrades of technologies enable collaboration in BDA work practices in organizations. As noted by one of the participants:

*"...when it comes to developing a new features for the application. Those usually come as requests ... from the business teams that we service. They might be a team that will come in and say hey, we are we want to move off this particular platform because of licensing costs...And so those are a lot of the requests that we get and when we improve the product from there onwards, so yeah, quite a quite a bit of collaboration…" [SAI0803]*

### *Processes and standards*

Most of the participants noted that processes and standards enacted in practice enable collaboration in BDA work practices in organizations. The need for processes and standards is triggered by factors that involve rules and laws enacted in practice, thereby enabling collaboration.

The deployment process is a process that requires collaboration with more than one stakeholder, and it exists as a standard process. As noted by one of the participants:

*"…when it comes to do our deployments, we first fill in some documents. And then after filling in that document, and then have to log in and ITSM and that's where you tell another department. Okay, move my stuff now from QA into prod…after that, there will be another ITSM that okay, it passed the QA then, another department must get it from QA into prod and then the other one will know from first dev to QA…" [DEW0202].*

The "morning stand ups" is a process that has been put in place which further enables collaboration and alignment with the client. As noted by some of the participants: *"…making sure that you continuously align with the with the client...where you have things like your morning stand ups…" [LDB0303]. "...when it comes to the collaboration. Then in the mornings, I think all the organizations are doing that... The stand ups...." [DEW0202].*

Agile has been noted as a process for running innovative projects, thus, enabling collaboration. As noted by one of the participants:

*"...we want to do things more agile and more innovative, and we do there still that context...it's more, both that decision and the way we collaborate and run projects…" [TAJ0503].*

Practices such as quality assurance are processes that further enable collaboration in the processes of developing a solution and implementation. As noted by one of the participants:

*"…also quality process, not only during solutioning, but also during implementation…" [LD0303].*

Collaborating professionals are also required to observe approval processes in certain scenarios. As noted by one of the participants:

*"…one rule I can see…to use some of this data to be able to use a particular data source or use particular data. You need to go to the request and approval process to use that, that use that data…" [SAI0803]*

Professionals adopt certain standards to aid and enable their collaboration. One other participant highlighted the use of a "one size fits all document" where the document contains specifics that need to be completed. As noted by one of the participants:

*"…what then happens is that you, you meet with your technical and non technical stakeholders like in the same meeting, discuss whether or not this ingestion will be accepted … formalization in the form of a document needs to take place…it's a one size fits all document…" [DEW0603]*

Specific teams are put in place to ensure that there is conformance to standards for a given BDA work practice. As noted by one of the participants:

*"...if you're trying to move that data from local into the cloud without including that, there's a team that is in between, that's using a tool called…that they will check, do conform to standard…" [DEW0202]*

To further ensure standards conformance organizations develop templates with best practices that even enables collaboration by ensuring uniformity and formality. These templates and other documents are to be followed and completed accordingly. The templates are embedded in technology platforms, such as the wiki with add-ons that further enable collaboration through its activity notification capabilities. Though the wiki

capabilities offer social interaction the unintended consequences of such a setup are the less human interaction disadvantage and the asynchronous type of interaction. As noted by one of the participants:

> *"…there's a template for this template for that...it makes the documentation start to look very, very similar...in those templates, we've got best practice examples...We've also bought some addons for the wiki to encourage collaboration....I can comment on your page, you get a notification, you can look at my comment, you can respond to my comment...once you've finished it, you can...send it...I'll read through it..." [BAC0703]*

#### 5.3.1.3.1.2 Formal Collaboration Sanctions Triggers Constraining Factors

##### *Governance Challenges*

Most of the participants noted that governance-enacted practices constrain collaboration in BDA work practices. The need for governance practices is triggered by factors that involve rules and laws enacted in practice, thereby constraining collaboration.

Embedding policies and rules on technology systems restrict certain levels of data accessibility and sharing, thus, constraining collaboration. As noted by one of the participants:

> *"…the sector that I'm working on is quite, a sector that has got some policies, strict policies and rules, and then especially departmentally. And then sometimes there are certain things that you can perform or inter relationship between systems where there's an open interrelationship…you can even if you're in this system can access such data that is sitting on the other one. And then sometimes it's quite restricted…" [DEW0202]*

In addition, legislative regulations or laws impede collaboration effectiveness. As noted by one of the participants:

*"…collaboration can be better. I think shared understanding, definitely can be better. But I also think tied to that is his shared goals would help us with that. Like if we had a true, absolutely true single view of the customer, which once again, gets really hard because of legislative constraints…" [BAC0703]*

Security measures also contribute to collaboration constraints. As noted by one of the participants:

*"…now you come to a corporate such as us, you want to run the same tool, but we have other security network standards, the way we've deployed things, which brings a few snags…" [TAJ0503]*

### *Processes and Standards Challenges*

Most of the participants noted that processes and standards enacted in practice constrain collaboration in BDA work practices in organizations. The need for processes and standards is triggered by factors that involve rules and laws enacted in practice, thereby constraining collaboration.

Automated processes are not always perfect, resulting in inefficiencies even in collaboration. One participant noted the importance of interacting with people directly than over a computerized system. As noted by some of the participants: *"…not just everything is just systematical…interacting with your laptop one. Sometimes those collaborations are needed…then we interact with several teams…instead of say, pushing a button…you sitting alone... you not interacting with anyone…" [DEW0202]. "machine learning can work for or against what you're trying to what you're trying to do" [DSE1104]. "…the SRM tool to log a service request...and it's like a, a wild guess you hope you get it, right. And very often you don't, and it goes to the wrong person…" [BAC0703]*

Often in general, though necessary governance processes slow down operations, as a result, impeding collaboration. This is often because of ineffective governance processes, such as the approval process. As noted by some of the participants: *"…the*

*sort of governance processes slow things down. You know the data access processes slow things down. And the security processes slow things down…" [BAC0703]. "…like I said, that person lives in XXXX. Sometimes it's 2pm. Somebody wants to make a change, they are unable to because they have to wait for somebody who needs to wake up at a certain time to then give them access…" [POK1204]. "…if those guys are delaying to do your approvals, then you can be delayed…" [DEW0202].*

Different teams and departments do not necessarily have the same coding standards, making it challenging to collaborate. As noted by one of the participants:

> *"…on the coding standards, yes, we differ, because we've got our own ways that we need to follow…" [DEW0202]*

#### 5.3.1.3.2 Formal Collaboration Norms

Governance norms, technology norms, and work practices norms enacted in BDA work practices influence mutual interaction during the collaboration of professionals in BDA work practices in organizations.

##### 5.3.1.3.2.1 Formal Collaboration Norms Enabling Factors

*Governance Practices*

Few participants indicated that governance (standards and rules) enacted in practice influence mutual interaction by enabling collaboration in BDA work practices in organizations. This is through the enactment of coding standards, technology standards, control measures, and ways of work, thereby enabling collaboration.

Organizations implement control measures as a norm (company rules) even on tools, and such is influenced by regulations. Regulations such POPI act have since led

organizations to implement control measures on their tools and technology systems. Such regulations can act in both by either enabling or constraining collaboration. Where regulations have been correctly implemented, collaboration is enabled. As noted by one of the participants:

> *"…when it comes to now the implementation…we're dependent on the tools…is encouraged by the business because I'll be safe, and then they can't get those files if they don't follow the POPIA..." [DEW0202].*

In other instances, professionals must sign a non-disclosure agreement as a control measure to further enable collaboration in BDA work practices. As noted by one of the participants:

> *"…you may be exposed to certain classified information, for instance, that should by nature shouldn't be shared with a wider audience of people. And yeah, in those cases, probably you may need to sign NDAs…" [DSE1104].*

Similarly, organizations have control measures for access control to further enable collaboration. As noted by one of the participants:

> *"…we are secure because we have a very small number of people who can make certain changes or make certain or pull certain requests…" [POK1204].*

Company business rules are also implemented on adopted ways of working, thus, enabling collaboration. As noted by one of the participants:

> *"…that has been the big push that has happened of recent, with when it comes to data sourcing, make data available as possible…that's what I've seen in terms of collaboration with trying to make the process easier…" [SAI0803].*

Such business rules foster standard ways of working, thus, enabling collaboration. As noted by one of the participants:

> *"…we do have the standard ways of working…there are some processes that were outlined to be followed…" [DEW0202].*

Also, standards and guidelines are applied to the BDA work. Such norms further enable collaboration as it creates a shared understanding among collaborating professionals. As noted by one of the participants:

*"…will determine how good if your model has got security flaws. If your model doesn't adhere to certain guidelines. it's an output from you, but it's an input to this other teams. It will determine the joy or the pain that the other teams are going to have…" [DSE1104].*

Not only are the standards applied to code but are also applied to the adopted technologies. As noted by one of the participants:

*"...it depends on technologies. And then who is administering it...who decide what standards need to be followed…those are some of the standards which we use in when like you are developing…" [TSG0903].*

### *Technology Usage*

Few participants indicated that technologies enacted in practice influence mutual interaction by enabling collaboration in BDA work practices in organizations. This is through access control technologies and work process technologies that are enacted in practice.

As a norm, technologies used by collaborating professionals in BDA work practices constantly require security patching, thus, enabling secure and effective collaboration. The requirement for patching the technologies is mandated as per the license agreement and security measures, among other things. As noted by one of the participants:

*"…we can still use for example, Microsoft services where required and a bit sensitive on you know, like the costs of such you know, like propriety like licenses…where you want what's new and what's latest…You have to keep patching your software or like a you open up yourself, you know, to some threats…with open source as well or with any software actually…" [POK1204].*

To ensure legitimate work process norms, organizations adopt communication and collaborative technologies to enable collaboration. Recently with the remote way of working, various communication and collaborative technologies have been employed.

Such technologies include the use of communication and documentation collaborative platforms. As noted by some of the participants: *"…with the whole move to remote working, we have used platforms like Microsoft Teams, a lot more than we did in the past…Microsoft teams players played a big role in terms of how easier it becomes to communicate with different colleagues within the environment…" [SAI0803]. "…use the confluence wiki as well…everything's on the wiki. Everything's very open…the vast majority of information, it's there to collaborate…" [BAC0703]. "…making use of Agile Software…a ticket has to be logged for that with that document attached to it…" [DEW0603].*

In addition to work process norms technologies, some formal processes for requesting access are automated. Such formal processes further enable collaboration through the automated platform. As noted by one of the participants:

> *"…formal ways of requesting access to a particular system particular…we have a another system within the company which automates this request and approval…" [SAI0803]*

### *Work Practices*

Various work practice norms are employed by organizations to enable collaboration in BDA work practices. Most of the participants noted that work practice norms enacted in practice influence mutual interaction by enabling collaboration. This is through a community of practices, data processing and analytics practices, security and access control practices, work sessions practice, work processes and standard practices, and up-skilling practices that are enacted in practice.

Organizations put work practices in place to enable them in their data processing and analytics. In enabling collaboration in data processing and analytic practices, specific norms such as defining a technical work environment are employed. As noted by one of the participants:

*"…your normal formal environment, you follow your sort of traditional SDLC, where you got a dev and acceptance, pre prod and production, and you've got to go to change control boards to sign up production changes…that makes it really easy to collaborate. And it makes it really easy to create models and build insights…" [BAC0703].*

Security and access control practices are also employed to further enable collaboration in BDA work practices. Some of the security measures that are put in practice include data masking. As noted by some of the participants: *"…we can apply security policies. And we have a duty to do that as well…so we do have the capability of applying certain amount of data masking on net to allow you to, to generate insights..." [BAC0703]. "…with the proper procedure, you're able to get granted access...in a manner that makes those who provided feel comfortable, that it's not going to be abused…in that sense, I think it does create the environment or enabled environment for collaboration even more…" [SAI0803]*

Furthermore, organizations adopt various work session practices that serve various purposes for collaboration in BDA work practices. Such include technical sessions, planning sessions, and collaborative sessions. The planning sessions are often formal in nature. As noted by one of the participants:

*"…that's also where there's a level of interaction, again, from a very formal annual planning type of cycle…" [TAJ0503].*

The collaborative sessions also serve various purposes, which include review and feedback, and problem-solving. As noted by one of the participants:

*"…we have a couple of sessions where we do review and feedback…those sessions get very interactive people listen, they get involved, you know, they pay attention. And generally, if there's a problem…they're very willing to get into a room and help solve the problem...there isn't that it's not my problem viewpoint, it's how do we solve the problem of viewpoint…" [BAC0703]*

The work processes and standard practices that organizations also adopt are structured formalized frameworks such as agile framework and software development lifecycle (SDLC) framework among others. Various formal and informal activities take place in these frameworks. As noted by some of the participants: *"…your normal formal environment, you follow your sort of traditional SDLC, where you got a dev and acceptance, pre prod and production, and you've got to go to change control boards to sign up production changes…" [BAC0703]. "…we use SAFE and everything runs on the different trains. And we have things like…daily stand ups we and planning as well…PI planning that we have at the beginning of every three months…and then every two weeks, we will have sprints. And again, these are the objectives…So that's basically how we communicate through the team, what the objectives…all the way down to these other tasks and then team backlog…" [POK1204].*

Communities of practices are some of the work practices norms that are meant to aid collaboration in BDA work practices in organizations. The community of practice is often made up of focus groups or groups of interest. As noted by some of the participants: *"…we've got engineering COP. So that's a type of a meeting its engineering community of practice…we collaborate with everyone, the entire group, everyone is there…" [DEW0202]. "…that scales cascades up to the tribe or the entire department. And sometimes to set it excuse me, sometimes to groups of interests…" [DSE1104]. "…that's usually in the context of a focus group…" [TAJ0503].*

For the purposes of upskilling, organizations adopted certain norms that encourage collaboration, such as knowledge sharing and coaching sessions. As noted by some of the participants: *"…Individuals can attend these sessions and in particular session we will be doing a deep dive into a certain knowledge sharing session on a particular thing regarding the platform or regarding how to create a particular stream…" [SAI0803]. "…because they can see that the other side is lacking on the AWS side, and then organizing…some data and analytics meetings or…some coaching things with one of the consulting companies…" [DEW0202].*

#### 5.3.1.3.2.2 Formal Collaboration Norms Constraining Factors

*Governance*

Few participants indicated that governance norms enacted in practice influence mutual interaction by constraining collaboration in BDA work practices in organizations. This is through the enactment of policies and regulations and processes in practice.

The need for establishing processes and standards has an influence on professional's work practices and their interactions. Access control automation is a norm adopted to aid the process of granting required access. Consequently, such norms impede or constrain collaboration as it reduces human interaction. As noted by some of the participants: *"…we have a another system within the company which automates this request and approval.." [SAI0803]. "…we then make sure we productionalize it in the best way possible and avoid back and forth between business and us and avoid human interaction…" [POT0102]. "...sometimes those models are kinda a little bit limiting or reducing collaboration, because everything has been set up...there is a logical structure…" [DEW0202].*

Government-passed regulations are often implemented as part of solutions, this has an impact on collaboration in BDA work practices. Due to regulations being implemented processes change, introducing difficulties in the interaction of collaborating departments and professionals. As noted by one of the participants:

> *"…when it comes to the collaboration side… let's say you were on par when it comes to developing… then only to find out no... the process that was outlined by the company that we must follow is not the proper one… after the introduction of the POPIA thing, they were like, no, let's change that…" [DEW0202]*

### *Technologies*

Few participants indicated that technological norms enacted in practice influence mutual interaction by constraining collaboration in BDA work practices in organizations. This is through access and permissions enacted in practice.

With licensing policies and standards being implemented on technologies, in order to enable collaboration all stakeholders must have the right permissions and adhere to the same standards. This further contributes to collaboration constraints in BDA work practices as some stakeholders do not have certain permissions. Also, different departments use different technologies to perform their work, thus, resulting in collaboration being difficult. The standards implemented on the technologies contribute to collaboration constraints, more especially with other organizations. As noted by some of the participants: *"…there certain functions and technology that's being used, but maybe other BI teams, or analytical teams don't, they don't quite have it accessible, because of the nature of our business…Another constraint that goes on to that constraint would be that the stakeholder that you are liaising with doesn't have security permissions, because it's a licensing matter…" [DEW0603]. "…you come to a corporate such as us, you want to run the same tool, but we have other security network standards, the way we've deployed things, which brings a few snags…" [TAJ0503].*

### *Work Practices*

Few participants note that work practices norms enacted in practice influence mutual interaction by constraining collaboration in BDA work practices. This is through activities related to knowledge-sharing enacted practices.

The lack of formal processes that support knowledge-sharing initiatives in certain instances contributes to collaboration constraints in BDA work practices. Also, what contributes to the constraints is the lack of initiatives that cut across multiple teams. As noted by one of the participants:

*"…the biggest challenge that I face or that I see is that we don't know what your neighbour is doing on the other side…people would want to do more…they just don't see enough of things immediately outside of their spaces to be able to begin those conversations…we have very few initiatives or projects I would say that cut across multiple teams…" [SAI0803]*

#### *5.3.1.4 Structures Unintended Consequences*

##### Resources and Capabilities

The enactment of various resources and capabilities during the collaboration of professionals in BDA work practices has unintended consequences. For example, the stakeholder engagement arrangement of consultancy structure (domination structure) serving various business units in BDA work practices can have an unintended consequence of delaying delivery and difficulty with knowledge retention (significant knowledge retention activities). This can be because of the consultant's limited time (resources) in the project. Such consequences can further influence collaboration value, which is of significance, as it can be rushed or impeded. As noted by one of the participants:

*"…it encourages a lot of learning a lot of understanding because you have a short period of time say you have to solve a problem in in two weeks because a sprint is two weeks…you have to assimilate quite a lot and understand so that you can implement a sound product…" [DSE1104]*

One participant noted that though the adopted infrastructure is intended to aid collaboration when enacted in BDA work practices, an individual's knowledge is key to enabling the effective use of such infrastructure. As consequence, collaboration may be constrained due to a lack of knowledge. Thus, upskilling activities might be necessary. As noted by one of the participants:

*"…I mentioned Informatica tools, if you go there, it'll tell you what it is. But it's not always very intuitive…it can be quite hard if you don't know what's going on…" [BAC0703]*

Also, though integrated technology systems are designed in a way that should allow collaboration efficiencies and encourage shared understanding when enacted in BDA work practices (domination structure), the unintended consequence with such nature of the technology system architecture is that it can in turn unintentionally cause working in silos by limiting human interaction (communication) as everyone has access to the different integrated components of the system. As noted by one of the participants:

> *"…collaboration is left there…because you're dealing with interacting with the system…" [DEW0202].*

Though having many people in a project, can be seen as though there is enough capacity, interaction in such a setting is not always seamless. As consequence, there are delays that impede the objective of the collaboration. Thus, implementing focus groups as a norm might be important. As noted by one of the participants:

> *"…the interaction is quite good, but a times it is delayed, because if there are so many people involved…" [DEW0202]*

The adoption of various scripting technology stacks influences collaboration in BDA work practices, as some professionals are more experienced in certain technology stacks than others. As consequence, upskilling and cross-skilling initiatives are important. As noted by one of the participants:

> *"…in the same application of programming, someone is running their model using SAS, and someone is doing R and someone is doing Scalar and someone is doing Python…" [POT0102]*

### Governance

Data governance intention includes enforcing certain practices and standards (Legitimation structure). Even though the intention of a shared platform is to simplify, often the mandate of what the platform can be used for render inflexibility. The adoption of an enterprise-wide shared platform has been criticized as not enabling flexibility. As consequence, inflexibility impedes effective collaboration. Thus,

exceptions are made for some experienced stakeholders. As noted by one of the participants:

> *"…there's also expectation from…the guys that use…the mature query tools…that what we work with, will be of the same standard...it is almost the way a big data competency is pitched in organization…as an enterprise function with all the enterprise bells and whistles…that by nature means you locking it down almost to a set of standards…and therefore we mandate that the analytics community should only use ABC…the flip side is you've got more…technologically savvy users. And they, they're willing to accept a level of instability in exchange for more flexibility…" [TAJ0503].*

The data security and access control measures are intended to safeguard data in BDA work practices collaboration. The implementation of security measures and access control, have unintended consequences for collaboration in big data analytics. For example, the implementation of security measures and access control can lead to the loss of time, thus, impeding knowledgeable professionals from interacting effectively and efficiently. As noted by one of the participants:

> *"...everything has to stop...I remember the time when we sat for two weeks. Nobody could do anything on the system because the security had to...with a security patch that needed to be done...that does impact..." [POK1204]*

The intended practice of contract agreements is that of ensuring a formal and standard procedure. However, such practice has the unintended consequence of further delaying collaboration in BDA work practices. Thus, rendering the collaboration process not efficient and effective as a shared strategic objective. As noted by one of the participants:

> *"…we first fill in some documents. And then after filling in that document, and then have to log an ITSM and that's where you tell another department. Okay, move my stuff now from QA into prod. So after that, there will be another ITSM…okay, it passed the QA then, another department must get it from QA into…So if those guys are delaying to do your approvals, then you can be delayed even though the actual development of work was quick, so that interaction is got both good and bad, depending on what level of the department you dealing with." [DEW0202].*

Formal frameworks such as the SDLC intend to formalize the collaboration of stakeholders, thus, putting controls and measures in place for the successful delivery of a task at hand. Such controls and measures can as consequence constrain collaboration as it slows down some delivery components in the SDLC. Often the collaborating stakeholders adopt other informal means to speed up delivery. As noted by one of the participants:

> *"…you follow your sort of traditional SDLC, where you got a dev and acceptance, pre prod and production, and you've got to go to change control boards to sign up production changes…that slows you down…" [BAC0703].*

The intended agile practice seeks to enable collaboration efficiency and speed up delivery. However, the practice is not as suitable for certain scenarios. As consequence, there is less tolerance due to the requirement for production environment stability. As noted by one of the participants:

> *"... expectations of stability of a big corporate…the tolerance for that would be less in a big corporate so. So even though we want to do things more agile and more innovative, and we do, there still that context…" [TAJ0503]*

### 5.3.2 Structures of Signification, Domination, and Legitimation that Enable and Constrain Informal collaboration

When informal practices, rules, resources, and meaning systems are enacted in BDA work practice reproduce and give rise to structures of signification, domination, and legitimation. Table 8 below summarise the detailed research findings of informal collaboration practices, rules, and resources enacted in BDA work practice.

| ***Structures, Modalities, and Agency Action, Needs and Triggers*** | ***Themes and Responses*** |
|---|---|
| *Signification Structure* | *Ad-hoc BDA platform services enacted in practice* |
| ***Action and Triggers*** | *Communication triggers (enabling):*<br>*Productionalizing practices. Project management practices* |
| | *Communication triggers (constraining):*<br>*Work activities nature* |
| ***Sample Responses*** | *"…interactions that takes place…so often is out of the blue...you get contacted by...process coordinator or project coordinator...for assistance…" [DEW0603]*<br>*"…some constraints will be that they can be time consuming…it does sort of remove you from maybe a pressing issue that you've been busy with…" [DEW0603]* |
| ***Modalities*** | *Interpretive schemes (enabling):*<br>*Work environment culture. Tribal knowledge. Interpersonal relations. Knowledge sharing. Problem-solving. Requirement analysis.* |
| | *Interpretive schemes (constraining):*<br>*Work environment culture challenges.* |
| ***Sample Responses*** | *"…you have to like have a good relationship with the people you're working with. So that like even communication is much easier…" [TSG0903]*<br>*"...we don't know what your neighbour is doing on the other side...it's a visibility problem more than a collaboration issue…" [SAI0803]* |
| ***Informal Collaboration in BDA Work Practices Domination Structure*** | *Social capabilities enacted in practice* |
| ***Action and Triggers*** | *Power triggers (enabling):*<br>*Professional's individual knowledge.* |
| | *Power triggers (constraining):*<br>*Time challenges* |
| ***Sample Responses*** | *"...it would be very, very informal...they called me for assistance...I actually understand the product or the requirement better..." [DEW0603]*<br>*"…sprints are two weeks normally data science projects you know, 80% of your time is spent wrangling with the data..." [DSE1104]* |
| ***Modalities*** | *Facilities (enabling):*<br>*Soft skills. Individual's knowledge. Collaborative technologies. Employee roles. Social technology capabilities.* |
| | *Facilities (constraining):*<br>*Time challenges.* |
| ***Sample Responses*** | *"…you should also you know, be a critical thinker…" [DEG1004]*<br>*"…some constraints will be that they can be time consuming…" [DEW0603]* |

| Structures, Modalities, and Agency Action, Needs and Triggers | Themes and Responses |
|---|---|
| **Informal Collaboration in BDA Work Practices Legitimation Structure** | *Social contracts, and informal sessions enacted in practice* |
| **Action and Triggers** | *Sanction triggers (enabling):*<br>*Informal meeting practices* |
| | *Sanction triggers (constraining):*<br>*Processes challenges.* |
| **Sample Responses** | *"…something good does come out from that little unstructured, can I say communication or meeting…" [DEW0603]*<br>*"…you have to wait for the ingestion process. So that you can be working with the correct type of data…" [DES1104]* |
| **Modalities** | *Norms (enabling):*<br>*Social sessions. Technical sessions.* |
| | *Norms (constraining):*<br>*Collaborating Platforms Preferences. Data Security and Non-Disclosure Agreements Practices.* |
| **Sample Responses** | *"…we actually have…a peer buddy, that you actually just collaborate with you run your codes, you run your whatever analysis that you are working on through that person…like throughout the week where we just have like a code review…" [DEG1004]*<br>*"…it might not be for some people as formalized as they would like because it's a, it's an instant messaging setup…" [SAI0803]* |
| **Unintended Consequences** | *Collaboration in BDA work enacted in practice* |
| **Action and Triggers** | *Knowledge retention activities triggered by consultancy enactment* |
| **Modalities** | *Collaboration value recognition challenges. Resources challenges. Challenges with Formal processes* |
| **Sample Responses** | *"…you know, log a jira…or whatever the case is, and it just takes forever… It's really, really hard to get right. So that organizational structure, and you know, very often, it's like, if you know the right guy, you can ping them and say can you just quickly help me out and do this for me…it's complex processes…" [BAC0703]* |

*Table 8: Research findings summary of informal collaboration practices, rules, resources, and meaning systems enacted in BDA work practice.*

#### *5.3.2.1 Informal Collaboration in BDA Work Practices Signification Structures*

##### 5.3.2.1.1 Informal Collaboration Communication Triggers

The communication triggers in BDA work practices include "informal collaborative activities" because of the need for productionalizing, work activities, and project management that is enacted in practice.

#### 5.3.2.1.1.1 Informal Collaboration Communication Triggers Enabling Factors

##### *Productionalizing Practices*

Due to technology failures, “informal engagements are of value in ensuring the continuity and stability of the production environment". One participant noted that though their technology systems are seamless, the failures that occur necessitate dialogue.

> *“…there is mostly constraints and failures that actually enables dialogue between stakeholders, because other than that is pretty seamless…” [DEW0603].*

##### *Project Management Practices*

Project management activities contribute as a trigger to ad-hoc informal collaborative activities. Participant [DEW0603] noted that *“…interactions that takes place…so often is out of the blue...you get contacted by...process coordinator or project coordinator...for assistance…”.*

#### 5.3.2.1.1.2 Informal Collaboration Communication Triggers Constraining Factors

##### *Work Activities Nature*

One participant noted that the nature of the project task at hand that a professional is working on, can also contribute as a constraining factor because of the allocated time to it.

> *“…some constraints will be that they can be time consuming…it does sort of remove you from maybe a pressing issue that you've been busy with…”* [DEW0603]

#### 5.3.2.1.2 Informal Collaboration Interpretive schemes

Various factors such as work environment culture, tribal knowledge, interpersonal relations, knowledge sharing, problem-solving, and requirement analysis when enacted in BDA work practices it influences mutual interactions, thus, contribute to enabling or constraining informal collaboration in BDA work practices in organizations. As a result, when the BDA platform service is enacted in practice, the collaborating professionals embrace these factors.

##### 5.3.2.1.2.1 Informal Collaboration Interpretive Schemes Enabling Factors

*Culture*

One participant stated that when *"…the people who you are working with, they're always willing to assist…that enables you to accomplish even more…" [DAS0403].* Making culture generally important to encouraging "ad hoc collaboration" in BDA work practices. Also, the culture encourages knowledge sharing which involves the sharing of ideas. As noted by one of the participants:

> *"…working in an environment like that, whereby people are always willing to engage, to share ideas…you will be able to…accomplish more…" [DAS0403].*

*Tribal knowledge*

One participant noted that when the "BDA platform service is enacted in practice", the collaborating professionals embrace tribal knowledge.

> *"…it's quite a big undertaking to start describing a data lake or Big Data platform like that…which is where there's a more of a, what they call a tribal knowledge...for me is kind of useful collaboration, and having technology to enable that, I think is quite useful, especially in the big data space making, making data just findable…" [TAJ0503]*

### *Interpersonal relations*

Few participants noted that building "interpersonal relations encourage social and improvised interactions" which further enable collaboration in BDA work practices. As noted by some of the participants: *"…they are the sole data owners, so you have to really collaborate with them...so you find that sometimes they are a bit hesitant to let you in on that information...so you really just have to work with them…" [DEG1004]. "…you have to like have a good relationship with the people you're working with. So that like even communication is much easier…" [TSG0903]*

### *Knowledge Sharing*

Often the knowledge-sharing initiatives are informed by the need for information. One participant noted that such a "need for information is mostly ad hoc in nature and through informal channels".

> *"…you might find somebody asking the wider audience within the group, whether they know where they can get a certain piece of information, whether they know how they could, how they could perform a certain piece of work on the platform on the tool in a certain way. And that sort of communication that happens within that chat platform that we've enabled, allows the collaboration to happen…" [SAI0803].*

### *Problem-solving*

The nature of "problem-solving sometimes necessitates ad hoc interactions" among the collaborating professionals. Most of the participants note that they collaborate in problem-solving for technical tasks that they are working on and improving the way they perform their tasks. For example:

*"…we show each other new, efficient ways on performing that specific task that you're trying to achieve…" [DEG1004].*

*Requirement Analysis*

At times "requirements analysis is facilitated informally", where professionals talk amongst themselves. One participant noted that practitioners talk to each other in ensuring that requirements are met.

*"…practitioners talking to each other, and making sure requirements are met…" [TAJ0503]*

#### 5.3.2.1.2.2 Informal Collaboration Interpretive Schemes Constraining Factors

*Culture*

Work environment culture is an influencer on the value of collaboration in BDA work practices, thus, it can either enable or constrain it. Even more, ad hoc informal engagements are impeded when such culture is lacking. One participant noted that a lack of visibility of what others are working on does not encourage professionals to embrace collaboration.

*"...we don't know what your neighbour is doing on the other side...it's a visibility problem more than a collaboration issue…" [SAI0803]*

### *5.3.2.2 Informal Collaboration in BDA Work Practices Domination Structures*

#### 5.3.2.2.1 Informal Collaboration Power Triggers

The power triggers in BDA work practices include informal collaborative activities as a result of the professional's individual knowledge and time enacted in practice.

#### 5.3.2.2.1.1 Informal Collaboration Power Triggers Enabling Factors

*Knowledge*

One participant noted that the collaborating professional's individual knowledge contributes as an enabling factor to informal collaboration in BDA work practices. When an individual's knowledge is enacted in BDA work practices enable power structures. As noted by one of the participants:

> *"...it would be very, very informal...they called me for assistance...I actually understand the product or the requirement better..." [DEW0603]*

#### 5.3.2.2.1.2 Informal Collaboration Power Triggers Constraining Factors

*Time*

Time constraints in BDA work practices enable power structures, as collaborating professionals are forced to work within the given time frame. Thus, constraining effective collaboration. Participant [DSE1104] notes that *"…sprints are two weeks normally data science projects you know, 80% of your time is spent wrangling with the data…".*

### 5.3.2.2.2 Informal Collaboration Facilities

Various resources such as soft skills, individual knowledge, collaborative technologies, employee roles, and social technology capabilities when enacted in BDA work practice influences mutual interaction, thus, either enabling or constraining collaboration in BDA work practices in organizations.

#### 5.3.2.2.2.1 Informal Collaboration Facilities Enabling Factors

*Soft skills*

Few participants noted people skills, emotional intelligence, critical thinking, and building interpersonal relations as some of the soft skills necessary and commanding to enable collaboration in BDA work practices. The ability to build interpersonal relationships has been noted among other soft skills as the most fundamental. Not only do interpersonal relationships enable collaboration but also enable speedy delivery of work. One participant said *"…there's a few people who've been around for long enough, who know who's got what data…they're the people who know, who know who's got what data, but that's not formal knowledge…if you know the right people you can do anything. And they're the people who will sort of say, I know you've got this data…I want to get access to it…" [BAC0703].* [TAJ0503] add that *"…there's also a bit of emotional intelligence that goes with it…".* Also noted by [DEG1004], *"…you should also you know, be a critical thinker…".*

*Individual's Knowledge*

The enactment of an individual's knowledge for knowledge sharing in BDA work practices enables collaboration. Professionals leverage their knowledge and skills to enable collaboration in BDA work practices by initiating informal knowledge-sharing sessions. One participant said *"…I've got my own way of doing things right…sometimes it's not straightforward …then the collaboration will come in such a way. Let me share the information that I have with the team members or any other team…" [DEW0202]*

*Collaborative Technologies*

Technology-enabled collaborative platforms intend to facilitate and promote interactions when enacted in practice. Few participants noted that organizations adopted automated technologies with notification functionality that integrates the ad

hoc type of communication between collaborating professionals. As noted by one of the participants:

> *"…actually there is notifications…that is also another form of communication between stakeholders, those automated messages that get sent out that we built into the automation software…which was simply to simply to notify the end consumer downstream…" [DEW0603].*

With the virtual way of working, collaborative technologies have been adopted to facilitate communication among other activities, thus, enforcing and making communication seamless through informal chat groups. As noted by one of the participants:

> *"…we have a support, chat on Microsoft Teams. Almost all of the users that we support, and what happens now in that support team is you have a diverse number of people from different areas...or on different projects in different spaces. And they are all in one central location…" [SAI0803].*

### *Employee Roles*

Processes centered around an employee role foster informal interactions in BDA work practices. Processes to grant access to collaborating professionals are established to ensure effective collaboration. These processes are at times arranged with senior members of the teams. One participant noted that because of such arrangements, anyone in the team or across the teams can on an ad-hoc basis approach the senior members requesting access without following any formal process.

> *"…and they actually don't have the capabilities to perform work on those files…they would come to the senior engineer. And they ask him to actually perform analytics himself on the work, because he's got access to all the correct technologies…" [DEW0603].*

*Social Technology Capabilities*

Few participants noted that the collaborating professionals in BDA work practices embrace the use of "technology with social capabilities" to maintain improvised interactions. Data catalogue technologies provide such social capabilities that include tagging other collaborating professionals, "liking" a dataset, and commenting on the dataset. Thus, enabling them to leverage each other's knowledge. As noted by one of the participants:

> *"...some of the tool sets we deploying, it's a data catalogue, but it offers social capability. So just people liking a dataset, people tagging it, commenting on it, so that you can get a sense of what data is being used by other practitioners... instead of going with a rulebook...But I think it's quite a big undertaking to start describing a data lake or Big Data platform like that...what does everybody know about the little bit of data that's stored on the platform..." [TAJ0503].*

Technologies such as data integration tools have social capabilities which enable collaboration. However, for such collaboration to be effective, it requires prior knowledge of the dataset. As consequence, fewer interactions are facilitated on these platforms due to professionals' lack of knowledge. As noted by one of the participants:

> *"…I mentioned Informatica tools, if you go there, it'll tell you what it is. But it's not always very intuitive. So it can be quite hard if you don't know what's going on…" [BAC0703].*

#### 5.3.2.2.2.2 Informal Collaboration Facilities Constraining Factors

*Time*

One participant highlighted that time as a resource constrains informal collaboration in BDA work practices.

> *"…some constraints will be that they can be time consuming…" [DEW0603].*

#### *5.3.2.3 Informal Collaboration in BDA Work Practices Legitimation Structures*

##### 5.3.2.3.1 Informal Collaboration Sanctions Triggers

The sanction triggers in BDA work practices include informal collaborative activities as a result of the need for informal meetings and processes enacted in practice.

###### 5.3.2.3.1.1 Informal Collaboration Sanctions Triggers Enabling Factors

*Informal Meeting Practices*

”Informal meetings enacted in practice” enable collaboration in BDA work practices. One participant noted that ad-hoc and unstructured meetings are adopted by professionals in their BDA work practices.

> *“…something good does come out from that little unstructured, can I say communication or meeting…” [DEW0603].*

###### 5.3.2.3.1.2 Informal Collaboration Sanctions Triggers Constraining Factors

*Processes Challenges*

The processes that are implemented in BDA work practices trigger sanctions. One participant noted that in their “informal collaboration”, the collaborating stakeholders needed to observe certain processes.

> *“…you have to wait for the ingestion process. So that you can be working with the correct type of data…” [DES1104].*

#### 5.3.2.3.2 Informal Collaboration Norms

##### 5.3.2.3.2.1 Informal Collaboration Norms Enabling Factors

Social sessions and technical sessions enacted in practice influence mutual interaction during the collaboration of professionals in BDA work practices in organizations.

*Social sessions*

"Social sessions" legitimize professional's collaboration in BDA work practices, thus, enabling it. Community of practices is intended to encourage knowledge sharing in a more informal and social setting. One participant noted that the outcomes of a community of practice sessions trigger other initiatives that are of benefit to the professionals, such as upskilling initiatives.

> *"...those meetings, that's when they decide...that's when they realize that no we need to do some AWS courses..." [DEW0202].*

*Technical Sessions*

The technical sessions take different forms depending on the need, like the need for code review. Thus, legitimizing the session. Code review sessions are often informal and ad-hoc. The need for code review enables constant collaboration in BDA work practices. One participant said

> *"…we actually have…a peer buddy, that you actually just collaborate with you run your codes, you run your whatever analysis that you are working on through that person…like throughout the week where we just have like a code review…" [DEG1004].*

#### 5.3.2.3.2.2 Informal Collaboration Norms Constraining Factors

##### *Collaborating Platforms Preferences*

Informal platforms for collaborating are not necessarily preferred by all collaborating stakeholders. The adopted norm of leveraging online chat groups is not always preferred by other stakeholders, thus, constraining informal collaboration. As noted by one of the participants:

> *"…it might not be for some people as formalized as they would like because it's a, it's an instant messaging setup…" [SAI0803]*

##### *Data Security and Non-Disclosure Agreements Practices*

Organizations as a norm, adopt the practice of non-disclosure agreements. One participant noted that this norm is also implemented for stakeholders collaborating in BDA work practices. Such is implemented also for security purposes. Thus, constraining informal collaboration where non-disclosure agreements are a requirement. As noted by some of the participants: *"…we have various, various agreements that you have to sign to access the data…" [BAC0703]. "…people are very sensitive about their data…" [BAC0703].*

### *5.3.2.4 Structures Unintended Consequences*

#### Governance

Processes are often put in place as a form of governance to enable and make collaboration effective. The ineffectiveness of formal processes enacted in BDA work practices (legitimation structure) can render collaboration ineffective. As consequence, processes are not adhered to. Such processes are supplemented by technologies, that might contribute to the ineffectiveness. Social relations enacted in BDA work practices (domination structure) often result in significant informal

interactions, one participant notes that "*if you know the right guy*" a process can be bypassed. As noted by one of the participants:

> *"…you know, log a jira…or whatever the case is, and it just takes forever… It's really, really hard to get right. So that organizational structure, and you know, very often, it's like, if you know the right guy, you can ping them and say can you just quickly help me out and do this for me…it's complex processes…" [BAC0703]*

## 5.4 Chapter Summary

This chapter presented the research findings from the twelve (12) interviewed professionals involved in BDA work practices. The research findings show evidence of the existence of both formal and informal collaboration, given the different natures of collaboration in BDA work practices in organizations. Also, the structures of signification, domination, and legitimation were noted. The following chapter aims to present a conceptual development and a theoretical elaboration of the findings presented in this chapter in comparison to the literature reviewed.

# 6 Conceptual Development and Theoretical Elaboration

## 6.1 Introduction

The purpose of the study was to explore how structures enable and constrain collaboration in BDA work practices in organizations. This chapter of the study seeks to discuss and present a detailed conceptual development and theoretical elaboration from the research findings as presented in the previous chapter in relation to the research questions the paper sought to answer. In addition, the findings are compared to the study literature review. Thus, presenting the revised conceptual framework and theoretical elaboration of the dynamic interplay of structures and collaboration constraining and enabling factors.

The sections of this chapter included: The introduction, which is followed by a discussion of the nature of collaboration in BDA work practices, the conceptual development of the structuration analysis of collaboration in BDA work practices, a revised conceptual framework, theoretical elaborations, and the chapter summary.

## 6.2 BDA Work Practices Collaboration Nature

The collaborative activities in organizations are triggered by multiple needs and factors in BDA work practices. Such needs can be triggered by the activities that take place in the different business domains. For example, collaboration activities triggered by the need for marketing business requirements (use case) from the marketing business domain. Stakeholders in the different business domains have various requirements and collaborate in BDA work practices in organizations. The nature of collaboration can be influenced by the requirements of various stakeholders. Thus, collaboration in BDA work practices can be formal or informal in nature. Affirming similar observations by Kaya (2019) and Dhlamini et al. (2021). As also noted by Dhlamini et al. (2021), the type of collaboration can be interdepartmental, inter-organizational, inter-teams, inter-discipline, and interprofessional. Which happens in different business domains, such as sales and marketing, human resources, risk, regulation, finance, investments,

wealth, etc. The BDA domain functions inform the diverse enacted BDA work practices in organizations. The following section provides a conceptual structuration analysis of collaboration in BDA work practices.

## 6.3 Structuration Analysis

As noted, professionals in BDA work practices interact over a specific need, for example, knowledge sharing. With formal collaboration, the enactment of various requirements in BDA work practices is significant and central to the enactment of BDA platform services in practice. The need for policies and regulations, processes, and standards in the collaboration of professionals in BDA work practices legitimizes the enactment of data governance and management work practices. The need for BDA-specific resources in BDA work practices commands the enactment of BDA capabilities in practice. Similar behavior is noted with structures enacted in informal collaboration, which includes ad-hoc BDA platform services enacted in practice, social capabilities enacted in practice, and social contracts and informal sessions enacted in practice.

### 6.3.1 Formal Collaboration in BDA work practices

#### *6.3.1.1 Enacted Structures*

With formal collaboration control practices are enacted to enable formal practices in the provisioning of BDA platform services. As consequence, control practices can enable or constrain collaboration in BDA work practices. Also noted in the literature, control practices such as formal contracts enacted in practice, have a significant impact on formal collaboration in BDA work practices in organizations (De Koker, 2019; Kaya, 2019). Figure 10 depicts three major structures enacted during the formal collaboration of professionals. The structures include BDA platform services enacted in practice (signification), BDA capabilities enacted in practice (domination), and governance and management enacted in practice (legitimation). When these

structures are enacted in the collaboration of professionals in BDA work practices it can be enabling or constraining.

Another interpretive scheme (frame of reference) and factor important to collaborating professionals is shared understanding (De Koker, 2019; Kaya, 2019; Hagen, 2021; Dhlamini et al., 2021). Professionals enact meaningful/important practices through the influence of shared understanding and assumptions, shared values, shared strategy, shared objectives, and shared integrated infrastructure and technologies (technology architecture), thus, enabling, or constraining collaboration in BDA work practices in organizations. Such practices are triggered by multiple needs and activities that are important to providing BDA platform services as a work practice. Additional requirements are logged as a result of the BDA platform services enacted in practice. Such requirements can be a result of a business's strategic objectives. This further trigger communication and interactions with stakeholders, resulting in the requirement being enacted in practice (duality of structures). Thus, enabling collaboration in the BDA work practices. In some cases, the process of enacting these practices constrains collaboration.

Central to BDA capabilities are BDA-specific resources that are necessary to maintain competitive advantage. Some of the resources are enforced by legislation and other factors, that can lead to the need for BDA capabilities enhancement or change. As a result of stakeholders' resource needs, various skills and roles have a dominant influence on the enactment of BDA capabilities during professional’s collaboration in BDA work practices. For example, professionals exercise their power by leveraging BDA capabilities which involve components of enforcing authority and power during their collaboration. Mikalef et al., (2018a) and Dhlamini et al., (2021) noted similar resources. However, Kaya (2019) noted that the nature of BDA does away with roles and power structures in BDA work practices. Both the practice of leveraging social and technical capabilities influences mutual interactions, thus, enabling or constraining collaboration in BDA work practices. As noted in the literature various resources and capabilities influence collaboration in BDA work practices (Wang et al., 2018; Mikalef

et al., 2018a; Ghasemaghaei, 2019; Ghasemaghaei, 2020; Mikalef et al., 2018b; Moseneke and Brown, 2022).

When collaborating in BDA work practices in organizations, professionals follow certain rules and laws. Additionally, the rules and laws are incorporated into adopted norms, and adopted norms have an impact on how professionals interact with one another while working together on BDA work practices. The enactment of various governance, management, and work practices norms influence mutual interactions, thus, enabling or constraining collaboration in BDA work practices. Such enactment of governance, management, and work practices is triggered by stakeholders' need for processes, standards, and governance. Similar triggers have been noted in the literature review (Patel et al., 2012; Poirier et al., 2016; Hagen, 2021; Dhlamini et al., 2021)

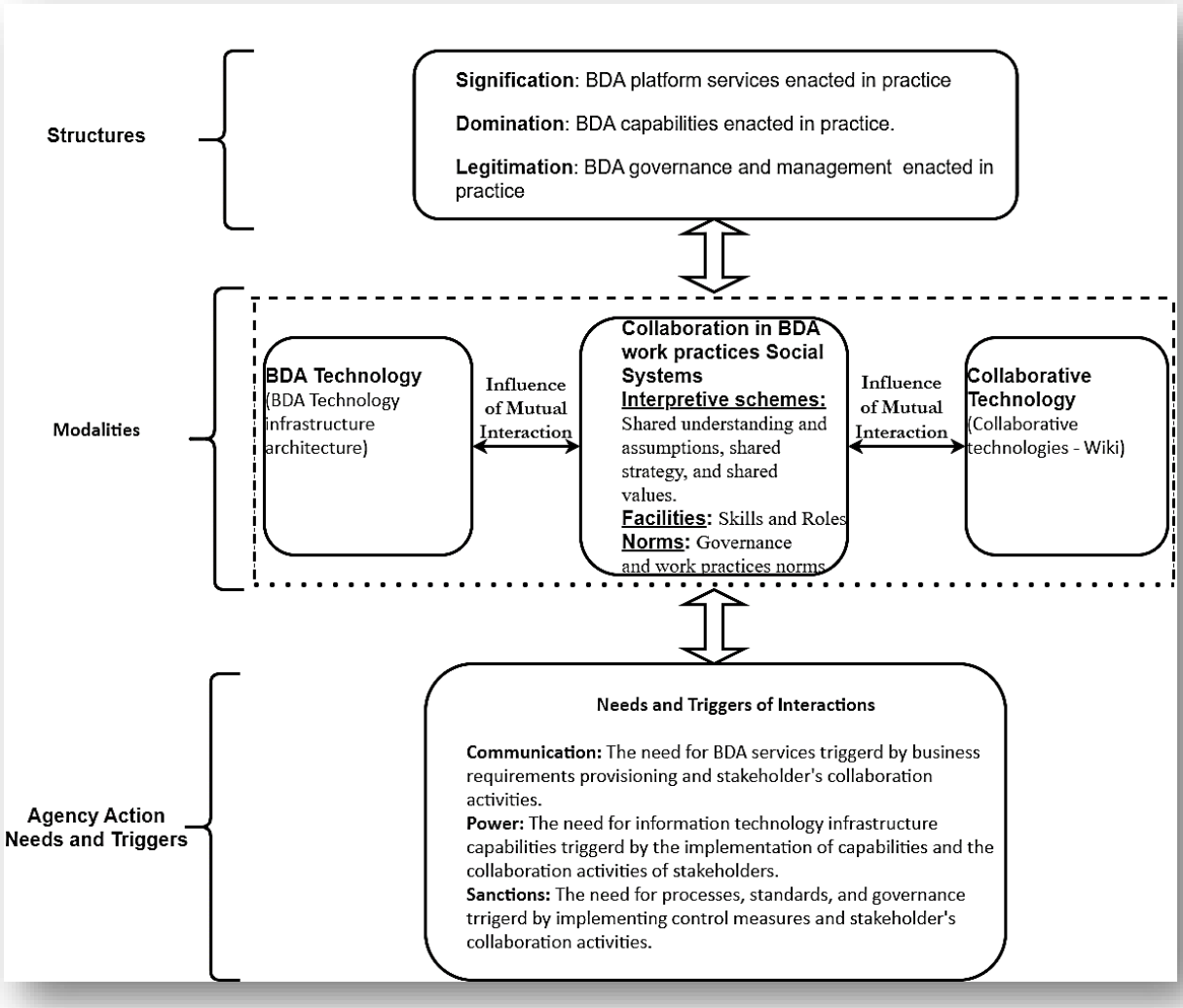


*Figure 10: Formal collaboration in BDA work practices enacted structures*

By design, the integrated infrastructure and technologies support collaboration in BDA work practices. Their architecture is designed to further enable shared understanding among the collaborating professionals. To legitimize communication with the recent rise of remote working, organizations leveraged communication and collaborative technologies with control measures embedded in the technologies. Williamson (2018) confirms similar claims. The enactment of both BDA technologies (BDA technology infrastructure architecture) and collaborative technologies (wiki) during professional collaboration in BDA work practices, influence the BDA work practice social systems interpretive schemes, norms, and facilities. Affirming similar claims by Orlikowski

(2000). Thus, either enabling or constraining collaboration in BDA work practices. This could be a result of unintended consequences.

#### *6.3.1.2 Unintended Consequences*

As a consequence of a formal consultancy structure (domination structure) serving various business units, the collaborating parties experience challenges with knowledge retention (significant knowledge retention activities) and work delivery being delayed. Due to a lack of resources like time, capacity, knowledge, and technology, collaboration is rushed or impeded, thus, undermining the value and significance of collaboration in BDA work practices. These resources have been noted as contributing factors that impede collaboration (Mikalef et al., 2018a; Hagen, 2021; Dhlamini et al., 2021). Furthermore, the integrated infrastructure and the technology architecture adopted in BDA work practices can as consequence encourages working in silos, thus, limiting interaction and communication. For other stakeholders, it might necessitate upskilling for the effective use of the infrastructure. Also, too many collaboration points can result in further collaboration challenges. For example, having too many stakeholders engaging does not necessarily translate to effectiveness, but can render collaboration ineffective. As a result, organizations implement focus groups as a norm and a way to allocate the workforce, thus, enabling collaboration.

Noted also by De Koker (2019), governance practices are associated with establishing formal processes, control, and standards. The consequence of that is inflexibility, thus, impeding effective collaboration in BDA work practices. Further confirming the findings by Dhlamini et al. (2021) and Hagen (2021). Thus, exceptions are made with some experienced stakeholders.

The enabling and constraining factors have unintended consequences in the collaboration of professionals in BDA work practices. In some instances, communication triggers specific needs and as consequence enacts different structures. For example, communication can be triggered by the need to improve a

process, leading to the enactment of sanction structures (rules and laws). Similarly, communication can be triggered to define requirements, thereby enacting commanding power structures, such as the implementation or use of specific facilities or resources. Figure 11 conceptualizes the unintended consequences of formal collaboration in BDA work practices in organizations.

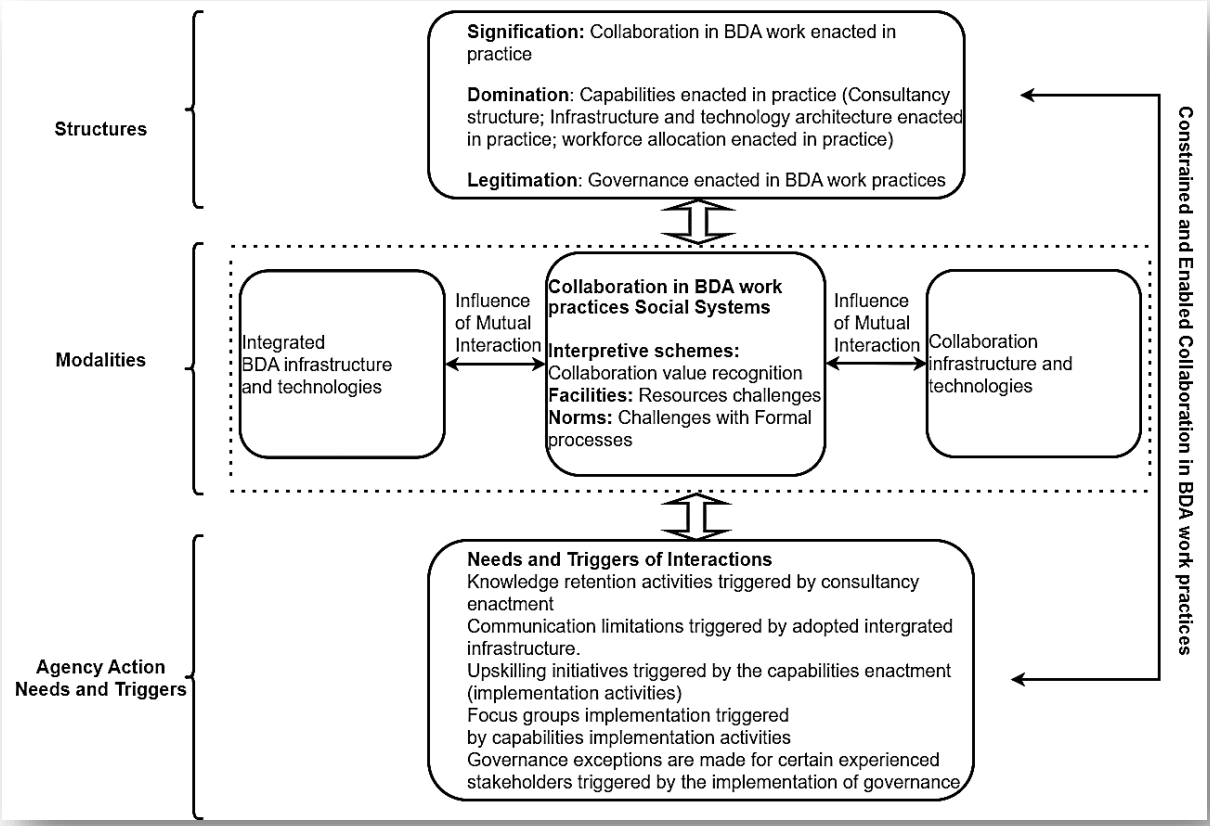


*Figure 11: Unintended Consequences with formal Collaboration.*

The following section details the informal collaboration structures enacted in practice.

### 6.3.2 Informal Collaboration in BDA work practices

#### *6.3.2.1 Enacted Structures*

With informal collaboration, social practices are enacted to enable informal/ad-hoc practices in the provisioning of BDA platform services. As consequence, such social practices can enable or constrain collaboration in BDA work practices. The major influence on informal collaboration is social and informal practices such as social contracts enacted in practice. Several scholars affirm these claims (Patel et al., 2012; Sungur et al., 2015; Dhlamini et al., 2021). Figure 12 depicts three major structures enacted in the informal collaboration of professionals in BDA work practices. The enacted structures include ad-hoc BDA platform services enacted in practice (Signification), social capabilities enacted in practice (Domination), and social contracts and informal sessions enacted in practice (Legitimation).

An organization's culture, individual's interest, and requirements for problem-solving have a significant influence on ad-hoc BDA platform services enacted in the collaboration of professionals in BDA work practices, which is triggered by stakeholders' needs for BDA information and problem-solving. Kaya (2019) notes some of these factors that influence ad-hoc BDA platform services enacted in practice. In addition, also noted by Hagen (2021) and Hagen et al., (2022) both social and human capital have a dominant influence on social capabilities enacted during professional's collaboration in BDA work practices. For example, professionals leverage their individual knowledge in their social interactions. Furthermore, various norms such as code review sessions legitimize social contracts, ad-hoc technical sessions, and social sessions that are enacted during professional's collaboration in BDA work practices. For example, professionals leverage informal meeting practices in their interactions.

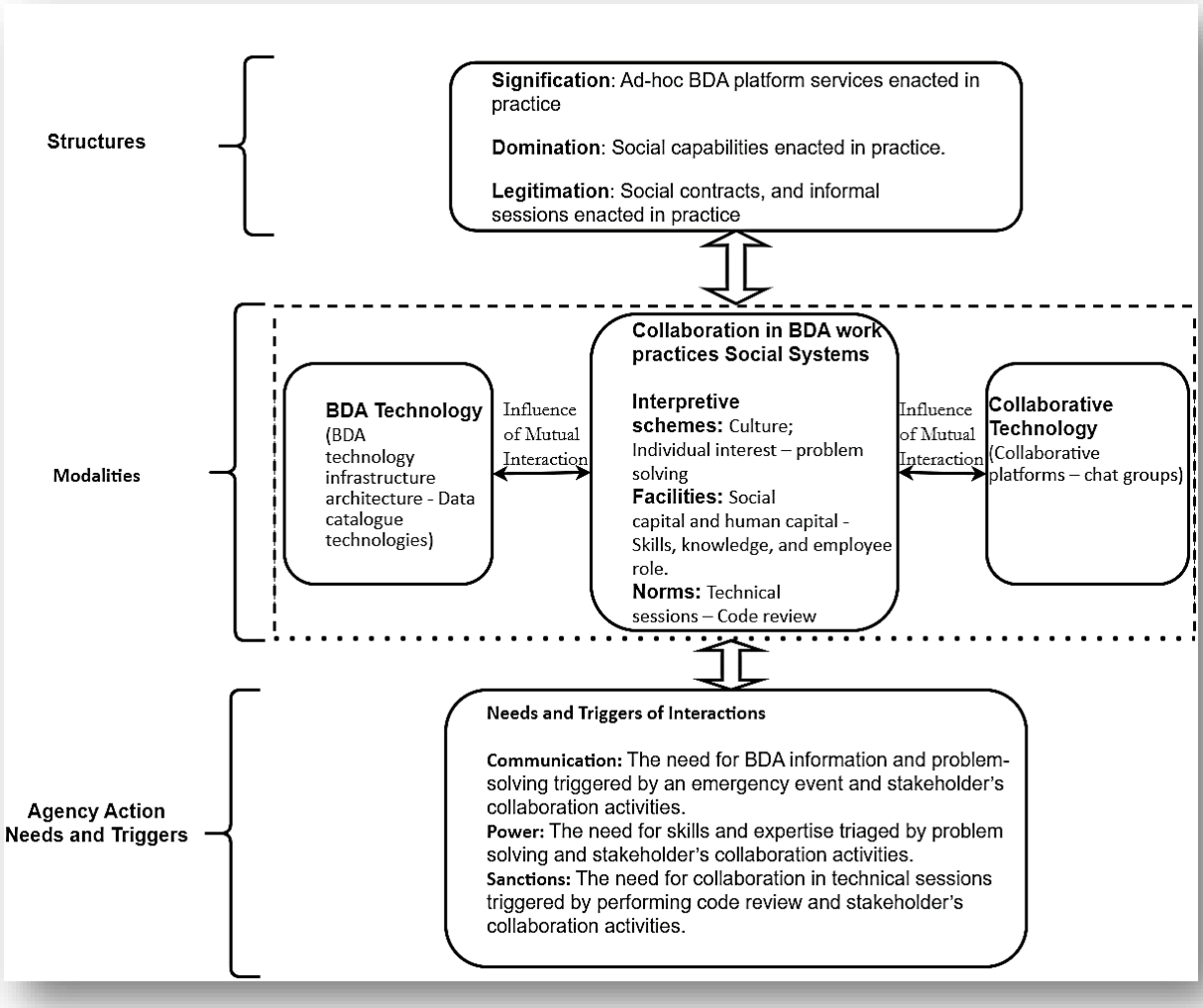


*Figure 12: Informal collaboration in BDA work practices enacted structures*

The enactment of both BDA technologies (data catalogue technologies) and collaborative technologies (chat groups) during professional collaboration in BDA work practices, influence the BDA work practice social systems interpretive schemes, norms, and facilities. Thus, confirming Orlikowski (2000) findings. As a result, collaboration in BDA work practices is either enabled or constrained, potentially resulting in unintended consequences.

### 6.3.2.2 *Unintended Consequences*

As noted by Dhlamini et al. (2021) and Hagen (2021) that challenges with governance factors impede collaboration. The unintended consequence of governance enacted in BDA work practices is that it enables significant informal collaboration in BDA work practices. Though organizations put processes in place supplemented by various collaborative and BDA technologies as a form of governance, the ineffectiveness of such processes encourages collaborating professionals to bypass the processes, because of the social relations enacted in BDA work practices. As a consequence, enabling informal engagements among the collaborating parties. Figure 13 conceptualize the unintended consequences of informal collaboration in BDA work practices in organizations.

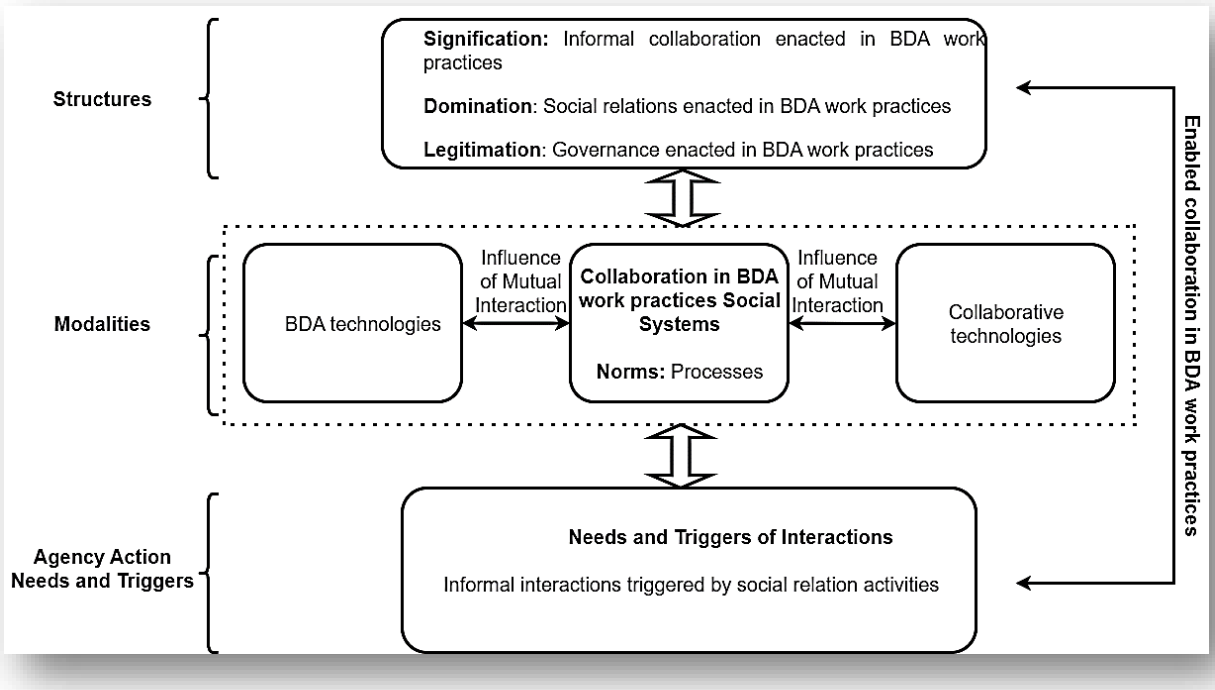


*Figure 13: Unintended Consequences with Informal Collaboration.*

The enacted structures in practice are greatly influenced by the technologies in use, thus, also contributing to the unintended consequences. The influence of technology on the collaboration of professionals is discussed in detail in the following section.

### 6.3.3 Technology influence

The literature notes that technologies influence both collaboration and BDA work practices in organizations. As also noted from the literature, the nature and architecture of collaborative and integrated BDA platforms enable the accessibility of information (Port and Kaiser, 1998; Innerbichler et al., 2017). The value of such platforms when enacted in practice, is that it provides a shared view and enable shared understanding among the collaborating professionals. However, the unintended consequence of an infrastructure with an architecture that enables a single view and collaborative functions is that it can in turn encourage a siloed way of work.

Both tangible and intangible resources are necessary resources in collaborative BDA work practices (Gupta and George, 2016). Organizations adopt infrastructure with capabilities that support integrated functions, facilitating interprofessional collaboration with the professionals involved. Also noted by Pham (2019), the collaborating BDA professionals leverage technology capabilities as resources that aid their work practices. The study notes that such resources when enacted in practice can be enabling or constraining to collaboration in BDA work practices in organizations. Furthermore, given the nature of BDA work and the required technical skills, the allocated capacity is influenced by the need to learn the technologies and execute associated tasks. This has a further influence on collaborative activities in BDA work practices.

Governance and work practices norms influence the adopted technologies. Williamson (2018) affirms these findings. The need for governance is to aid BDA work practices, while the need for technologies is to aid both governance and work practices. Thus, it is often a norm that organizations adopt technologies to aid the

governance of their BDA work practices. The unintended consequence of this practice is the vulnerability technologies face. Constant upgrades and patching of the system are required as a result. Figure 14 conceptualize technology's influence on collaboration in BDA work practices in organizations.

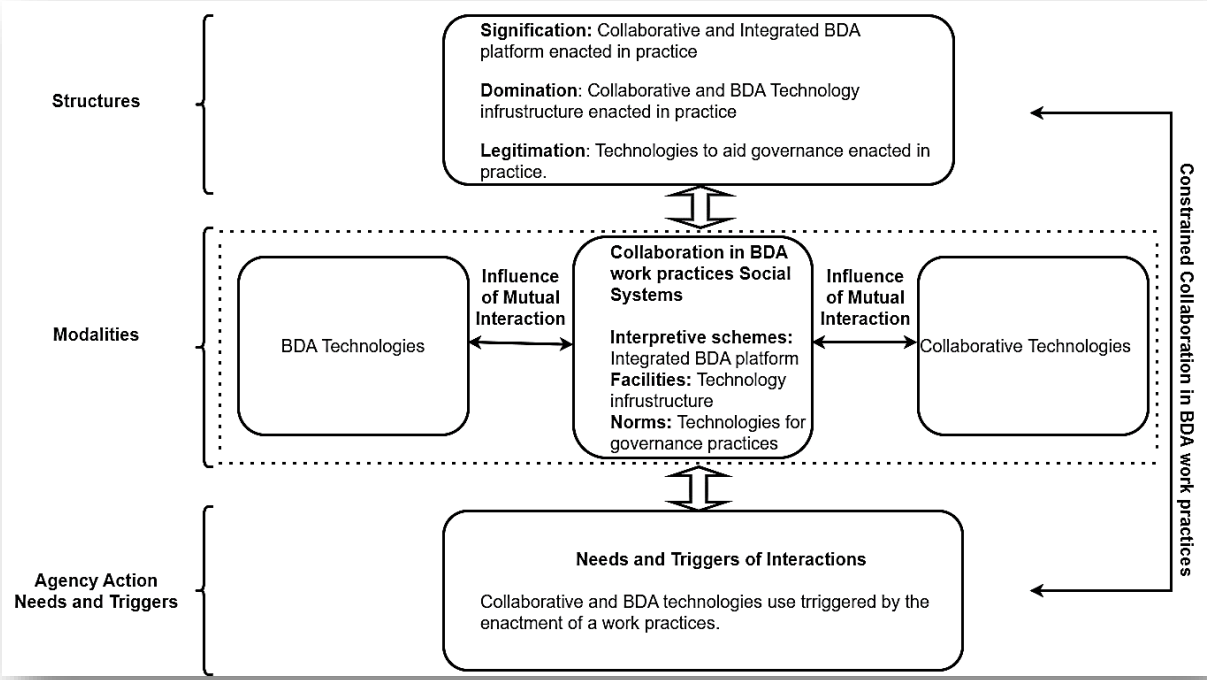


*Figure 14: Technology Influence*

The next section presents the revised conceptual framework from the study findings.

## 6.4 Revised Conceptual Framework

Professionals in organizations enact different structures in their formal and informal interactions in BDA work practices. The interaction of professionals (in their social and technical systems) in BDA work practices has both intended and unintended consequences, thus, either enabling or constraining collaboration in BDA work

enacted in practice. Figure 15 below depicts the revised framework of the structuration of collaboration in BDA work practices in organizations.

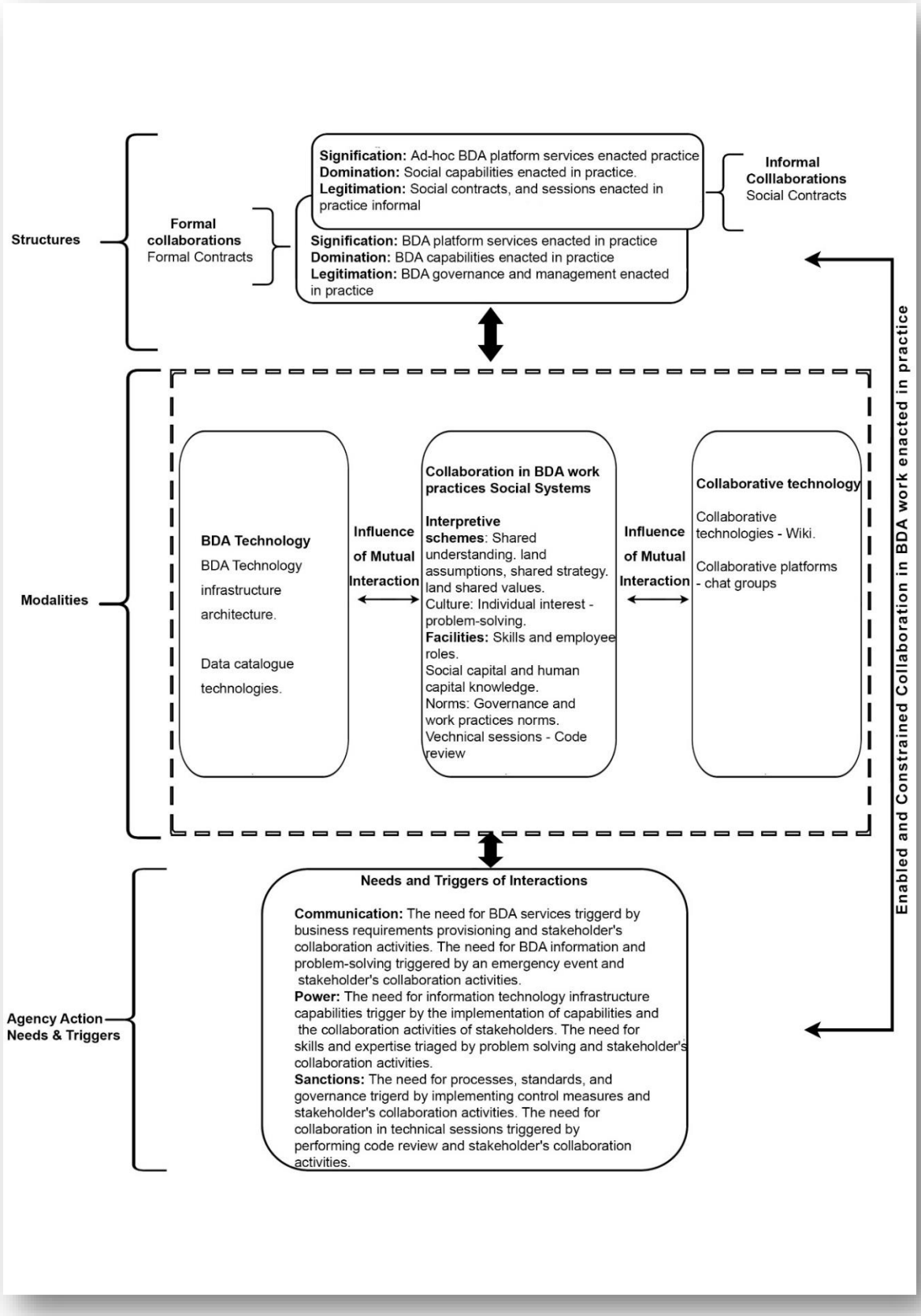


*Figure 15: A revised conceptual framework (Structuration analysis of collaboration in BDA work practices in organizations)*

The following section discusses theoretical elaboration and theoretical propositions that emerged from the study.

## 6.5 Theoretical elaboration

### 6.5.1 Collaboration System Dynamics

Though, an organization's collaboration systems can be both structured and unstructured, and informal and formal (Prakash et al., 2020; Impink, Prat, and Sadun, 2020). Various electronic and physical patterns of collaboration can be identified when professionals are interacting in structured and unstructured collaboration systems (Impink et al., 2020). In addition, organizations have put in place processes and structures in place to do away with limitations to collaboration (Impink et al., 2020). However, certain adopted work practices can influence how collaboration takes place (Waizenegger, McKenna, Cai, and Bendz, 2020). Thus, making collaboration a dynamic practice or system. To understand such a dynamic system, Impink et al. (2020) suggests studying the recorded collaboration practice patterns data. Other scholars have sought to understand collaboration by integrating both a social theory such as activity theory and system dynamics (Liu, Lin, and Qu, 2020).

Dynamic and iterative collaborative practice is analogous to a complex system in which the underlying structures transform (Wang, Zhang, Hao, and Chen, 2019). Not only an understanding of the underlying structures is required to understand collaboration, but also the understanding of the objective and goal for collaboration over time (Wang et al., 2019). As a result, the system dynamics method can help understand and model how structures and collaboration interact in work practices. Such a process involves formulating the system dynamics model, simulating the model, designing policy alternatives, and implementing the modal (Forrester, 1994).

With system dynamics “the dynamic behaviour of the system arises from the interactions amongst its structures overtime” (Wang et al., 2019; p. 472). Similarly, multidisciplinary collaboration introduces the complex interaction of structures in collaboration in work practices (Klee et al., 2021). Also, collaboration is a “result of the reciprocal causation and interaction” (Wang et al., 2019; p. 475). Thus, interaction and collaboration in a social setting are influenced by actors drawing on various structures (Poirier et al., 2016). Furthermore, with a system dynamics model such as a causal loop, collaboration, and its internal structures need to represent the behavior of the social setting (Barlas, 1996). The following section demonstrates such collaborative behavior in BDA work practice in a social setting.

### 6.5.2 Causal loop and Propositions

In further answering the question of how structures enable and constrain collaboration in BDA work practices and how structures and collaboration interact in BDA work practices in organizations, a causal loop of the dominant structures is developed. The study findings presented three interacting structures in the formal and three in the informal collaboration of professionals in BDA work practices in organizations. The structures include BDA platform service enacted in practice, BDA capabilities enacted in practice, and governance and management enacted in practice in formal collaboration. In the informal collaboration, the structures include ad-hoc BDA platform services enacted in practice, social capabilities enacted in practice, and social contracts and informal sessions enacted in practice. Figure 16 illustrates the relationship of these structures depicted in a causal loop diagram.

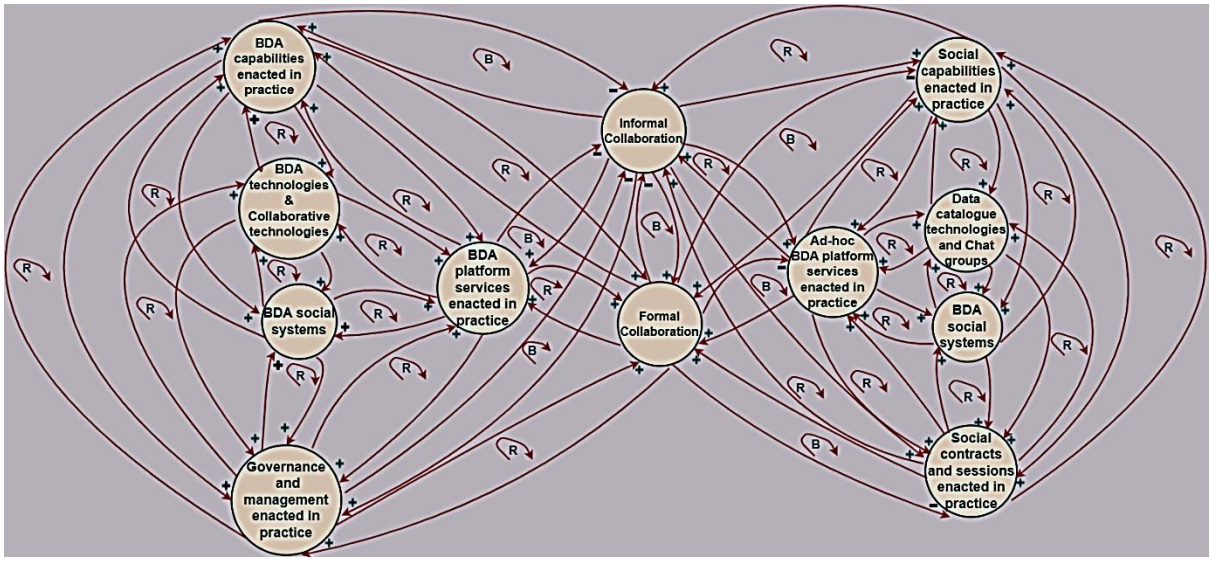


*Figure 16: Causal Loop of Collaboration in BDA Work Practices in Organizations.*

The interplaying relationship of the structures as depicted in the causal loop diagram reinforce and balance each other. The causal loop diagram provides a holistic understanding of interaction, and how the structures influence formal and informal collaboration in BDA work practices in organizations. The structures are further presented with propositions that form a basis for future research. Thus, detailing both the collaboration enabling and constraining factors and their behavior in a social setting.

The study observes that informal collaboration is constrained by formal collaboration's enacted structures. Furthermore, the study notes that formal collaboration is enabled by the enacted structures in both formal and informal collaboration. Informal collaboration, on the other hand, is only enabled by the enacted structures in informal collaboration. Though the benefits of collaborative and BDA technologies with BDA social systems enable collaboration, the challenges associated with their interaction with BDA social systems constrain collaboration.

#### *6.5.2.1 Collaboration Enabling Factors*

Formal contracts enacted in the collaboration of professionals in BDA work practices generally enable collaboration. Such formal contracts are a result of the need for interaction triggered by various events or activities in BDA work practices in organizations. Thus, enabling formal collaboration in BDA work practices. However, informal and social contracts also lead to the enablement of collaboration in BDA work practices.

The interaction of professionals collaborating in BDA work practices is triggered by multiple events or activities that lead to BDA platform services in practice. The events or activities include the provisioning of BDA services, productionalizing, business strategy, insight sharing, process improvement, problem-solving, and stakeholder engagements. For example, associated with BDA services the collaborating parties receive requirements for data sourcing, data warehousing, data analysis and reporting, data quality, and data platform. To ensure collaboration and the provision of the requirements and stakeholders' needs, the collaborating professionals leverage various established interpretive schemes, which include shared understanding and assumption, shared strategy and objectives, shared infrastructure and technologies, and shared values. Thus, influencing the stakeholder's needs. For example, common objectives are established so to leverage collaborating parties' expertise, as noted in the literature review (De Koker 2019; Kaya, 2019; Hagen, 2021; Dhlamini et al., 2021). Furthermore, collaborating parties embrace shared strategy and objective, which involves data-specific objectives, performance, skills, project work delivery, and business value objectives. For example, fostering enterprise-wide data literacy can assist with collaboration from the strategy level to the project work execution level. Thus, organizations adopt the practice of data golden sources, such as data lakes and data marts.

Various factors are dominant in enabling formal collaboration in BDA work practices in organizations, thus, leading to the enactment of BDA capabilities in practice. Such factors include governance, agreements, IT infrastructure, access control, federated

data capability, and management. For example, governance, standards, and procedures are enforced in collaboration through the use of facilities such as templates. These factors are influenced by collaborating professionals leveraging their resources and capabilities in BDA work practices. Also noted in the reviewed literature, the resources and capabilities involve social skills, technical skills, and individual roles (Mikalef et al., 2018a; Mikalef et al., 2018b; De Koker, 2019; Akhtar et al., 2019 Hagen, 2021; Dhlamini et al., 2021; Moseneke and Brown, 2022). For example, professionals leverage their knowledge power in their collaboration, and management allocates capacity and time so to enable collaboration.

Sanctions such as governance, processes, and standards are implemented to further enable formal collaboration in BDA work practices, thus, leading to the enactment of governance and management in practice. For example, security measures, data masking, and contract agreement measures are put in place to enable collaboration. These sanctions are influenced by collaborating professionals' norms. Also noted in the reviewed literature, such norms include governance practices, technology use, and work practices (Patel et al., 2012; Poirier et al., 2016; Pham, 2019; Moung Yin Chan et al., 2020; Hagen, 2021; Dhlamini et al., 2021). For example, to further enable collaboration in BDA work practices non-disclosure agreements and control practices are established. In addition, changes may be made to the established non-disclosure agreements and control practices. Such changes to governance practices, work practices, and standards may also happen because of new laws or regulations. As a result, processes and standards can be incorporated to work processes and project delivery processes. Some of these processes are automated to further assist with effective project delivery.

Social contracts enacted in BDA work practices are central to problem-solving and ad-hoc provisioning of BDA platform services. For example, the enactment of BDA platform services in practice can be triggered by technology failures which result in dialogue and the need for informal collaboration in problem-solving. Contrary to these findings, Dhlamini et al., (2021) note that technology challenges are barriers to collaboration in BDA work practices. This implies that technological challenges can

act as both enabling and constraining factors. Noted by other scholars, an organization's culture as an interpretive scheme is the most significant enabler for such collaboration in BDA work practices (De Koker, 2019; Kaya, 2019; Dhlamini et al., 2021). Confirming some of Patel et al. (2012) claims, other significant enablers which are elements of an organization's culture include tribal knowledge, interpersonal relations, trust, knowledge sharing, problem-solving, and requirement analysis. For example, common knowledge as a result of tribal knowledge is embraced by collaborating professionals in BDA work practices. Interpersonal relations enable improvised interactions, knowledge sharing enables informal channels of interactions, problem-solving enables informal engagement on technical tasks, and requirement analysis enables both formal and informal engagements in ensuring requirements are met.

Multiple resources are dominant in enabling informal collaboration in BDA work practices in organizations. Soft skills, an individual's knowledge, collaborative technologies, employee role, and technology-embedded social capabilities when enacted in practice it enables both formal and informal collaboration. The literature reviewed affirms these findings (Mikalef et al., 2018a; Morrison-Smith and Ruiz, 2020; Dhlamini et al., 2021). For example, social capabilities such as soft skills, emotional intelligence, critical thinking, and building interpersonal relations when enacted in practice are commanding in enabling both formal and informal collaboration in BDA work practices.

Norms such as social sessions and technical sessions legitimize informal collaboration when enacted in BDA work practices in organizations. For example, a community of practices prompts informal engagement for knowledge sharing. As a consequence of such norms, upskilling initiatives are triggered. Ad-hoc and informal technical sessions are triggered by various needs and events such as code review, thus, enabling constant engagement in BDA work practices. The literature reviewed only confirms work practices (e.g., code review) from these findings (Patel et al., 2012; Dhlamini et al., 2021).

**Proposition 1a**: The mutual interaction of BDA technologies, collaborative technologies, and BDA social systems influence the enactment of BDA platform services in enabling formal collaboration, and ad-hoc BDA platform services in enabling informal collaboration in BDA work practices.

**Proposition 1b**: The mutual interaction of BDA technologies, collaborative technologies, and BDA social systems influence the enactment of BDA capabilities in enabling formal collaboration and social capabilities in enabling informal collaboration in BDA work practices.

**Proposition 1c**: The mutual interaction of BDA technologies, collaborative technologies, and BDA social systems influence the enactment of governance and management in enabling formal collaboration, and social contracts and informal sessions in enabling informal collaboration in BDA work practices.

The research findings confirm the literature reviewed. Furthermore, the study adds to the body of knowledge by demonstrating the dynamic interaction of collaborative and BDA technologies with BDA social systems, as it influences the static nature of the ratified rules, resources, and meaning systems in collaborative BDA work practices, thereby enabling collaboration. Dhlamini et al. (2021), for example, noted that social contracts are used in professional collaboration in BDA work practices. Individual interpersonal relationships, on the other hand, can influence social contracts and enable informal collaboration over formal collaboration. De Koker (2019) also noted that contractual agreements adopted in practice enable collaboration in BDA work practices. In addition, Kaya (2019) and De Koker (2019) noted that the organizational strategy adopted in practice enables collaboration in BDA work practices. Confirming the influence of collaborative technologies, Cross, Borgatti, and Parker (2002) noted that for a distributed work setting, virtual technology platform implemented in practice enables collaboration in BDA work practices. In addition, Moung Yin Chan et al. (2020) noted that the enactment of BDA technologies in practice enables collaboration in BDA work practices.

#### *6.5.2.2 Collaboration Constraining Factors*

There are various challenges associated with collaboration and the provisioning of BDA platform services in practice. Also noted in the reviewed literature, the prevailing legacy infrastructure significantly impedes collaboration in BDA work practices (Wang, 2017, Hagen, 2021; Dhlamini et al., 2021). This is further exacerbated by the influence of a lack of shared understanding and assumption, shared strategy and objectives, and shared values during the collaboration of professionals in BDA work practices. For example, collaborating professionals might not have similar priorities. Also, the most significant is the collaborating professional's skills and data literacy.

The challenges associated with resource management such as the management of infrastructure, time, and skills contribute to what constrain collaboration in BDA work practices. Confirming some of Morrison-Smith and Ruiz (2020)'s findings, temporal complexity, management, geographic settings, subject-matter expert culture, governance, and access control are some of the factors that are dominant in constraining collaboration in BDA work practices. For example, time frame and geographic location factors such as language and a country's legislation enable these constraining factors. Also, these factors are influenced by social and technical capabilities challenges leveraged by professionals collaborating in BDA work practices. For example, lack of domain knowledge and infrastructure scalability challenges constrain social and technical capabilities. The literature reviewed affirms these findings (Kaya, 2019; Hagen, 2021; Dhlamini et al., 2021). With the remote work adoption, temporal and location complexities contribute to the collaboration constraints.

Sanction challenges associated with governance, processes, and standards impede collaboration in BDA work practices. For example, it is the policies and rules that are put in place as a form of governance that restrict data accessibility and sharing. Governance restrictions were noted in the reviewed literature as contributing factors to barriers to collaboration in BDA work practices (Hagen, 2021; Dhlamini et al., 2021). These sanctions are influenced by collaborating professionals' norms challenges.

Such norms include governance practices, technology use, and work practices. The governance practices challenges include policies and rules limitations, data security implementation limitations, and process limitations. For example, the change of processes as a result of legislation humpers effectiveness, thus, rendering collaboration ineffective. Technology license limitations constrain collaboration in BDA work practices. In addition, because of these constraints, a change in the adopted norms might be necessary.

Furthermore, the challenges associated with work environment culture are central to factors that constrain collaboration in BDA work practices in organizations. Other constraining factors enacted in BDA work practice include work activity nature, time challenges, preferences, and non-disclosure agreements. For example, a lack of visibility of what other teams are working on fosters a culture of working in silos. Such constraints are further enabled by an enterprise-wide work culture. From the literature reviewed, several scholars confirm that organizational context and culture contribute as a barrier to collaboration in BDA work practices in organizations (Poirier et al., 2016; De Koker, 2019; Kaya, 2019; Dhlamini et al., 2021).

**Proposition 2a**: The mutual interaction of BDA technologies, collaborative technologies, and BDA social systems influence the enactment of BDA platform services in constraining informal collaboration, and ad-hoc BDA platform services in constraining formal collaboration in BDA work practices.

**Proposition 2b**: The mutual interaction of BDA technologies, collaborative technologies, and BDA social systems influence the enactment of BDA capabilities in constraining informal collaboration and social capabilities in constraining formal collaboration in BDA work practices.

**Proposition 2c**: The mutual interaction of BDA technologies, collaborative technologies, and BDA social systems influence the enactment of governance and management in constraining informal collaboration, and social contracts and informal sessions in constraining formal collaboration in BDA work practices.

The research findings confirm the literature reviewed. Furthermore, the study adds to the body of knowledge by demonstrating the dynamic interaction of collaborative and BDA technologies with BDA social systems, as it influences the static nature of the ratified rules, resources, and meaning systems in collaborative BDA work practices, thereby constraining collaboration. In terms of the influence of enacted BDA social systems in practice, Hagen (2021) and Dhlamini et al. (2021) noted that shared understanding and language challenges constrain collaboration in BDA work practices. Because of language barriers, informal interactions are constrained. In addition, the challenges associated with technologies, skills, and domain knowledge in practice constrain collaboration in BDA work practices in organizations (Mikalef et al., 2018a; Hagen, 2021; Dhlamini et al., 2021). Similar findings were confirmed to constrain collaboration, specifically with the influence of BDA technologies adopted in practice (Ghasemaghaei, 2019). Limitations with governance implemented in practice were also confirmed to constrain collaboration in BDA work practices in an organization (Hagen, 2021; Dhlamini et al., 2021).

## 6.6 Chapter Summary

This chapter detailed the conceptual development and theoretical elaboration based on the research findings, which were compared to what the study reported in the reviewed literature. The findings presented sought to answer the questions of what and how structures enable and constrain collaboration in BDA work practices in organizations, as well as how structures and collaboration interact in BDA work practices. A detailed account of the structuration analysis of collaboration in BDA work practices in organizations was presented. In both formal and informal collaboration, three major structures of signification, domination, and legitimation emerged for each. For the formal collaboration, the structures include BDA platform services enacted in practice, BDA capabilities enacted in practice, and governance and management enacted in practice. For the informal collaboration, the structures include ad-hoc BDA platform services enacted in practice, social capabilities enacted in practice, and social contracts and informal sessions enacted in practice. The study also included a revised

conceptual framework and a causal loop depicting the dynamic interplay of collaboration and structures, as well as theoretical propositions.

# 7 Conclusion

## 7.1 Research objectives summary

Organizations face challenges in adopting collaboration across departments for leveraging Big Data due to structural practices in BDA work practices, making it a difficult concept to implement for fostering innovation and long-term competitiveness. The main objective of this study was to explore how structures enable and constrain collaboration in BDA work practices in organizations. The following are the sub-objectives

- To understand what are the structures that enable or constrain collaboration in BDA work practices in organizations.
- To understand how structures and collaboration interact in BDA work practices in organizations.

The summary of the key research findings is presented in the next section.

## 7.2 Summary of Key Findings

The study found that the nature of collaboration in BDA work practices in organizations can be interdepartmental, inter-organizational, inter-teams, inter-discipline, and interprofessional. The collaboration is triggered by multiple business needs or requirements from different business units or domains. In addition, collaboration in BDA work practices can be both formal and informal. Structures of signification, domination, and legitimation emerged for both formal and informal collaboration in BDA work practices in organizations. The three structures for formal collaboration include BDA platform services enacted in practice (signification), BDA capabilities enacted in practice (domination), and governance and management enacted in practice (legitimation). For informal collaboration, the structures include ad-hoc BDA platform services enacted in practice (signification), social capabilities enacted in practice (domination), and social contracts and informal sessions enacted in practice (legitimation). The practical enactment of these structures leads to both intended and

unintended consequences, resulting in either enabling or constraining collaboration in BDA work practices. The study further found that the dynamic interplay relationship of the structures and collaboration reinforce and balance each other. The theoretical and practical contributions to this study are presented in the next section.

## 7.3 Study Contributions

### 7.3.1 Theoretical Contributions

The study further affirms the usefulness of using structuration theory as a theoretical lens to study collaboration and work practices (Jones and Karsten, 2008; Pham, 2019). The impact of collaborative and BDA technology in practice on collaboration has also been reported in the literature (Daniel, 2019; Morrison-Smith and Ruiz, 2020). Figure 15 depicted the revised conceptual framework, indicating the presence of mutual interaction between BDA social systems and collaborative and BDA technologies. Both collaborative technologies and BDA technologies have distinct effects on collaboration in BDA work practice. However, more research should be explored in this field. Though the enactment of collaborative and BDA technologies in practice can enable or constrain collaboration in BDA work practices, the study does not detail how their underlying structures enable and/or constrain collaboration in BDA work practices.

The literature also confirms that a variety of work activities trigger the need for collaboration in BDA work practices (Dhlamini et al., 2021). As a result, professionals in BDA work practices communicate, exercise their knowledge power, and interact in accordance with established processes and standards. Figure 15 presents the structures of signification, domination, and legitimation that are enacted in both formal and informal collaboration in BDA work practices' social systems. As noted in the literature, Figure 15 presents both the formal contract and social contract structures enacted in BDA work practices in organizations (De Koker, 2019; Kaya, 2019; Dhlamini et al., 2021). Furthermore, Figure 15 depicts that the unintended consequence of the duality of structures can be enabling and/or constraining collaboration in BDA work practices in organizations.

Figure 16 presents a causal loop of collaboration in BDA work practices in organizations, together with theoretical propositions. The causal loop demonstrates how the enacted structures are influenced and influence both formal and informal collaboration in BDA work practices in organizations. More theoretical inferences can be developed by building on the study's theoretical findings. For example, how collaboration in BDA work practices is enabled and constrained in organizations can be understood through the lens of both formal and informal collaboration in BDA work practices through the enactment of formal contracts or social contracts in practice. The next section presents the practical contribution of the study.

### 7.3.2 Practical Contributions

The study aimed to shed light on the structures that enable and constrain collaboration in BDA work practices in organizations. The findings from this study present a structuration analysis of collaboration in BDA work practices in organizations. According to the empirical findings, collaboration in BDA work practices is enabled and/or constrained as a result of formal and informal collaboration enacted in practice. Practitioners in big data and BDA domains can leverage this understanding in their undertakings to implement and assess collaboration in BDA work practices. As Poirier et al. (2016) point out, context shapes collaboration; the study findings can help in understanding and defining fit-for-purpose collaboration interpretive schemes, resources, and norms in BDA work practices. Furthermore, organizations can use the study findings to define and develop a BDA collaborative platform. The limitations experienced in the study are presented in the next section.

## 7.4 Study Limitations

The use of grounded theory necessitates the researcher's engagement (analysis) with data as data collection proceeds. Furthermore, the nature of qualitative research necessitates that the researcher reflects and improves. As a result, given the time

allotted for the study, time constraints influenced data collection. The study was cross-sectional. The recruitment of participants was done virtually. This was primarily due to the global COVID-19 pandemic's constraints. The difficulty with such an approach is obtaining consent and, eventually, participation on time. Although some participants had agreed to participate, scheduling interviews was not possible. Future research suggestions are presented in the next section.

## 7.5 Future Research Suggestions

This research study can be expanded by looking into the mutual shaping relationship of BDA and collaborative technologies, as well as the BDA social system. Though the influence of technology on BDA social systems has been noted, it remains to be seen how the technology underlying structures influence collaboration in BDA social systems. Examining a specific level and stage of collaboration may provide a better understanding of the structures that either enable or constrain collaboration in BDA work practices. A case study attempting to answer the same research question as this study may yield more contextual findings. Furthermore, the same research question can be investigated using a different theoretical lens, such as social capital theory.

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## Appendices

### Appendix A: Interview guide and questions.

### Interview guide

1. Thank the participant for taking part in the study.
2. Identify and assign alias to each participant and record the date, time and location/platform used to conduct the interview.
3. Confirm to the participant that their identity will be kept confidential.
4. Request permission to record the interview from the participant, if permission is not granted, inform the participant that you will take notes as the interview progresses.
5. Confirm that the recoding will be kept secure and only accessible by the researcher and supervisor.
6. Confirm participant's consent and if the participant has gone through the interview questions.
7. Clearly state purpose of the study
8. The purpose of this study is to understand how structures enable and constrain collaboration in BDA work practices in organizations.
9. Confirm if the participant has any questions before proceeding to the interview questions.
10. Ask and record participant demographic information. (Industry/year of Exp/Their Role)
11. Proceed to asking the interview questions per the interview schedule. Allow the conversation to flow naturally. Prompt and seek clarity on any ambiguity.
12. Ask the participant if they have anything additional to add or share.
13. Ask the participant to recommend participant(s) in the organization that are knowledgeable and does Big Data Analytics Work. Also, request if the

participant can inform the recommended participants that you may contact them to request them to participate.

14. Ask the participant if they interested in receiving a copy of the overall findings.
15. Request permission if the participant is willing to be contacted later if any clarity is required.

## Interview Questions

| Collaboration | BDA Work Practices |
|---|---|
| **Structures**<br>1. What are the types of collaboration practices in BDA work practices in organizations that professionals interact in? What are the parts that interact in collaboration in BDA work practices?<br>2. What is the nature of the collaboration in BDA work practices?<br>3. How does the nature (Formal/Informal) of collaboration influence the BDA work practices?<br>4. What rules, resources and norms that are put to practice when collaborating in BDA work practices?<br>5. How are these rules, resources and norms influence collaboration?<br>6. How do inter/intra departmental collaboration influence the BDA work practices? | **Structures**<br>1. What types of BDA work practices in organizations does analytics professionals collaborate in?<br>2. What is the nature of the BDA work-practices that professional collaborate in?<br>3. How does the type and nature (Algorithmic or Human based intelligence/inductive or deductive) of the BDA work-practices influence collaboration?<br>4. What rules, resources and norms that are put to practice in the BDA work practices?<br>5. How are these rules and resources influence BDA work practices? |
| **Interpretive schemes**<br>7. How do interpretive schemes (social/technical) that analytics professionals use in their | **Interpretive schemes**<br>6. How do interpretive schemes (social/technical) that analytics professionals use in the BDA work |

| | |
|---|---|
| collaboration influence the BDA work practices?<br>8. How do shared objectives/understanding in collaboration influence BDA work practices?<br>9. How do collaboration rules and resources influence collaboration technologies?<br>10. How do the nature of the collaboration technologies influence (enable/constrain) BDA work practices?<br>11. How does the nature of collaboration influence the collaboration technologies?<br><br>**Facilities**<br>12. How does human capital in the collaboration practice influence BDA work practices?<br>13. How do power positions influence collaboration?<br>14. How do the social/technical facilities used by professional's influence collaboration in BDA work practices?<br>15. How do collaboration technology facilities influence collaboration?<br>16. How do BDA technologies influence collaboration?<br><br>**Norms** | practices influence their interactions/collaboration?<br>7. How do the BDA work practice outputs/objectives influence collaboration?<br>8. How do BDA work practices rules and resources influence BDA technologies?<br>9. How does the nature of BDA technologies influence (enable/constrain) collaboration in BDA work practices?<br>10. How does the nature of BDA work practices influence the BDA technologies?<br><br>**Facilities**<br>11. How does human capital in BDA work practice influence collaboration?<br>12. How do power positions influence BDA work practice?<br>13. How do BDA technology facilities influence BDA work practices?<br>14. How do the BDA technologies influence BDA work practices?<br><br>**Norms**<br>15. How do BDA work practices norms (social/technical) influence collaboration?<br>o How do such norms influence the BDA work practices? |

| | |
|---|---|
| 17. How do collaboration norms (social/technical) influence BDA work practices?<br>o How do such norms influence collaboration?<br>18. How do processes/standards influence collaboration? | 16. How do processes/standards influence BDA work practices? |
| **Agency**<br>19. What drives the need for collaboration in BDA work practices?<br>20. How is collaboration in BDA work practices motivated?<br>21. How does collaboration happen?<br>22. How do the interactions of the analytics professionals influence collaboration in BDA work practices in organizations?<br>23. How does the interaction of analytics professionals in their work practices influence BDA technologies? | **Agency**<br>17. What drives/motivate the need for BDA work practices?<br>18. How does the BDA work practices happen? |

## Appendix B: Cover Letter - consent form Individual Participants.

**Department of Information Systems**
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dd/mm/yyyy

Request to conduct research and interview participation consent form

Dear Sir/Madam,

In terms of the requirements for completing an Masters Degree in Information Systems at the University of Cape Town a research study is required.

The researcher, in this case Mr Mpumelelo Dhlamini, has chosen to conduct qualitative research entitled "Structuration analysis of collaboration in Big Data Analytics work practices in organizations". The study aims to perform an analysis of the interplay between structures and collaboration in Big Data Analytics work practices in organizations. The research also seeks to understand how structures enable and constrain collaboration in Big Data Analytics work practices in organizations.

Your participation in this research is voluntary. All information will be treated in a confidential manner and used exclusively for the purpose of this study. No individual names will be recorded or published. You will not be requested to supply any identifiable information, ensuring anonymity of your responses. You can choose to withdraw from the research at any time for whatever reason, in accordance with ethical research requirements.

The data collection method will be one-on-one interviews with professionals performing the analytics work in organizations. The interviews will be conducted at a convenient location or virtual platform and will last about 1 hour. If you are willing to participate in this study, kindly sign the attached form and return to me at your earliest convenience.

Should you have any questions regarding this research, please feel free to contact me on 081 XYX 6561 or email: XYXYX@gmail.com

Your participation in this study would be greatly appreciated, but is entirely voluntary.
Sincerely,

Mpumelelo Dhlamini

Researcher \ Masters Student, (UCT)
Department of Information Systems
University of Cape Town

Prof. Irwin Brown

Research Supervisor
Department of Information Systems
University of Cape Town

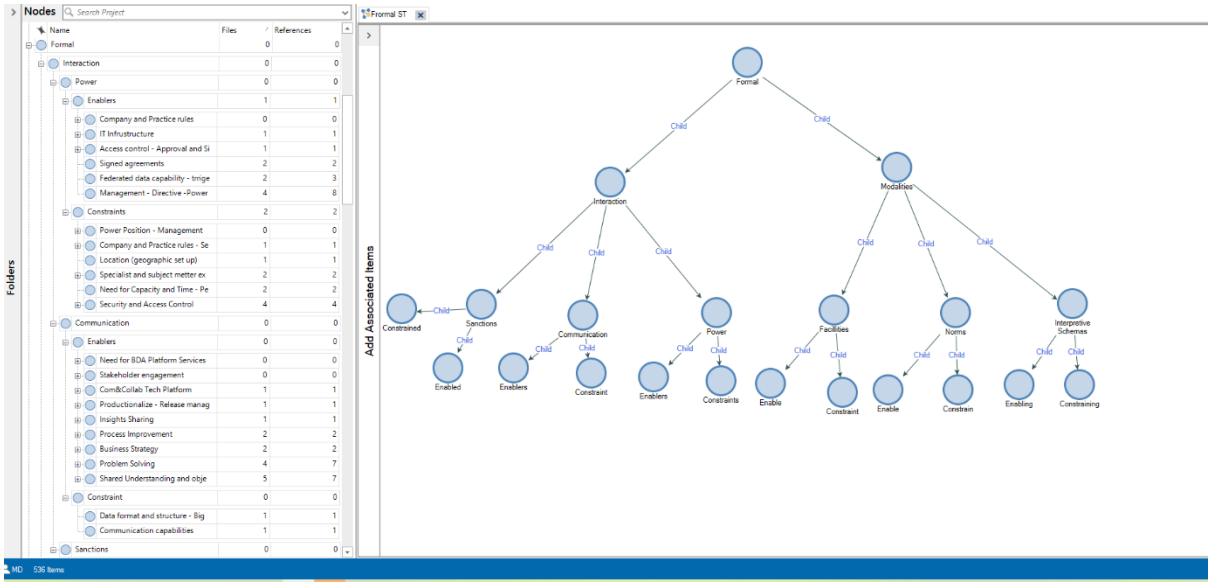
**Research Participant Consent Form**

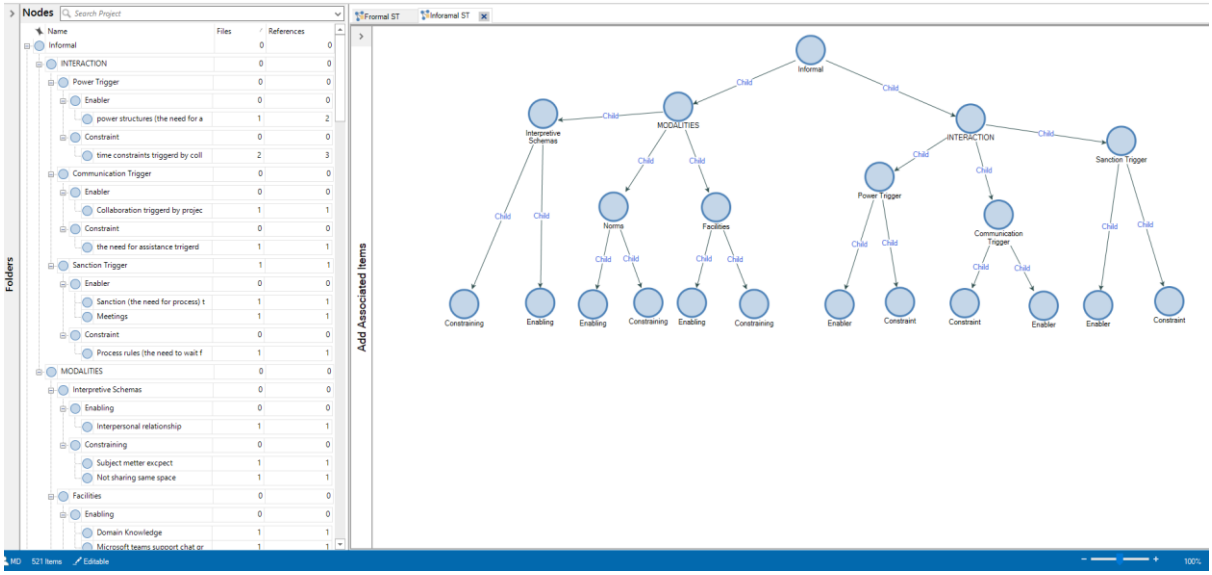
I, _____, consent to participate in the research on "Structuration analysis of collaboration in Big Data Analytics work practices in organizations".

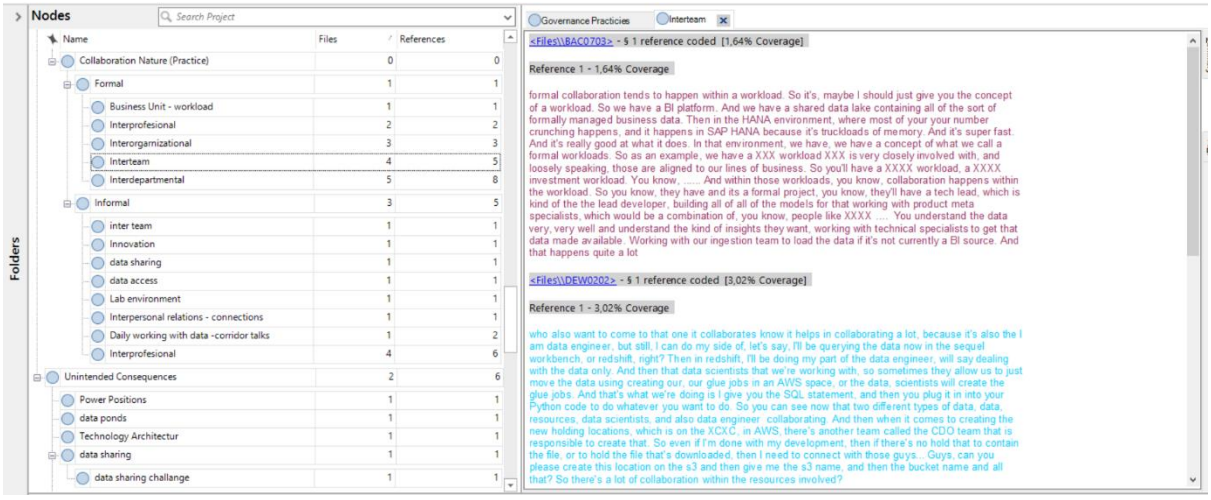
I am aware that participation is voluntary and that I may choose to withdraw from this study at any time, should I choose to do so.

_____ _____
Signature Date

## Appendix C: Analysis work with Nvivo.

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Interorgarnizational 3 3
Interteam 4 5
Interdepartmental 5 8
Informal 3 5
inter team 1 1
Innovation 1 1
data sharing 1 1
data access 1 1
Lab environment 1 1
Interpersonal relations - connections 1 1
Daily working with data -corridor talks 1 2
Interprofesional 4 6
Unintended Consequences 2 6
Power Positions 1 1
data ponds 1 1
Technology Architectur 1 1
data sharing 1 1
data sharing challange 1 1
Folders
Governance Practicies
Interteam
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Reference 1 - 1,64% Coverage
formal collaboration tends to happen within a workload. So it's, maybe I should just give you the concept of a workload. So we have a BI platform. And we have a shared data lake containing all of the sort of formally managed business data. Then in the HANA environment, where most of your your number crunching happens, and it happens in SAP HANA because it's truckloads of memory. And it's super fast. And it's really good at what it does. In that environment, we have, we have a concept of what we call a formal workloads. So as an example, we have a XXX workload XXX is very closely involved with, and loosely speaking, those are aligned to our lines of business. So you'll have a XXXX workload, a XXXX investment workload. You know, ..... And within those workloads, you know, collaboration happens within the workload. So you know, they have and its a formal project, you know, they'll have a tech lead, which is kind of the the lead developer, building all of all of the models for that working with product meta specialists, which would be a combination of, you know, people like XXXX .... You understand the data very, very well and understand the kind of insights they want, working with technical specialists to get that data made available. Working with our ingestion team to load the data if it's not currently a BI source. And that happens quite a lot
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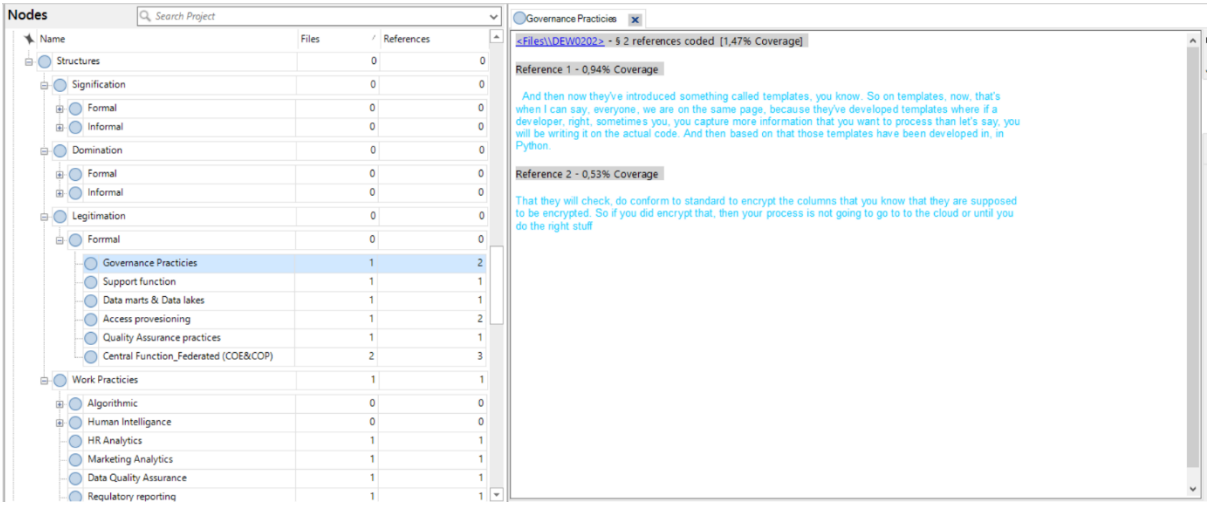
Reference 1 - 3,02% Coverage
who also want to come to that one it collaborates know it helps in collaborating a lot, because it's also the I am data engineer, but still, I can do my side of, let's say, I'll be querying the data now in the sequel workbench, or redshift, right? Then in redshift, I'll be doing my part of the data engineer, will say dealing with the data only. And then that data scientists that we're working with; so sometimes they allow us to just move the data using creating our, our glue jobs in an AWS space, or the data, scientists will create the glue jobs. And that's what we're doing is I give you the SQL statement, and then you plug it in into your Python code to do whatever you want to do. So you can see now that two different types of data, data, resources, data scientists, and also data engineer collaborating. And then when it comes to creating the new holding locations, which is on the XCXC, in AWS, there's another team called the CDO team that is responsible to create that. So even if I'm done with my development, then if there's no hold that to contain the file, or to hold the file that's downloaded, then I need to connect with those guys... Guys, can you please create this location on the s3 and then give me the s3 name, and then the bucket name and all that? So there's a lot of collaboration within the resources involved?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Governance Practicies 1 2
Support function 1 1
Data marts & Data lakes 1 1
Access provesioning 1 2
Quality Assurance practices 1 1
Central Function_Federated (COE&COP) 2 3
Work Practicies 1 1
Algorithmic 0 0
Human Intelligance 0 0
HR Analytics 1 1
Marketing Analytics 1 1
Data Quality Assurance 1 1
Regulatory reporting 1 1
Governance Practicies
<Files\\DEW0202> - § 2 references coded [1,47% Coverage]
Reference 1 - 0,94% Coverage
And then now they've introduced something called templates, you know. So on templates, now, that's when I can say, everyone, we are on the same page, because they've developed templates where if a developer, right, sometimes you, you capture more information that you want to process than let's say, you will be writing it on the actual code. And then based on that those templates have been developed in, in Python.
Reference 2 - 0,53% Coverage
That they will check, do conform to standard to encrypt the columns that you know that they are supposed to be encrypted. So if you did encrypt that, then your process is not going to go to to the cloud or until you do the right stuff