UNIVERSITY OF GHANA

COLLEGE OF HUMANITIES

MUTUAL UNDERSTANDING IN INTEROPERABLE FINANCIAL MANAGEMENT SYSTEMS DEVELOPMENT IN THE PUBLIC SECTOR OF GHANA: A SENSEMAKING THEORY PERSPECTIVE

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DEPARTMENT OF OPERATIONS AND MANAGEMENT INFORMATION SYSTEMS

AUGUST 2022

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THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN INFORMATION SYSTEMS

DEPARTMENT OF OPERATIONS AND MANAGEMENT INFORMATION SYSTEMS

AUGUST 2022

DECLARATION

I certify that this thesis, which I now submit for examination for the award of a Doctor of Philosophy, is the result of my own work and has never been presented either in whole or in part for any other degree at this University or elsewhere. All references to other people's work have been duly cited. This thesis has been prepared according to the regulations for postgraduate study by the University.

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ABSTRACT

The extent to which stakeholders have a shared understanding of a project in terms of its goals, processes, roles, and outcomes is known as mutual understanding (MU). MU is a focal cognitive outcome that stems from episodes of cognitive activities—sensegiving and sensemaking—during the ongoing dialogue among the diverse stakeholders of a project. The link between MU and the success of a project has been well established in research on information systems. A closer examination of information systems development (ISD) research, however, reveals the lack of a theoretical and practice-oriented understanding of how MU is created and sustained among key stakeholders throughout the phases of an ISD project. To address this lack of understanding, the purpose of this study is to develop a framework to explain the creation and sustenance of mutual understanding between stakeholders in the development of an interoperable financial management system (IOFMS) in the public sector of a developing economy. In the public sector, interoperability occurs when independent information systems of different governmental departments, agencies, units and external partners work together (exchange information) efficiently and effectively in a predefined or agreed-on fashion. The development of interoperable systems in the public sector is complex, in that it involves unifying diverse interests, emotions, and political nuances. This makes it an ideal setting for investigating how MU is created and sustained. Further, three interrelated research gaps have been identified in the literature: the need for more theorisation in interoperability research, the need for more social theories in integrated financial management information systems research, and the need to examine how barriers or influencing factors shape the development of interoperable platforms in government.

To address the above gaps, three research questions are examined in this study: (a) *What are the triggers for creating and sustaining mutual understanding in the development of* an *IOFMS*

in a developing economy? (b) *How do ISD project mechanisms (problem definition, requirement analysis, development, and implementation) affect the sensemaking process and outcomes during the development of an IOFMS in a developing economy*? (c) *What are the factors that influence the creation and sustenance of mutual understanding in the development of an IOFMS in a developing economy*? This study employs sensemaking theory and the paradigm of critical realism to explore the mechanisms that underpin the creation and sustenance of mutual understanding in the development of an IOFMS. A case study of the payroll add-on systems in the public sector of Ghana is the vehicle for this exploration. As an example of a developing economy, Ghana provided the opportunity to examine a government institution that had experienced the development and implementation of three new systems that were interoperable with an existing payroll management system. The payroll add-on system consists of three independent, interoperable modules: the Electronic Salary Payment Voucher, the Electronic Payslip, and the Third-Party Referencing System. Through the paradigm of critical realism and the analytical techniques of Miles and Huberman, the study led to the development and verification of a framework and 14 findings that explain how MU is created and sustained throughout the development of interoperable systems.

Concerning the first research question, the findings suggest that in the development of interoperable systems in the public sector, a mix of major planned and unplanned events tend to trigger organisational actors to engage in sensemaking and sensegiving activities. ISD is thus more likely to start as a major event or activity involving senior management in this setting. These events may originate from internal contradictions and ambiguities or from an external stimulus. The triggers tend to increase in severity as a project progresses to meet the demands of its later stages/phases. The project stages/phases and their mutually agreed-on deliverables also serve as triggers for sensemaking in subsequent phases of the project.

Previous research has not identified the increasing severity of triggers or the function of project stages as triggers for sensemaking.

Concerning the second research question, previous studies outlined three sensemaking processes: creation, interpretation, and enactment. However, these processes had not been explored in ISD projects. The findings of this thesis confirm these processes and then outline the mechanisms that characterise each of them. This thesis establishes the creation mechanisms as *sense integration, data integration,* and *developing and distributing new data/information for use;* the interpretation mechanisms as *prototyping, joint reviewing, consultation, testing,* and *training;* and the enactment mechanisms as *formalisation and institutionalisation, the establishment of consent, illustration/demonstration,* and *documentation*. Beyond outlining these mechanisms, the study also explains how they affect MU in interoperable systems development. For example, enactment mechanisms can serve as protective mechanisms that reduce or remove the potential for actors to revoke, undermine, subvert, or weaken the 'sense' or mutual understanding that has been established. Concerning sensemaking outcomes, the study reveals four levels of MU that hierarchically span the ISD project phases. It was found that MU starts as a shared understanding at the senior management level and then progresses to broader consensus beyond the senior management. As more consensus is gained, there is a need to demonstrate the viability of the 'sense' that has been made. The focus, therefore, moves to the technical expression of the shared understanding (e.g. a prototype), which can serve as an enactment mechanism to protect the shared understanding. In addition to the technical expression, measures may be taken to ensure that the MU is institutionalised and formalised. At the start of a project, mutual understanding may manifest as shared understanding between the developer and the senior management on the client side, but as the project progresses, it expands to include other organisational members, thereby institutionalising the new

understanding. This progressive perspective of MU in ISD projects and interoperability research is a novel contribution of this study.

Concerning the third research question, this thesis identifies factors that can stall a project [inhibitors]—financial resources, context-based experiences, and negative emotions—and factors that reinforce the need for sensemaking or demonstrate its value [enablers]—technology [prototypes] and cognitive frames. This categorisation of influencing factors is not mentioned in the sensemaking literature, but it is important. Sensemaking processes have the potential to create or affect the cognitive framing of the project actors. When the processes or tangible outcomes [prototypes] adequately address the context-based experiences of the beneficiary actors, MU is a more plausible outcome. Hence, this study establishes that understanding the relationships between influencing factors is as important as identifying the factors.

The originality and contributions of this study to research and practice are as follows. This study is the first to propose a framework that explains how the triggers, processes, outcomes, and influencing factors of MU change throughout the phases of ISD projects. This provides knowledge to researchers and practitioners that hitherto could not be found in other studies. Although projects may differ in scale and the nature of stakeholder interaction, the framework and findings of this study can be adapted as a guide for other IOFMS and ISD projects in the public sector. The study also suggests that the techno-organisational perspective of interoperability should be the focus of academics and practitioners. The findings of this study indicate that both actors and technology shape MU and project outcomes. The above contributions have been published in one book chapter and one conference paper (see Appendix D). A manuscript is also under preparation for submission to *Information Systems*, a tier 4 journal in the information systems discipline.

DEDICATION

This thesis is dedicated to God, my beloved wife, and my lovely children.

ACKNOWLEDGEMENT

Many have contributed in diverse ways to this PhD thesis, both directly and indirectly; and I would like to thank them for their support and encouragement. Firstly, I am thankful and grateful to the Almighty God for granting me the grace and opportunity to go through this PhD work. Secondly, I express my profound gratitude to my supervisor, Prof. Richard Boateng for his confidence and trust in me to carry out this PhD work. I am also thankful to him for his guidance, constructive criticism, availability, advice and prayers. May God richly bless him. To Prof. John Effah and Dr. Acheampong Owusu, my co-supervisors, I say thanks for his academic support and guidance. God bless you.

I am very much grateful for the time given to me by the CEO and employees of KariTech and the former Controller and Accountant-General, Deputy Controller and Accountant-General (Finance) and the Head of Payroll (CAGD). To all the participants in and outside of the Controller and Accountant General Department (CADG) and the employees in the various governmental departments, agencies and units who made this research possible, I say thanks.

To my fellow course mates who were nurtured with me to this expected end, I am very grateful for your companionship, especially, Vonbackustein Klaus Komla.

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LIST OF ABBREVIATIONS

API	-	Application Programming Interface
BPEMS	-	Public Expenditure Management System
CAGD	-	Controller and Accountant General Department
CR	-	Critical realism
CRM	-	Customer Relationship Management
E-Payslip	-	Electronic Payslip
ESPV	-	Electronic Salary Payment Voucher
GIFMIS	-	Ghana Integrated Financial Management Information Systems
ICT	-	Information and Communication Technologies
IEEE	-	Institute of Electrical and Electronics Engineers
IFMIS	-	Integrated Financial Management Information Systems
IOFMS	-	Interoperable Financial Management Systems
IS	-	Information Systems
ISD	-	Information Systems Development
MU	-	Mutual Understanding
PFM	-	Public Financial Management
PUFMARP	-	Public Financial Management Reform Programme
S/MTAP	-	Short Term and Medium Action Plan
TPRS	-	Third-Party Referencing System

CHAPTER 1: INTRODUCTION

1.1 Research Background

Financial Management Information Systems (FMIS) or financial management systems apply information and communication technologies (ICT) to support the automation and integration of financial management processes in large organisations or institutions, as in the public sector (Nuhu *et al.*, 2018; World Bank, 2015). Public financial management processes include budget preparation and execution, accounting and financial reporting, cash and asset management, and human resource and payroll management (Alsharari & Youssef, 2017; Hove & Wynne 2010; Rodin-Brown, 2008; World Bank, 2015). Integrated financial management information systems (IFMIS) are deployed to replace stand-alone, often legacy systems used by public or government agencies (Hendriks, 2013). IFMIS integrate all the financial management activities of the government into an application suite that facilitates public financial management processes (Nuhu *et al.*, 2018). These systems are crucial, especially in developing economies (Alsharari & Youssef, 2017), and are core elements of public financial management (PFM) reform programmes in various developing countries (World Bank, 2015). Their implementation responds to the increasing pressure from institutions, including the International Monetary Fund, to improve fiscal management and reporting and achieve better information disclosure (Alsharari & Youssef, 2017; World Bank, 2015).

For example, in South Africa, IFMIS were adopted as part of a broad financial management reform in the public sector, introduced in 1994, after democracy was attained. They replaced different transversal systems, namely, Supply Chain Management, Human Resources, and Finance and Business Intelligence, with a single system (Hendriks, 2012). In Ghana, the introduction of Ghana Integrated Financial Management Information Systems (GIFMIS) was part of the Public Financial Management Reform Programme (PUFMARP) implemented in

1999–2008 to enhance monetary discipline and macro stability (Betley, Bird, & Ghartey, 2012; Nuhu *et al.*, 2018; Tanko, 2013). Three financial management systems were introduced by 2009. The PUFMARP comprised various modules such as budget preparation, account and reporting, procurement, revenue management, aid and debt management, and payroll. However, it failed to effectively aid budget preparation and provide automated auditing and accounting for expenditure. This programme was followed by the Public Expenditure Management System (BPEMS), supposed to integrate with other information systems to support the transfer of financial data between the central bank, tax payment, procurement, and audit functions and the Controller and Accountant General Department. The BPEMS also featured inadequate power supply and poor end-user and management commitment and ownership. Between 2006 and 2009, a Short Term and Medium Action Plan (S/MTAP) was introduced to address the weaknesses of the BPEMS. An integrated payroll and financial database was created. The S/MTAP addressed open issues in budgeting, revenue allocation irregularities, and external and internal audit. However, its implementation was affected by poor end-user commitment, inadequate oversight account monitoring, weak (outdated) legal framework, problematic integration, and inefficient budgeting process.

GIFMIS aimed to achieve an adequate formulation of budget and revenue mobilisation and strengthen internal and external audits (Betley *et al.*, 2012; Nuhu *et al.*, 2018). They were meant to replace all stand-alone legacy financial management systems at the Ministries, Departments, Agencies (MDAs), and the Metropolitan, Municipal, and District Assemblies (Ofori-Atta, 2017).

IFMIS ensure efficiency, transparency, and accountability in fiscal management across all government agencies and departments by exchanging information enabling various components or modules to work together as a single system. This ability is known as

interoperability or “the ability of two or more systems or elements to exchange information and to use the information that has been exchanged” (Institute of Electrical and Electronics Engineers [IEEE], 2000, p. 582). It is also referred to as “the ability to share and exchange information using common syntax and semantics to meet an application-specific functional relationship through the use of a common interface” (International Organisation for Standardisation [ISO], 2009, p.7). At the government level, integration aims to form a larger unit of governmental entities, temporary or permanent, to share information and merge processes (Klischewski & Scholl, 2006). Interoperability occurs when heterogeneous or independent information systems of various agencies, jurisdictions, departments, administrations, or external partners work together efficiently in a predefined or agreed-on fashion (Tripathi, Gupta, & Bhattacharya, 2012). Compared to integration, interoperability involves a more loosely-coupled approach, where information systems remain independent but coordinated (Weichhart, 2014). Systems are truly interoperable when a coherent exchange of information and services between independent information systems is observed (Tripathi *et al.*, 2012). An interoperable government depends on integration. Hence, interoperability is becoming an emerging area of interest to private- and public-sector institutions (Sharma & Panigrahi, 2015). For governments, interoperability provides advantages such as lower costs and transparency in governance systems and processes as it eliminates corruption by offering new tools for eradicating poverty and inequality (Dener *et al.*, 2011; Wadia, 2000); It is considered an indicator of e-government systems' maturity (Estermann *et al.*, 2009).

Despite this promise, the adoption of IFMIS has produced mixed results. In a study on the impact of IFMIS in Somalia, Nor (2019) concluded that the federal government's revenue increased between 2013 and 2018, strengthening the relationship with international development agencies and the confidence that public funds are managed in a transparent,

equitable, and accountable manner. However, tax compliance rules were still needed to prevent tax evasion and avoidance. Chalu (2019) also found that IFMIS adoption improved the clarity and reliability of financial reporting for local governments in Tanzania. Utilisation capacity and internal audit effectiveness were critical to ensuring the reliability of financial reporting. The former was constrained by weak IFMIS system policies, lack of knowledge, limited skills, limited management and technical support, poor understanding of IFMIS, and resistance to change. These findings are consistent with other studies on Kenya and South Africa (Gcora & Chigona, 2019; Micheni, 2017).

For example, in South Africa, change management was not factored into IFMIS implementation in municipalities. Project implementation primarily focused on the success of IFMIS, with little consideration of end-users' needs. Hence, user-resistance was encountered (Gcora & Chigona, 2019). Besides, Micheni's (2017) analysis of IFMIS adoption in selected Kenyan counties concluded that change management should be improved by providing regular training and phased implementation (and testing) of IFMIS. Researchers and practitioners have previously cautioned that limited impact of IFMIS adoption might be observed in contexts where information technology (IT) infrastructure and skills are inadequate (Andrews *et al.*, 2018; Dorotinsky & Watkins, 2013).

Interoperability or interoperable information may be hindered by various constraints such as technology, organisational capabilities, and syntactic and semantics limitations (Scholl & Klischewski, 2007). In the public sector, these constraints depend on the prevailing political, economic, social, and technological conditions (Sharma & Panigrahi, 2015). For example, in Ghana and South Africa, the effective implementation of the government IFMIS is largely hinged on sustained political support and commitment and change management amidst other

technological, legal, and social factors (Hendricks, 2013; Nuhu *et al.*, 2018; Yeboah, 2015). How to sustain political support and harmonise different government agencies' interests to ensure the implementation and continuous usage of IFMIS (and interoperable systems in general) remains an open question (Boateng *et al.*, 2019; Effah & Nuhu, 2017; Hendricks, 2013). Therefore, a study that seeks to explore such knowledge is a step towards the achievement of these objectives, especially for developing economies. This doctoral research aims to achieve such understanding.

1.2 Research Problem

Research on interoperability may be classified into four sub-themes: technical, syntactic, semantic, and organisational interoperability (see Chapter 2). Technical interoperability refers to hardware or software components, systems, and platforms that enable machine-to-machine communication and are focused on communication protocols, and the infrastructure required for those protocols to function (Rezaei *et al.*, 2014; Van der Veer & Wiles, 2008). Syntactic interoperability indicates the ability of two systems or platforms to exchange data. It is usually associated with message transfer by communication protocols and defined syntax and encoding (Rezaei *et al.*, 2014; Van der Veer & Wiles, 2008). Semantic interoperability refers to the definition of content, and it deals with "humans" rather than "machines" in the interpretation of this content (Guijarro, 2009). Organisational interoperability indicates organisations' ability to effectively communicate and transfer information across information systems, geographic regions, and cultures (Kubicek & Cimander, 2009). The dominant research focus is on organisational and semantic interoperability.

Various concerns may inform future research. First, to adopt interoperable systems and take advantage of the standardisation they offer, organisations need to adapt their technical and

organisational/institutional processes (Gogan *et al.*, 2007; Tripathi *et al.*, 2012). Scholl, Kubicek, Cimander, and Klischewski (2012) identified nine constraints in the implementation of interoperable platforms by the government: constitutional or legal, jurisdictional, collaborative, organisational, informational, managerial, cost, technological, and performance constraints (Scholl & Klischewski, 2007). Other interoperability barriers classified as conceptual, technological, organisational, economic, and regulatory constraints have been addressed by Chen (2006), Widergren, Hardin, Ambrosio, Drummond, Gunther, Gilchrist and Cohen (2007), and Rezaei *et al.* (2014). These factors create a favourable environment for certain intergovernmental interactions but limit others at various levels. The strategies adopted by organisations and governmental institutions to implement interoperability, especially in developing countries, need to be further explored (Tripathi *et al.*, 2012). The technological and non-technological (process, administrative, and structural) changes that governmental institutions undergo in the process need to be investigated. Further, since interoperability or integrated systems, such as IFMIS, involve multiple stakeholders or intended users, it is vital to understand how stakeholders' differing interests are unified, or mutual understanding is created and sustained in the development and implementation of IFMIS and during continuous use.

Second, a lack of theorisation is observed in interoperability research (see Chapter 2). A few studies adopted a theory, framework, or model. The complex adaptive systems (CAS) theory (Weichhart, 2015) was used to conceptualise the dynamics of interoperable systems that are functionally dependent (integrated with others) or independent (may be changed without affecting others). Guijarro (2009) combined the eGovernment Interoperability Framework (eGIF), the Danish eGovernment Interoperability Framework (DIF), and the Le Cadre Commun d'Intéroperabilité (CCI) to investigate how e-government agencies in Europe and the

United States have developed tools such as interoperability frameworks and enterprise architectures. The study proposed a two-phase interoperability roadmap of governments, the enabler (interoperability framework) and the alignment (enterprise architecture) phase. The former provides the essential technical standards and policies to enable a seamless flow of information between different government agencies. The latter allows for the alignment of administrative procedures with technical systems.

Most studies focused on the technical dimensions of interoperability, which are crucial to ensuring data, process, and communicative integration. Hence, theoretical approaches tend to serve this focus of research. However, some studies used both technical and social theoretical approaches, drawing attention to the need to understand how interoperability dynamics impact competing initiatives or interests of stakeholders. For example, Nayar and Beldona (2010) used the technology co-adoption model, interorganisational systems standards, and process innovations (IOS SPI) model and institutional theory to evaluate the strategic perspectives of key industry players regarding the potential of interoperability technology and various factors pertaining to its adoption. The study argued that different perspectives/interpretations of requisite industry standards and system functionalities could influence the implementation of interoperability systems (Nayar & Beldona, 2010). This socio-technical perspective allows addressing the impact of mutual and competing interests, level of understanding, appreciation and technical skills readiness of government officials for interoperability, and the related non-technical theoretical approaches (Tripathi *et al.*, 2012).

This doctoral thesis attempts to address these gaps in research. Concerning theorisation, the longitudinal study by Jenkin *et al.* (2019) offers some direction. The study focused on information systems development (ISD). It highlighted the need to explore how mutual

understanding (MU) between key stakeholders (business and IT managers, users, and developers) is created, or the extent to which they have a shared conception of the ISD project, and how such mutual understanding changes, develops, or deteriorates over time. This scenario is characteristic in creating and sustaining or managing mutual interests and understanding in interoperable systems. Mutual, shared, or congruent understanding refers to "the extent to which stakeholders have a shared conception of the project regarding, for example, its goals and processes, and stakeholder roles" (Gregory *et al.*, 2013, cited in Jenkin *et al.*, 2019). The link between MU and project success has been well established in the literature (Boateng & Hinson, 2008; Gregory *et al.*, 2013; Lyytinen, 1987). Previous research on MU showed that it is a focal cognitive outcome, which stems from episodes of cognitive activities in the ongoing dialogue between different stakeholders in a project (Gioia & Chittipeddi, 1991; Stigliani & Ravasi, 2012). In ISD projects, the continuous dialogue between IT and business stakeholders involves episodes of sensegiving and sensemaking. Sense may be referred to as the meaning or interpretation given to a piece of information held by or known to an individual or a group concerning a phenomenon, artefact, situation, people, or scenario (Sandberg and Tsoukas, 2014; Weick, 1979). This sense can inform behaviour or create an interest in an issue. IS projects often involve various stakeholders with differing "senses" or interests, conflicting or not.

Different stakeholders may largely pursue individual "senses" or interests. At the individual level, sensemaking refers to the frameworks through which individuals construct, interpret, update, and reconstruct their meanings (Gioia & Chittipeddi, 1991). In organisations, sensemaking is the continuous interplay of sensemaking at the individual and group level (unit, communities of practice, and teams, among others), through conversations and artefacts (models, diagrams, and reports, among others) (Weick *et al.*, 2005). After an individual makes

"sense", activities in a group or a project may necessitate the individual to communicate his/her sense to influence others' sense or interpretation of a situation (sensemaking). Achieving that influence requires sensegiving (Gioia & Chittipeddi, 1991). Sensegiving and sensemaking are arguably co-dependent constructs in ISD projects.

Previous ISD studies link MU development to project planning in information systems development (Wallace *et al.*, 2004), control mechanisms (Gregory *et al.*, 2013; Kirsch, 2004), and cognitive activities (sensegiving and sensemaking) (Vlaar *et al.*, 2008). However, the relationship between project management mechanisms and sensemaking in interoperability systems has not yet been fully investigated. This gap in research is more evident in developing economies, where public sector financial reforms are characterised by meta-level interests and influences (funding), which affect the development of MU and shape project management mechanisms. Jenkin *et al.* emphasised the potential of the model they developed and related theories for future studies on sensemaking.

In summary, three primary research gaps may be observed. First, how interoperability constraints shape the implementation of interoperable platforms in governments (Scholl *et al.*, 2012) and enterprises (Chen, 2006; Rezaei *et al.*, 2014) is not entirely clear. In this regard, the technological and non-technological changes that governmental institutions undergo in the development and implementation of interoperable platforms have not been determined yet. Second, more theorisation is needed in interoperability research. Future studies should adopt either socio-technical or social theories to examine the non-technical dimensions of interoperability (Nayar & Beldona, 2010). Third, the effects of the relationship between project management mechanisms and MU (and sensemaking processes) on ISD project outcomes should be further explored.

To address these research gaps, this doctoral research examines the structures and mechanisms that underpin the creation and sustenance of MU in IFMS, particularly GIFMIS add-on systems, in Ghana. Various studies addressed the GIFMIS; however, most previous studies have focused on a project's implementation and the impact of GIFMIS (Betley *et al.*, 2012; Effah & Nuhu, 2017; Nuhu *et al.*, 2018; Yeboah, 2015). Nuhu *et al.* (2018) recommended that future studies should adopt non-deterministic theories and focus on government agencies to uncover unique institutional factors that affect the implementation of GIFMIS in Ghana. This study, therefore, takes the perspective of sensemaking theory, which explains how "sense", or MU, is created in organisations.

Further, previous studies have primarily focused on the core modules of the GIFMIS. Arguably, no research has clarified how payroll add-on systems have been developed and implemented to be interoperable with the GIFMIS (Nuhu *et al.*, 2018; Yeboah, 2015). The payroll add-on systems consist of three independent interoperable modules, namely, the Electronic Salary Payment Voucher, the Electronic Payslip, and the Third-Party Referencing System. Payroll systems are critical for the well-being of governments. Since the government is the largest employer in a country, it is typically concerned with employee tensions and the related political and social ramifications (Telegdy, 2018). Therefore, a study of government payroll systems is likely to generate far-reaching benefits to academics, policymakers, and practitioners. This study's originality lies in the application of the sensemaking theory to investigate payroll add-on systems of the GIFMIS. In contrast with previous research, this study employs a non-deterministic theory to examine GIFMIS add-on systems' implementation. Addressing the above research gaps from a developing economy perspective generates valuable insights to follow-up previous work on sensemaking/MU and IS research.

1.3 Research Purpose

This study investigates the role of MU between stakeholders in developing interoperable financial management systems (IOFMS) in the public sector. Sensemaking theory is employed to explore the structures and mechanisms underpinning MU's creation and sustenance in IFMS, particularly payroll add-on systems in the public sector of Ghana.

1.4 Research Objectives and Questions

This doctoral research adopts the organisational perspective of sensemaking, as posited by Sandberg and Tsoukas (2014). The authors conceptualised sensemaking as a constructive, not purely cognitive, practice to describe how individuals with knowledge and concern of their identity in a social context (of other actors) engage in ongoing events (planned or unplanned; minor or major). Individuals extract cues and make plausible sense from events while enacting more or less order into those events. Being retrospective and episodic, people know that they have made sense or MU has been created after it has happened.

This practice is influenced by various factors: individual/social, organisational, technological, and political. Therefore, sensemaking consists of triggers, processes, outcomes, and influencing factors.

Regarding the development and implementation of interoperable systems, this doctoral research seeks to achieve the following objectives:

1. *To explore the triggers for creating and sustaining MU in the development of IOFMS in a developing economy.*

The first objective responds to the need for more theorisation in interoperability research and the call for more non-deterministic or social theories in IFMIS research (Jenkin *et al.*, 2019; Naya & Beldona, 2010; Nuhu *et al.*, 2018). This objective draws on the sensemaking theory to

examine MU in developing and implementing the GFMIS payroll add-on systems in Ghana. The concept of MU and the application of sensemaking theory in ISD processes are discussed in Chapter Three (theoretical foundation) and Chapters Five and Six (case study findings, analysis, and discussion).

The second objective is:

2. *To determine how ISD project mechanisms (problem definition, requirement analysis, development, and implementation) affect the sensemaking process and outcomes (MU and enacted actions of stakeholders) in developing IOFMS in a developing economy.*

The second objective responds to the need to explore the effects of the relationship between project management mechanisms and MU (and sensemaking processes) on ISD project outcomes in future ISD research (Jenkin *et al.*, 2019). In this study, the ISD process is conceptualised in four key phases—problem definition, requirement analysis, development, and implementation. In each step, the study examines the interrelationships between ISD activities and the sensemaking process and outcomes (Chapters 5 and 6).

The third objective is:

3. *To explore the factors that influence (enable or constrain) the creation and sustenance of MU in developing IOFMS in a developing economy.*

Various barriers or constraints of interoperability in governments (Scholl *et al.*, 2012) and enterprises (Chen, 2006; Rezaei *et al.*, 2014) have been addressed in the literature. This objective responds to the need to examine how these constraints shape interoperable platforms' implementation in governments. This doctoral research explores the technological and non-

technological changes that governmental institutions undergo to achieve interoperability (Tripathi *et al.*, 2012). The influencing factors of interoperability and the respective organisational responses are analysed.

Based on the above objectives, the following research questions are addressed:

1. What are the triggers for creating and sustaining MU in the development of IOFMS in a developing economy?
2. How do ISD project mechanisms (problem definition, requirement analysis, development, and implementation) affect the sensemaking process and outcomes (MU and enacted actions of stakeholders) in the establishment of IOFMS in a developing economy?
3. What factors influence (enable or constrain) the creation and sustenance of MU in the development of IOFMS in a developing economy?

1.5 Significance of the Research

This study significantly contributes to the academic, practitioner, and policy perspectives. First, this research responds to the need for more theorisation in interoperability research. The study examines the application of sensemaking theory from a developing economy perspective in examining the creation and sustenance of MU in the development and implementation of IOFMS. The study follows-up the work of Jenkins *et al.* (2019). It contributes to further understanding the concept of MU and sensemaking theory in information system development in a developing economy. The contextual influences, constraints, and dynamism of information system development and usage in developing economies have been demonstrated as an opportunity for contributing to theory (testing or building) (Boateng, 2016; Effah, 2016). Along

these lines, this study explains the creation and sustenance of MU between stakeholders in the implementation and usage of IOFMS in a developing economy.

From a practitioner perspective, the proposed framework first offers a guide to the creation and sustenance of MU between stakeholders in the implementation and usage of IOFMS. This approach can inform future developments in deploying add-on systems for IFMIS in Ghana and similar countries. Second, practitioners can understand how information systems development activities affect sensemaking and MU between key stakeholders and ISD project success. From a developing economy perspective, these issues have not been fully addressed yet.

From a policy perspective, this research helps inform the development of policies and standards related to IFMIS and other IOFMS for governments and the private sector. It also helps develop interoperable systems planning and control guidelines. By focusing on payroll systems, which are central to governments' well-being, this study provides valuable insights for policymakers, practitioners, and researchers (Telegdy, 2018).

1.6 Synopsis of Chapters

The research is structured as follows. Chapter One sets the context for the study. Chapter Two explains the key concepts in interoperability systems and IFMS and reviews the literature on interoperability. It also presents an overview of the IFMIS, their antecedents, and a description of their components. Chapter Three discusses the theoretical underpinnings of this study, particularly MU and the sensemaking theory. It also proposes a conceptual framework to address the research objectives. Chapter Four examines the philosophical assumptions of this research and establishes the research methodology and the data collection methods and data

analysis techniques. Chapter Five presents a case study, which explores the structures and mechanisms behind the creation and sustenance of MU in the development and implementation of the GIFMIS payroll add-on systems in Ghana. Chapter Six discusses the case study in relation to the conceptual framework and the tenets of MU and the sensemaking theory. Chapter Seven summarises the study's results, illustrates a post-study framework, and discusses the study's contributions to research and practice and its policy implications, limitations, and future research directions.

CHAPTER 2: Interoperability and Financial Management Information Systems - Key Concepts and Review of the Literature

2.1 Chapter Overview

This chapter describes the key elements of interoperable information systems and reviews the literature on interoperability. The chapter also provides an overview of IFMIS and their components and a review of selected studies on IFMIS. The chapter concludes with the research gaps that inform the selection of theory, the development of the conceptual framework, and the knowledge contribution of this research.

2.2 Interoperable Systems—Conceptual Explanation

Interoperability has been defined from a technological and organisational perspective based on the definition of interoperability. Definitions based on a technological perspective were provided by IEEE (2000) and Archmann and Kudlacek (2008). For instance, IEEE (2000) presented four definitions, two discussed here. Interoperability is the ability of "**two or more systems or elements to exchange information** among themselves and **to use that information that were exchanged**" (IEEE, 2000, p.582). IEEE (2000) also defined interoperability as the ability of "**two or more systems or components to exchange information in a heterogeneous network and to use this information**" (IEEE, 2000, p.582). Archmann and Kudlacek (2008) contended that interoperability occurs when systems communicate, interpret, and interchange data meaningfully. However, from an organisational perspective, IEEE (2000) also defined interoperability as the capacity of **equipment units of working together** to accomplish **useful functions**.

Other definitions reflect both the technological and organisational perspectives of interoperability. For instance, dos Santos and Reinhard (2012) argued that interoperability occurs when "**heterogeneous or independent information systems** of **different agencies, jurisdictions, departments, administrations or external partners work together (exchange information)** efficiently and effectively in a **predefined or agreed-on fashion**" (Gottschalk & Solli-Saether, 2009, cited by dos Santos and Reinhard, 2012, p. 73). Similarly, IEEE (2000) defined interoperability as the capacity, promoted but not guaranteed by a particular group of standards, of **heterogeneous equipment, usually manufactured by several suppliers, to work together in a network environment**. Interoperability has also been referred to as the capacity of organisations, such as governmental agencies and institutions, to share and integrate information and business processes by adopting common standards (State Services Commission, 2007). The previous definitions and their perspectives are summarised in Table 2.1. The technology perspective tends to be dominant in studies that focus on technical standards underpinning interoperability. However, techno-organisational perspectives are common in studies that focus on achieving interoperability in an organisational or institutional context. Hence, most studies on interoperability in governments tend to adopt a techno-organisational perspective. This study also draws on the techno-organisational perspective.

Table 2.1 Interoperability Definitions and Perspectives

Source	Definition of Interoperability	Perspective
IEEE (2000)	The ability of two or more systems or elements to exchange information among themselves and to use that information that were exchanged.	Technology
IEEE (2000)	The ability of two or more systems or components to exchange information in a heterogeneous network and to use this information.	Technology
IEEE (2000)	The capacity of equipment units of working together to accomplish useful functions.	Organisational
IEEE (2000)	The capacity promoted but not guaranteed by the adhesion to a certain group of standards, that enables heterogeneous equipment, usually manufactured by several suppliers, to work together in a network environment.	Techno-organisational
State Services Commission (2007)	The capacity of organisations, such as government agencies and institutions, to share information and integrate information and business processes by use of common standards.	Techno-organisational
dos Santos and Reinhard (2012)	Interoperability occurs when heterogeneous or independent information systems of different agencies, jurisdictions, departments, administrations or external partners work together (exchange information) efficiently and effectively in a predefined or agreed-on fashion.	Techno-organisational

Source: Author's Illustration

Interoperable systems comprise two or more information systems or modules that exchange information and interpret or use said information to produce outputs or support other processes (Weichhart, 2014; Delarama & Valilaia, 2017). Hence, interoperable systems contribute to a defined purpose, such as decision-making, carried out by a specified user or set of users. These systems sometimes work within and across organisational boundaries to advance the effective delivery of information, services, and products to defined stakeholders for a given purpose.

2.3 Interoperable Systems—Review of the Literature

A search for the phrase "platform interoperability" and the keyword "interoperability" was conducted on the abstracts, keywords, and titles "search spaces" across various databases. Collections of studies through electronic sources are mostly performed to identify articles that justify arguments or assertions on a particular subject (Petter & McLean, 2009). Searches were conducted in five journal databases: Online Wiley, Emerald, EBSCOhost, ScienceDirect, and Taylor & Francis. As Levy and Ellis (2006) suggested, these databases feature the top-fifty information systems journals. Therefore, we believe that a fair representation has been achieved. We investigated studies published between 2008 and 2018. A detailed explanation of the review methodology is outlined in Appendix A.

A total of 80 papers were initially identified and downloaded. However, only 70 articles met the selection criteria and were used for the analysis. These studies were summarised according to three themes: dominant issues, conceptual or theoretical approaches, and methodological approaches to studying platform interoperability.

2.3.1 Dominant Issues in Interoperability Research

The literature review classified interoperability into four major themes, further categorised into

sub-themes. The four primary themes are *dimension*, *perspective*, *levels and domain*, and *application*. The classification of schemes in the literature may be challenging as all aspects must be considered (Senyo *et al.*, 2018). Therefore, this study's classification was primarily adapted from three studies, with some modifications to reflect changes in the literature (Rezaei *et al.*, 2014; Senyo *et al.*, 2018; Tripathi *et al.*, 2012).

The *dimension* theme relates to the technological adoption space of studies concerning platforms. The relative sub-themes are **data** integration, namely, the combination of data from different sources and user provision of a unified view of this data (Halevy, 2001); **process** integration, which refers to various processes (Tripathi *et al.*, 2012); **communication** integration, or the use of electronic computers, computer software, and computer networks to convert, store, protect, process, transmit, and securely retrieve information (Vernadat, 2010); and **multi-dimension**, which refers to studies focussing on more than one technology adoption space. In total, 110 papers (70%) were based on process integration, 28 (18%) on data integration, 16 (10%) on communication integration, and 3 (2%) were multi-dimensional. The *perspective* theme indicates the various perspectives on the solution. The relative sub-themes are **service orientation** and **database** perspectives (Rezaei *et al.*, 2014; Weichhart *et al.*, 2018). The former focuses on processes and functions developed as serviceable resources, while the latter considers the contribution of interoperable platforms to the provision of services based on storage and manipulation of data. In total, 128 papers (82%) were service-oriented, and 29 (18%) adopted a database perspective.

The *levels* theme relates to the levels at which interoperability can be attained and requires resolution (Morris *et al.*, 2004; Munk, 2002). Four sub-themes are identified: technical, syntactic, semantic, and organisational interoperability. **Technical interoperability** refers to

hardware or software components, systems, and platforms that enable machine-to-machine communication and are focused on communication protocols and the infrastructure required for those protocols to function (Rezaei *et al.*, 2014; Van der Veer & Wiles, 2008). **Syntactic interoperability** indicates the ability of two systems or platforms to exchange data. It is usually associated with message transfer by communication protocols and defined syntax and encoding (Rezaei *et al.*, 2014; Van der Veer & Wiles, 2008). **Semantic interoperability** is generally related to the definition of content, and it deals with humans' rather than machines' interpretation of content. **Organisational interoperability** indicates organisations' ability to communicate effectively and transfer information despite using a variety of information systems across significantly different types of infrastructure and, possibly, geographic regions and cultures. As presented in Table 2.1, we identified 31 papers (20%) as technical, 30 (19%) as syntactic, 31 (20%) as organisational, and 65 (41%) as semantic.

The *domains and applications* theme borders on a specific societal sector where interoperability has a significant impact. The sub-themes include hospitality, e-government, IT, e-business, education, knowledge management, health, manufacturing/engineering, building/facilities management, geographic/geospatial, disaster risk, management, supply chain, transportation, energy and power, cross-domain, and general issues. The results indicate that 3 papers (2%) related to hospitality, 12 (8%) to e-government, 34 (22%) to IT, 10 (6%) to e-business, 32 (20%) to education and knowledge management, 16 (10%) to health, 8 (5%) to manufacturing/engineering, 6 (4%) to building/facilities management, 3(2%) to geographic/geospatial, 3 (2%) to disaster risk management, 2 (1%) to supply chain, 2 (1%) to transportation, and 2 (1%) to energy and power. In addition, 6 papers (4%) were concerned with more than one sector and were classified under the cross-domain sub-theme. Eighteen

papers (11%) could not be classified under any particular theme and were placed under the general issues sub-theme.

Table 2.2 Dominant Issues in Platform Interoperability Studies

Themes	Sub-Themes	Number of Papers	Percentage
Dimensions	Process integration	110	70%
	Data integration	28	18%
	Communication integration	16	10%
	Multi-dimension	3	2%
	Total	***157***	***100%***
Perspective	Service-oriented	128	82%
	Database perspective	29	18%
	Total	***157***	***100%***
Levels	Technical	31	20%
	Syntactic	30	19%
	Organisational	31	20%
	Semantic	65	41%
	Total	***157***	***100%***
Domains & Applications	Hospitality	3	2%
	E-government	12	8%
	Information technology	34	22%
	E-business	10	6%
	Education and knowledge management	32	20%
	Health	16	10%
	Manufacturing/engineering	8	5%
	Building/facilities management	6	4%
	Geographic / geospatial	3	2%
	Disaster risk management	3	2%
	Supply chain	2	1%
	Transportation	2	1%
	Energy and Power	2	1%
	Cross-domain	6	4%
	General issues	18	11%
	Total	***157***	***100%***

Source: Author's Illustration

2.3.2 Dominant Conceptual Approaches in Platform Interoperability Research

Different theories, frameworks, models, and concepts have been employed in platform interoperability research. Some studies used more than one theory, framework, or model, while others did not rely on any identifiable theory or concept. As mentioned before, the CAS theory (Weichhart, 2015) was used to address the dynamics of interoperable systems that learn and are concurrently functionally dependent or independent. Such frameworks include the resource description framework (RDF), used by Puustjärvi (2008), who studied semantic interoperability in electronic auctions by examining the advantages and disadvantages of hard-coding and semantic messages for communication between the auction system and participants. These approaches also comprise the government interoperability frameworks (GIFs) used by Ray *et al.* (2011) for a critical survey of selected government interoperability frameworks.

As mentioned earlier, Nayar and Beldona (2010) used the technology co-adoption model, interorganisational systems standards, and IOS SPI model and institutional theory to investigate various strategic perspectives of interoperability technology. Guijarro (2009) combined the eGIF, DIF, and CCI to investigate e-government agencies in Europe and the United States. Some studies used less-theoretical frameworks. Prodanović and Vulić (2017), for example, used the certification authority trust model to address a model of PKI interoperability in Serbia. Some studies conceptualised models to study platform interoperability, such as Ghenassia *et al.* (2017), who proposed a general method for improving the spatial interoperability of medical and ecological databases. Baskar, Shakeel, Kumar, Burhanuddin and Sampath (2020) also use the dynamic and interoperable communication framework (DICF) to explore the interoperability of wearable devices to acclimatise to dynamic nature of different tracking healthcare applications.

Other studies did not rely on theoretical frameworks. For example, Birrell *et al.* (2010) summarised the methodology and findings of the Online Catalogue and Repository Interoperability (OCRIS), a project recently carried out by the Centre for Digital Library Research at the University of Strathclyde funded by the Joint Information Systems Committee. Janssen and Feenstra (2010) introduced the concept of "service portfolio", a web instrument used to support manufacturing chains' composition and reconfiguration. Hence, we argue that many studies on cloud platform interoperability relied on little or, in some cases, no theoretical frameworks. We, therefore, posit the need for more theorisation in platform interoperability research. Table 2.3 shows the use of frameworks, models, theories, and concepts in existing studies. In total, 121 papers (77.1%) did not use any theoretical framework, model, theory, or concept, while 15 papers (9.6%) used conceptualised frameworks.

Table 2.3 Dominant Research Frameworks, Models, Theories, and Concepts

Research Framework	**Number of Papers**	**Percentage**
Conceptual	15	9.6%
No Framework	121	77.1%
Certification Authority Trust Model	1	0.6%
Technology Co-adoption model & Institutional theory	1	0.6%
Resource Description Framework (RDF)	2	1.3%
Government Interoperability Frameworks (GIFs)	1	0.6%
FIPA (Foundation for Intelligent Physical Agents) Contract Net Protocol	1	0.6%
IFP (Industry Foundation Processes)	1	0.6%
eGovernment Interoperability, Danish eGovernment Interoperability ,"Le Cadre Commun d'Intéroperabilité" (CCI)	1	0.6%
Existing ERP Interoperability frameworks	2	1.3%
Policy and Quality Interoperability Framework	1	0.6%
The FLEXINET Ontology	1	0.6%
Web Feature Service (WFS)	1	0.6%
Existing e-business interoperability framework	1	0.6%
Complex Adaptive Systems (CAS) Theory	1	0.6%
Reference model for supporting a technology classification of mobile content and service delivery platforms	1	0.6%
ONC Framework	1	0.6%

Research Framework	Number of Papers	Percentage
The Building Handover Information Model (BHIM)	1	0.6%
Dynamic and Interoperable Communication Framework (DICF)	1	0.6%
Future Internet Fusion (FIFu) Framework	1	0.6%
Public Administration Interoperability Capability Model (PAICM)	1	0.6%
Total	***157***	***100%.***

Source: Author's Illustration

2.3.3 Dominant Methodological Approaches to Platform Interoperability

Among the reviewed papers, 40 papers used a qualitative approach, 45 used design science, 43 had no method, 19 used quantitative approach, and 10 used mixed-methods approach. Henning (2018) used a qualitative approach and proposed a theoretical framework for investigating the determinants of the organisational adoption of interoperability standards in government information networks. Sandy and Freeland (2016) studied the importance of interoperability in the context of the Digital Public Library of America. Studies that employed a design science approach include Golzarpoor *et al.* (2018), who investigated ways to improve the interoperability of construction industry processes and industry foundation processes, and Alfaro *et al.* (2009), who studied business process interoperability and collaborative performance measurement.

Some studies did not employ any identifiable methodology. Examples include Buhalis and Leung (2018), who conceptualised smart and agile hospitality enterprises of the future and proposed a smart hospitality ecosystem that adds value to all stakeholders. Llanes-Padrón and Pastor-Sánchez (2017) examined records in the context of the conceptual model proposed by the International Council on Archives (ICA) based on the archival description and proposed a W3C Web Language (OWL) ontology for its implementation in the semantic web. One

possible explanation could be that some studies were purely conceptual and did not use data.

Some articles adopted a quantitative approach. For example, Tripathi *et al.* (2012) examined the interoperability of government and corporate portals in India's technological adoption space. They highlighted three critical dimensions: data, process, and communication integration. For instance, as mentioned above, Birrell *et al.* (2010) summarised the methodology and findings of the OCRIS.

Finally, studies applying a mixed-methods approach include Maheshwari and Janssen (2014), who described an interoperability measurement instrument combining technical and organisational interoperability, and Ghezzi *et al.* (2012), who developed a technology classification model for mobile content and service delivery platforms, the core of mobile middleware technology providers' value propositions.

2.3.4 Research Gaps and Priorities for Future Research

The identified gaps in the literature align with three main themes: planning and implementation, the characteristics of interoperability, and the impacts and limitations of interoperability.

Adoption of Interoperable Platforms. Several factors should be considered when developing interoperable systems in developing countries, such as interoperability layers, the need for standards, information-sharing capabilities, and the need for single identity and digital signatures for authenticating transactions (Pardo & Tayi, 2007). Kubicek and Cimander (2009) identified four layers of interoperability: technical, syntactical, semantic, and organisational. The reviewed studies present different dimensions and contexts for interoperability, which form the basis for studies that enable the faster proliferation of interoperability, especially

between government departments. Guijarro (2007) and Kubicek *et al.* (2011) contended that open standards play an essential role in the operability of government systems. Different techniques for implementing interoperable systems are based on the tasks in which various applications are involved, owned, and run. While such systems may be easy to implement in small countries, their application is challenging in large developed countries due to the influence of jurisdiction, authority, and politics (Sharma & Panigrahi, 2015).

Moreover, organisations may need to revise their technical and organisational processes (Gogan *et al.*, 2007). There is, therefore, a need to explore the techniques adopted by organisations and governmental institutions, especially in developing countries, for implementing interoperability. We propose the following research questions to be explored in future studies:

i. What techniques should organisations adopt to implement interoperability in developing countries?

ii. What technological and non-technological changes do organisations undergo while attempting to adopt interoperability in developing countries?

Impact and Limitations of Platform Interoperability. Despite the advantages of interoperability for citizens and governments, several challenges and limitations to its proliferation exist, as it is a complex phenomenon with constraints related to technology, organisational capabilities, and syntactic and semantic elements (Guijarro, 2007; Scholl *et al.*, 2012). These constraints depend on the prevailing political, economic, social, and technological conditions, and a wide disparity exists among countries regarding the maturity of e-government services (Perucci, 2020).

Other limitations may hinder interoperability from proceeding efficiently (Tripathi, Gupta, & Bhattacharya, 2013). As mentioned before, Scholl *et al.* (2012) identified nine types constraints that affect the implementation of interoperable platforms. Novakouski and Lewis (2012) investigated how to address interoperability requirements and the challenges that policymakers and system developers face regarding interoperability in e-government systems. However, the problems of interoperability and context-dependent factors that influence its implementation should be further investigated. The following questions should be explored in future research:

i. What are the antecedents of platform interoperability in the public sector, and how are the differing interests of stakeholders unified and pursued?

ii. What context-based factors influence interoperability (such as technological, institutional, and environmental elements– including policy/legal factors)? How do these factors compare or contrast across private- and public-sector organisations?

2.4 Integrated Financial Management Information Systems—Conceptual Explanation

The principles that govern sound budgeting and financial management are comprehensiveness, legitimacy, flexibility, predictability, contestability, honesty, transparency, and accountability (Dener *et al.*, 2011). To achieve these principles, governments need to allocate and manage public resources effectively. These PFM processes include various functions (Alsharari & Youssef, 2017; Hove & Wynne 2010; Rodin-Brown 2008; World Bank, 2015). Information systems that enable governments to manage financial resources and the related activities are known as Financial Management Information Systems (FMIS). FMIS are defined as "a set of automation solutions that enable governments to plan, execute, and monitor the budget by assisting in the prioritisation, execution, and reporting of expenditures, as well as the custodianship and reporting of revenues" (Dener *et al.*, 2011, p. 1). Through centralised web-based solutions, these systems offer different authorisation levels for users to allocate and

manage resources while complying with local and international financial regulations and reporting standards. Governments comprise several agencies, departments, and units and manage various projects; hence, FMIS often are stand-alone systems used by different agencies and units across the public sector. These systems do not share a central database, and thus, the coordination of activities and monitoring of resources may be hampered. When FMIS and other public financial management information (for example, payroll) share a central database for financial transactions, performance monitoring, and reporting, they are referred to as IFMIS (Dener *et al.*, 2011). As a result, the government's financial management activities are typically integrated into an application suite that facilitates PFM processes (Nuhu *et al.*, 2018).

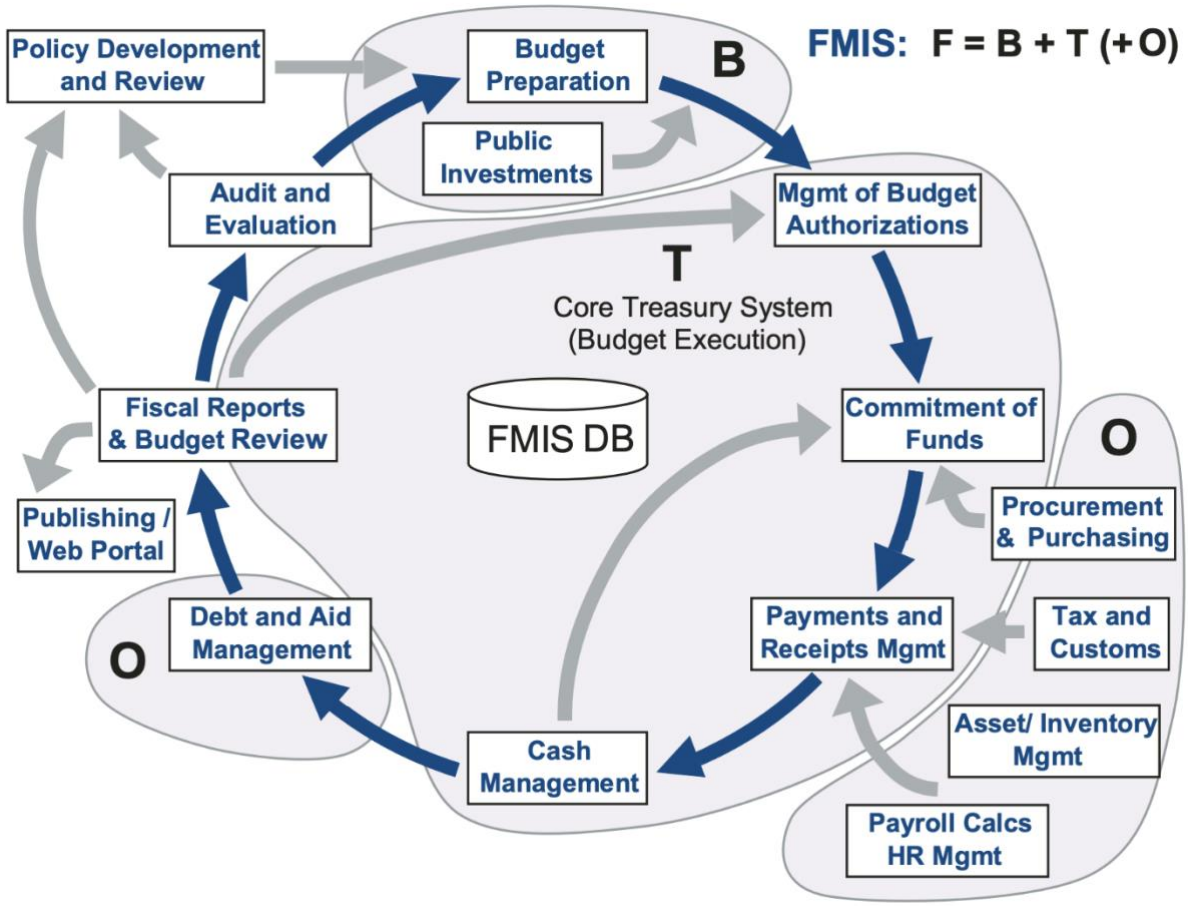
By integrating information management and financial management across government units, IFMIS improve interactions across these units, contributing to transparency and efficiency in the delivery of services and government business conduct.

2.4.1 Components of Integrated Financial Management Information Systems

IFMIS comprise two types of systems. First, the core systems, namely, treasury systems to support "key budget execution functions such as accounts payable and receivables, commitment and cash management, and the general ledger and financial reporting, combined with budget formulation (multi-year), debt management, and public investment management modules" (Dener *et al.*, 2011, p. 3). Second, the non-core systems, often linked with FMIS, such as "personnel management/payroll, revenue administrations (tax and customs), public procurement, inventory and property management, and performance management information" (ibid, p. 3). Hence, beyond financial or budgetary control, IFMIS allow governments to effectively manage and make informed decisions regarding policies and programmes and readily publish information on the budget performance and related policies and programmes.

Figure 2.1 (overleaf) shows the distinction between core (**B**udget and **T**reasury) and non-core (**O**ther) FMIS. Table 2.3 (overleaf) explains the coding of IFMIS project components.

Figure 2.1 IFMIS project components



Source: Dener *et al.* (2011)

Table 2.4 Coding of IFMIS Project Components

Code	IFMIS Project Components
B	Budget systems (budget planning + preparation) including: • budget planning/formulation • medium-term frameworks • public investment management
T	Treasury systems (budget execution) supporting: • management of budget authorisations/releases • commitment of funds • payment/revenue management (mostly based on treasury single accounts (TSAs)) • cash forecasting and management • accounting and reporting
F	FMIS: a combination of Budget and Treasury systems (***F*** = ***B*** + ***T***)
O	Other FMIS components may be present in FMIS (***F*** = ***B*** + ***T*** + ***O***): • revenue collection (mainly interfaces with tax and customs systems) • debt management (covering both domestic and external debt) • procurement/purchasing (tracking all payments after contract signature) • asset and inventory management
P	Preparatory work (advisory support/training) for Treasury or FMIS implementation: • accounting/financial reporting reforms, including compliance with International Public Sector Accounting Standards (IPSAS) • budgeting and macroeconomic forecasting in the Ministry of Finance/Economy • establishment of TSA • improvement of budget classification (BC) and unified chart of accounts (CoA)

Source: Dener *et al.* (2011)

2.4.2 Key Recommendations for Designing and Implementing Integrated Financial Management Information Systems

IFMIS are complex systems involving various stakeholders from different government units and agencies. Research on IFMIS identified various prerequisites and recommendations to ensure success in the development and implementation of IFMIS (Alsharari & Youssef, 2017; Dener *et al.*, 2011; Effah & Nuhu, 2017; Hendricks, 2013; Nuhu *et al.*, 2018). In an extensive review of ninety-four FMIS projects in fifty-one countries carried out by the World Bank, Dener *et al.* (2011) advised on the following FMIS prerequisites and FMIS design and implementing stages. First, to minimise the risks of cost overruns, delays, and failure, various prerequisites should be acquired before contracting an IT solution provider. These elements are categorised into three groups: functional aspects, technical aspects, and human resources (see Table 2.5).

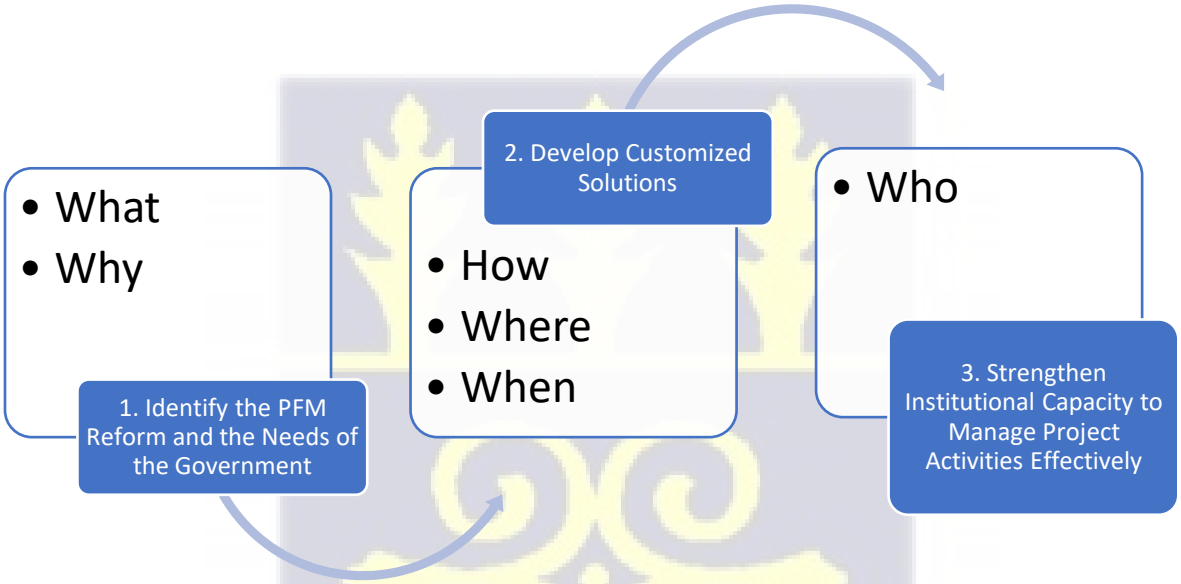
Table 2.5 Prerequisites for Designing and Developing IFMIS

Functional Aspects	Technical Aspects	Human Resources
• Improvement of budget classification • Development of a unified chart of accounts, integrated with the budget classification • Improvement of treasury single-account operations • Development of commitment control and monitoring mechanisms • Establishment of cash management functions	• Establishment of a secure countrywide communication network • Preparation of system/data centres	• Presence of a core team of ICT specialists within PFM organisations

Source: Dener *et al.* (2011)

The extent of the influence of these elements depends on the country. In the case of South Africa and Ghana, discussed in Chapter One, success depends on adequately preparing for the implementation of IFMIS. Since such projects are complex, hinged on financial reforms in the public sector, and often resulting in large ICT contracts, the government's political commitment and ownership are critical (Betley *et al.*, 2012; Hendricks, 2013; Nuhu *et al.*, 2018). Second, concerning the design and implementation of IFMIS, the above-mentioned World Bank Study recommended different stages, summarised in Figure 2.2 and Table 2.6.

Figure 2.2 Stages of IFMIS Design and Implementation



Source: Dener *et al.* (2011)

Table 2.6 Stages of IFMIS Design and Implementation

First, Identify the PFM Reform and the Needs of the Government (What, Why)

This stage includes assessing existing PFM capacity and needs, assisting in the development of a country-led PFM reform strategy (if not already available), identifying priorities and sequencing of country-specific reform actions, and developing a Conceptual Design covering the functional review of PFM organisations, the recommendations for improving the institutional capacity, and the definition of FMIS functional modules (business processes and information flows), together with the necessary procedural and organisational changes.

Second, Develop Customised Solutions (How? Where? When?)

This stage involves assessing existing ICT capacity, the; development of ICT modernisation strategy, and the System Design's preparation to define FMIS functional requirements, technology architecture, and implementation method, in line with the Conceptual Design. The preparation of a realistic cost/time estimate, procurement plan, disbursement schedule, and technical specifications (bidding documents) and the clarification of FMIS prerequisites, need to be completed during project preparation.

Third, Strengthen Institutional Capacity to Manage Project Activities Effectively (Who?)

The formation of a Project Management Group (PMG) of key managers from all stakeholder groups and the establishment of a Project Implementation Unit (PIU) for building/strengthening institutional capacity within the client's organisational structure for project preparation and implementation (based on existing country systems, if possible) are crucial elements at early stages. The PIU is expected to provide administrative and procurement support to the PMG. Proper mechanisms should be established for monitoring and evaluating project activities, and the measures of success for the project should be clearly defined in the Project Appraisal Documents.

Source: Dener *et al.*, 2011

2.4.3 Integrated Financial Management Information Systems in Developing Economies—Directions for Future Research

Various studies on IFMIS addressed developing economies and highlighted gaps in the literature, as summarised in Table 2.7.

Table 2.7 Directions for Future Research

Issue	Gaps	Corresponding Studies
Project Development and Implementation	• Explore measures to reduce costs through FMIS solutions vendor and clients considering the use of Open-Source Applications	Dener *et al.* (2011)
	• Explore why limited digitalisation of financial processes occur, failing to institutionalise the whole budgeting cycle	Effah & Nuhu (2017)
	• Explore the macro and micro level of institutional change, which takes place during the FMIS project process	Alsharari *et al.*(2015); Effah & Nuhu (2017)
Project Stakeholder Management	• Explore measures to ensure continuity in reform initiatives and consider longer-term and flexible approaches to support new stakeholders	Betley *et al.* (2012)
	• Explore demand and management factors that are likely to facilitate successful reform (for example, the role of Civil Society Organisations – CSOs and peer-to-peer learning opportunities)	Betley *et al.* (2012)
	• Explore measures to improve knowledge sharing and learning among client countries and within the World Bank – promoting debates	Dener *et al.* (2011)

	around emerging practices and innovative solutions	
Project Outcome and Impact	• Explore significant failure rates in Africa and lessons from other developing countries • Explore lessons from developed countries	Dener *et al.* (2011); Effah & Nuhu (2017) Dener *et al.* (2011)
	• Assess the impact of FMIS on public financial outcomes (e.g., timely reporting, better decision-making)	Dener *et al.* (2011)
Theoretical Approach	• Need for theories that allow exploring the influence of micro and macro-level institutions and powers on FMIS project outcomes • Future studies could adopt non-deterministic theories and focus on other agencies, perhaps non-core modules of FMIS	Alsharari *et al.* (2015); Effah & Nuhu (2017) Nuhu *et al.* (2018)

Source: Author's Illustration

The above research gaps relate to four key issues: project development and implementation, project stakeholder management, project outcomes and impact, and theoretical approach of future research. Concerning project development and implementation, micro- and macro-level institutions' influence and the need to reduce the cost of implementation when running IFMIS have been emphasised (Alsharari *et al.*, 2015; Dener *et al.*, 2011; Effah & Nuhu, 2017). Future research recommendations also relate to the second issue, namely, the need to involve internal and external stakeholders at micro- and macro-levels and meta-levels in IFMIS project implementation. Betley *et al.* (2012) contended that new stakeholders might belong to either level of society (micro or macro) or be determined by electoral processes and, therefore, need

to be considered during the project implementation. A detailed analysis of key stakeholders and their readiness and interests is critical to the success of any IFMIS project. The recommendation of considering measures to reduce costs from FMIS solution vendors (who are also stakeholders) reiterates the argument that all stakeholders matter and need to commit to the client's mutual interests (the government). However, the government also needs strategies to ensure continuity in reforming initiatives and explore longer-term and flexible approaches to support new stakeholders. In this respect, Dener *et al.* (2011) advised future research to learn from IFMIS projects' failures in Africa and their successes in a developed country. These lessons are necessary and should also consider successful IFMIS projects in Africa, or developing economies, since contextual influences may be common; hence, the shared knowledge can be more readily transferable to other developing economies.

The final issue centres on theoretical approaches to address some of the above gaps in research. Future studies need to explore the macro- and micro-level institutional change, which occurs during FMIS projects: the definition, elaboration, building, transition, go live, and rollout (Alsharari & Youssef, 2017). Alsharari *et al.*'s (2015) framework identified multiple institutionalisation levels by linking the wider institutional influence of political and economic factors with the organisational level. The proposed framework argues that four dimensions of institutional power exist in such IFMIS projects: 1) power over resources, 2) processes, 3) meanings, and 4) systems (Alsharari *et al.*, 2015). These powers are also influenced by external political and economic systems at the macro-level and sometimes at the meta-level. Hence, a multi-institutional perspective exploring the effect of these powers is required. Effah and Nuhu (2017) also proposed an institutional perspective and confirmed that the digitalisation initiative of the government budgeting process was a partial success in "promoting data sharing at the preparation and execution phases but failed to institutionalise the whole budgeting cycle as an

integrated multi-agency digitalised process" (p. 13). The key barriers identified were primarily used as macro-level pressures or powers: (1) failure to adopt an integrated process approach; (2) failure to completely deinstitutionalise the current paper-based process flow and physical signatures, and (3) inability to update outdated laws and procedures. Both authors highlighted the need for research on how to address these powers and pressures from institutions since they affect the MU and commitment of various stakeholders in complex FMIS projects.

2.5 Chapter Summary and Gaps to be Addressed by this Doctoral Research

The chapter provided an overview of IFMIS and their components and reviewed selected studies on IFMIS. The contributions of this doctoral study are as follows:

- Helping understand how the differing interests of stakeholders are unified during implementation and sustained during continuous usage of IFMIS;
- Providing a non-deterministic approach that facilitates the understanding of how different interests of stakeholders are unified;
- Exploring how strategic measures such as managing the different stakeholder interests at different levels–micro, macro, and sometimes meta-levels– influence project outcomes, be it success or failure;
- Helping understand how governments can ensure continuity in reform initiatives and explore longer-term and flexible approaches to support new stakeholders, which may join IFMIS projects for various reasons or at different times either during implementation or beyond implementation (at usage).

CHAPTER 3: ACHIEVING MUTUAL UNDERSTANDING IN INFORMATION SYSTEMS DEVELOPMENT PROJECTS – A CONCEPTUAL FRAMEWORK

3.1 Chapter Overview

The previous chapter presented a review of research in interoperable systems and FMIS research. The objective of the review was to identify research gaps that will inform the selection of theory, development of conceptual framework, and knowledge contribution in this research. This chapter presents a review of the concept of mutual understanding (MU) and the sensemaking theory to establish how sensemaking is created in organisational activities. It also presents an overview of the information systems development life cycle (ISDLC) and conceptualises how MU and sensemaking are achieved in information systems development (ISD) projects. The chapter concludes with a conceptual framework which explains the development of MU in ISD projects.

3.2 Defining Mutual Understanding

Mutual understanding refers to "the extent to which stakeholders have a shared conception of a project regarding, for example, its goals and processes, and stakeholder roles" (Gregory *et al.,* 2013, as cited in Jenkin *et al.,* 2019, p. 650). MU is also referred to as congruent understanding (Vlaar *et al.,* 2008) or shared understanding (Gregory *et al.,* 2013).

The IS literature has often argued that MU is critical to the innovativeness of technology (e.g., Nelson & Cooprider, 1996) and the performance of IS groups (e.g., Lind & Zmud, 1991). For example, a study on 86 IS departments by Nelson and Cooprider (1996) showed that "shared knowledge mediates the relationship between IS performance, trust, and influence, and that,

increasing levels of shared knowledge between IS and line groups leads to increased IS performance" (p. 409). Additionally, Lind and Zmud (1991) found that frequent and rich communication exchanges produce a convergent (congruent) understanding between technology providers and users. Other works have also echoed that developing a shared understanding from different goals and interests as well as conceptions of reality is fundamental to the success of IS projects (Boateng & Hinson, 2008; Gregory *et al.*, 2013). Based on a study of ISD in an offshoring project, Gregory *et al.* (2013) argue that executing control during the life cycle of a project is highly intertwined with the development of shared understanding between clients and vendors which influences the balancing of the control. Such IS projects are more likely to be successful when shared understanding or MU is achieved. Boateng and Hinson (2008) further opined that achieving an accurate and complete interpretation of the requirements of ISD projects requires that user interests and values (both conflicting and harmonious) should be considered, and amicable resolutions should be made to meet the interests of all key stakeholders in the case of conflicting interests.

Overall, mutual, shared, or congruent understanding is critical to the development of IS.

3.3 Sensegiving and Sensemaking Activities and MU

MU may change over time or deteriorate, and this may occur at different rates (Jenkin *et al.*, 2019). Therefore, because ISD projects are characterised by overtime implementation, measures to achieve and sustain MU matter more. Technology providers and users must find strategies or mechanisms for sustaining MU through the lifecycle of the ISD projects and, perhaps, during the usage and maintenance of the IS beyond implementation (Boateng & Hinson, 2008; Joshi *et al.*, 2007; Gregory *et al.*, 2013). In addressing this, the literature explains that **MU is a focal cognitive outcome which stems from episodes of cognitive activities**—

sensegiving and sensemaking—during the ongoing dialogue among diverse stakeholders in a project (Gioia & Chittipeddi, 1991; Stigliani & Ravasi, 2012). Thus, during ISD projects, the continuous dialogue between IT and business stakeholders involves episodes of sensegiving and sensemaking.

Sense may be referred to as the meaning or interpretation of a piece of information held by or known to an individual or a group concerning a phenomenon, artefact, situation, people, or scenario. This sense can inform behaviour or create interest in an issue. IS projects often span diverse stakeholders with differing 'senses' or interests, including those which conflict and those in concert.

These stakeholders, if left unattended, may largely pursue individual 'senses' or interests. Therefore, sensemaking refers to the frameworks through which individuals construct, interpret, update, and reconstruct their meanings (Gioia & Chittipeddi, 1991). Sensemaking at the organisational level is a continuous interplay of sensemaking at the individual level and group level (e.g., unit, communities of practice, and teams) as well as through conversations and artefacts (e.g., models, diagrams, and reports) (Weick *et al.*, 2005). After an individual makes 'sense', activities in a group or project may necessitate the individual to communicate the 'sense' to influence others' 'sense' or interpretation of a situation (sensemaking), and sensegiving is required to achieve that influence. Thus, through sensegiving, individuals influence the 'senses' or sensemaking of others (Gioia & Chittipeddi, 1991). Sensegiving and sensemaking are arguably co-dependent on each other and in ISD projects. IT and business users must provide sense through communication and artefacts.

Sensemaking has several theoretical perspectives in the literature. The review reported in this thesis identified two dominant strands of the literature—sensemaking from science education and sensemaking from organisational studies. These theoretical perspectives are discussed in the following sub-section.

3.3.1 Sensemaking from the Science Education Literature

Arguably, the literature on sensemaking in science education has been posited as being theoretically fragmented, and this fragmentation comprises three strands: sensemaking as a stance/approach towards science learning, sensemaking as a cognitive process, and sensemaking as a particular form of discourse (Odden & Russ, 2017). The stance perspective embraces the approaches people take to science learning, their attitudes, or frames. Thus, individuals or groups bring 'frames' expectations to an activity, and it is expressed in 'the how' they seek to answer the question 'what's going on here?' (Tannen, 1993). Thus, through their epistemological frames (the way they seek to know) they seek to know. People engage frames or mental 'spaces' in trying to 'figure something out' (how and why something happens) through their own ideas, intuitions, and experiences. This enables them to build a new explanation for something unknown or not understood. The stance perspective outlines that sensemaking is influenced by goals, expectations, and frames. The literature does not prescribe any set of 'best' frames or mental 'spaces' for making sense but rather emphasises that learning can be dynamic (people shift into different types of frames) or static, relatively enduring for some time (Rosenberg *et al.,* 2006). For example, a manager who places a high value in understanding concepts or visuals in a communication or project meeting may experience conflicts when such 'frames' are not the dominant approach in a training workshop or project meeting. On the other hand, another manager may not be concerned about such frames but prefer exploring details and narratives.

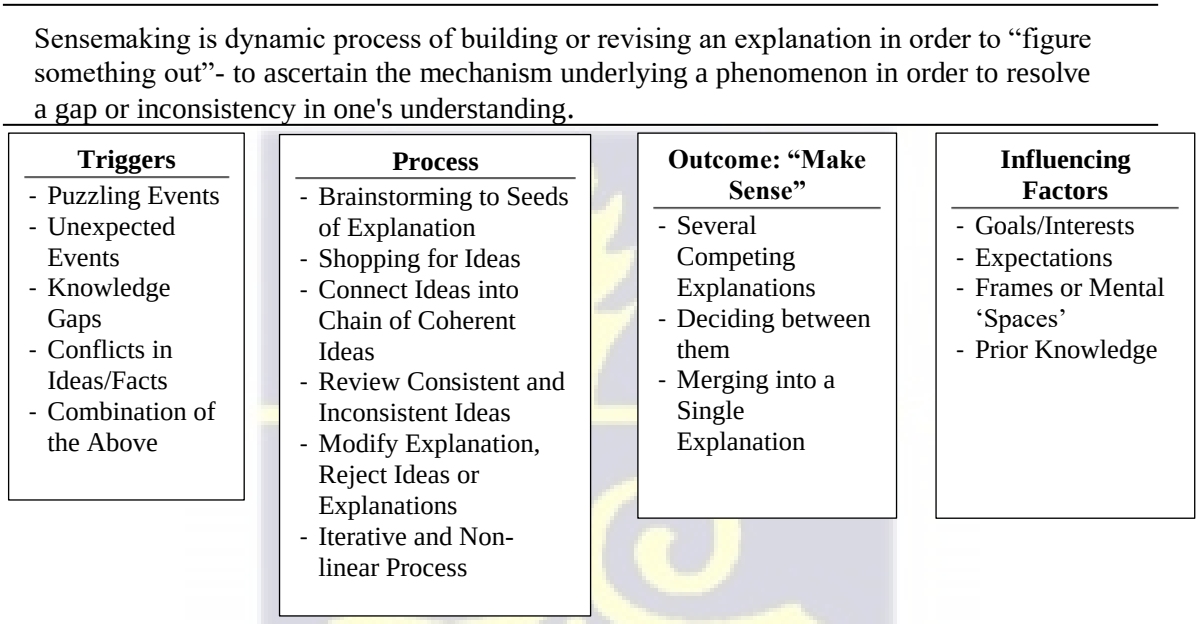
The cognitive perspective considers sensemaking as a cognitive process which has been explained through the *theory of knowledge integration* (Chiu & Linn, 2011) and the *resources model of cognition*/knowledge in pieces (DiSessa, 1993). The theory of knowledge integration denotes knowledge integration as a process in which people articulate their mental models, consider new models, compare their current models to the new models, and ideally integrate the two (Odden & Russ, 2017, p. 8). Sensemaking is therefore a part of the process in which people iteratively compare and integrate parts of the new model with their articulated mental model (Shen & Linn, 2011). The knowledge in pieces framework argues that several 'pieces' of intuitive knowledge or *resources* make up knowledge (Hammer *et al.*, 2005), and these resources are abstracted from our daily experiences. Thus, as scientific models are represented in equations, graphs, pictures, analogies, metaphors, and other representations, sensemaking involves extracting and connecting the essential features of these representations. These essential features incorporate the represented model into their knowledge framework. The cognitive perspective specifically explores what happens in the frames or mental spaces of people—how people use or modify mental models and prior knowledge through interactions with established representations and models.

Finally, sensemaking as a discourse refers to the observable event as a particular style of communication and interaction (Ford, 2012). In this perspective, some consider sensemaking as argumentation—building and defending arguments. However, argumentation as used here does not refer to 'winning' an argument but denotes a process of constructing claims and explanations (connecting pieces of evidence to support a claim) and a process of critiquing or checking coherency in the explanation (checking whether connected pieces hold together). Sensemaking is not competitive like the goal of persuasion; it rather focuses on being

collaborative—building explanation together and critiquing not to 'win' but to strengthen the explanation (Osborne & Patterson, 2011).

Upon reviewing these three perspectives of sensemaking, Odden and Russ (2017) proposed a unifying definition for sensemaking: "a dynamic process of building or revising an explanation in order to "figure something out"- to ascertain the mechanism underlying a phenomenon in order to resolve a gap or inconsistency in one's understanding" (p. 5–6). This process of sensemaking is illustrated below in Figure 3.1:

Figure 3.1: An Illustration of Odden and Russ' Unified Definition of Sensemaking



Source: Illustrated from Odden & Russ (2017)

Although sensemaking may be considered as a form of learning, learning is a much broader construct. For example, memorisation is a form of learning, but because it does not necessarily seek to 'figure out something', it does not involve sensemaking. Therefore, learning is a more complex phenomenon which embraces sensemaking as one of its activities. Sensemaking is triggered by the determination that something needs an explanation, and that decision may be triggered by any or a combination of knowledge gaps, conflicts in facts/ideas, and puzzling or

unexpected events. The next step involves brainstorming to establish seeds of explanation which is an iterative and non-linear process of shopping for and reviewing ideas to establish, modify, or support explanations. The process of shopping for ideas (Hammer & van Zee, 2006) is also referred to as 'mode-skimming' (Sherin *et al.*, 2012) and the cultivation of various alternative suggestions (Dewey, 1910, p. 75). As connections of ideas or cultivated ideas are formed, an explanation or explanations are developed, and this may lead to a coherent explanation or several competing explanations for the same phenomenon. Where there are several explanations, one will be selected or all will be merged into a single explanation.

3.3.2 Sensemaking from the Organisational Studies Literature

The organisational studies perspective of sensemaking stems from the works of Weick (1979; 1995), especially the later in which the author posited that "people make sense of things by seeing a world on which they already imposed what they believe. People discover their own inventions, which is why sensemaking understood as invention, and interpretation understood as discovery, can be complementary ideas" (Weick, 1995, p. 15).

Since then, sensemaking has been viewed as making something sensible and as a process that is not purely cognitive" (Sandberg & Tsoukas, 2014). It is a constructive practice "which includes how people concerned with identity in the social context of other actors engage ongoing events from which they extract cues and make plausible sense retrospectively while enacting more or less order into those ongoing events" (Weick, 2001, p. 463).

Thus, sensemaking is "social, retrospective, grounded on identity, narrative, and enactive" (Sandberg & Tsoukas, 2014). Sensemaking is retrospective in nature as people only know they made sense of something after it is done. Weick captured this in his well-known question,

"How can I know what I think until I see what I say?" (Weick, 1995, p. 18). This retrospective nature is followed by a forward action which is based on the provisional sense that has been made; moreover, it may initiate another retrospective deliberation of the new action, and the process may continue. Therefore, enactment refers to the "'strange sensemaking loop of forward action and retrospective deliberation" (Sandberg & Tsoukas, 2014). However, before enactment can occur, people *create* some provisional sense and focus on it for *interpretation* and *enactment* based on the interpretation. Further, sensemaking is made by an entity—a person's sense of self which defines an identity—and the real or imagined presence of others, making it social. Sensemaking is also narrative in nature because as people extract cues and make plausible sense retrospectively, they develop a *plausible* narrative about what is happening or what they have 'figured out'.

Within organisations, some ongoing organisational activities enable employees as individuals to interactively undertake action (enactment) through which they confront their 'environment' and retrospectively deliberate on what they know and do to make sense in a specific activity or episode of activities. In this respect, the moment ongoing organisational activities are interrupted, employees need to make sense of the occurrence to restore the activities or allow the activities to be permanently interrupted. Within this perspective, 'sensemaking' is conceptualised as "the specific episodes that occur from the moment some ongoing organisational activities are interrupted until they are satisfactorily restored (or in some cases permanently interrupted)" (Sandberg & Tsoukas, 2014, p. 12). For an interruption to occur, a trigger event or disruptive ambiguity is needed (Weick *et al.*, 2005, p. 413). This event, planned or unplanned, major or minor, can stir up processes (creation, interpretation, and enactment) through which employees attempt to make sense of the interruption and generate sensemaking outcomes (restored sense, restored action, non-sense, and no restored action). The processes

and outcomes of sensemaking are both influenced by factors including contexts, language, identity, cognitive frames, emotion, politics, and technology. Figure 3.2 illustrates the major constituents of sensemaking as presented by Sandberg and Tsoukas (2014).

Figure 3.2: An Illustration of the Constituents of Sensemaking

The Overarching Constituent of the Sensemaking Perspective

Sensemaking is delimited to the *episodes* that take place from the moment some aspect of the ongoing process of organising are interrupted until they are satisfactorily restored (or in some case) permanently interrupted.

Major Specific Constituents of the Sensemaking Perspective

Events that trigger sensemaking	*Processes of sensemaking efforts*	*Outcomes of sensemaking*	*Factors influencing sensemaking*
- Major planned events - Major unplanned events - Minor planned events - Minor unplanned events - Hybrid events	- Creation - Interpretation - Enactment	- Restored sense - Restored action - Non-sense - No restored action	- Context - Language - Identity - Cognitive frames - Emotion - Politics - Technology

Source: Sandberg & Tsoukas (2014)

3.3.3 Brief Definitions of the Constituents of Sensemaking

Based on the work of Sandberg and Tsoukas (2014), the constituents of sensemaking are briefly outlined below.

3.3.3.1 Events that Trigger Sensemaking

- **Major planned events** are temporary and deliberate strategic change initiatives that affect most of an organisation's activities, thereby interrupting the common ways of accomplishing things (Sandberg & Tsoukas, 2014).
- **Major unplanned events** are events that interrupt the activities of an organisation, thereby negatively influencing sensemaking efforts and affecting organisational activities. An example is a technical failure in the use of an information system which

triggers intensive sensemaking efforts among personnel on how to restore the system to mitigate the costs of system failure (Dunbar & Garud, 2009).

- **Minor planned events** are happenings that often interrupt organisational activities in various ways, thereby triggering actors into sensemaking efforts to restore the interrupted activity. An example is a policy introduction or adjustment intended to address a particular problem (Sandberg & Tsoukas, 2014).
- **Minor unplanned events** are little glitches that occur in the daily activities of an organisation. An example is a slight misunderstanding between project actors about how to conduct an activity (Sandberg & Tsoukas, 2014).
- **Hybrid events** are a mixture of minor planned/unplanned events and minor planned/major unplanned events.

3.3.3.2 Processes of Sensemaking Efforts

- **Creation** involves grouping, noticing, and extracting cues from the lived experience of the interrupted situation. It is an initial sense of the interrupted situation which people then start interpreting (Weick, 1995).
- **Interpretation** involves unveiling the initial sense generated in the creation process and developing it into a more complete and narratively organised sense of the interrupted situation.
- **Enactment** is further action regarding a complete sense made of the interrupted situation to see the extent to which it restores the interrupted activity.

3.3.3.3 Outcomes of Sensemaking

A specific sense refers to a springboard for the actions that actors take to reinstate an interrupted activity.

- **Restored sense** is the instance where sense that could lead to an action is made.
- **Restored action** is a decision to restore organisational activities (or further interrupted activities) that ensue during a sensemaking process, based on the restored sense. This does not mean that new actions are taken or not; it means that sense has been made, and an action will be enacted.
- **Non-sense** is the instance where sense is not made; thus, there is no decision to take a resulting action.
- **No restored action** means there is no decision or action to be enacted because no sense is made (non-sense).

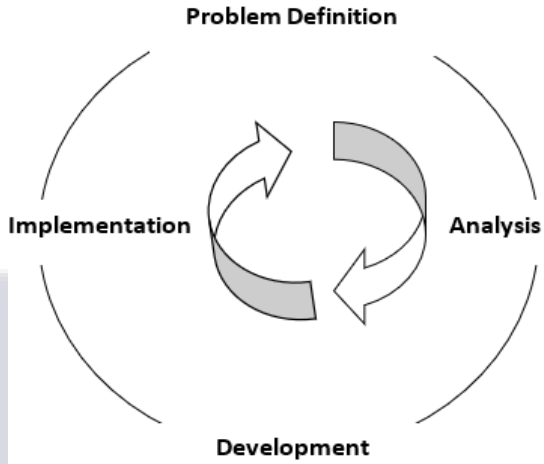
3.3.3.4 Factors Influencing Sensemaking

- **Context** is the setting in which an activity has been interrupted. There are two types of contexts: (1) social context (which binds people to actions that they must justify); (2) institutional context (e.g., historical, cultural, epistemic, and industrial), within which the interrupted organisational activity occurs.
- **Language** is the discourse, narratives, rhetoric, tropes, and stories that are used in communication and acting on sensemaking efforts.
- **Identity** refers to how actors see themselves when making sense in an interrupted activity (Weick, 1995).
- **Cognitive frames** refer to the mindset of actors as they notice and extract, combine, and create representations of things or events (Bogner & Barr, 2000).
- **Emotion** is a reaction to events that occur in a sensemaking activity. There are two types of emotions: (1) positive emotions which can facilitate actors' efforts to make sense of the change initiative (Maitlis & Sonenshein, 2010), and (2) negative emotions which disrupt the initiation of sensemaking (Dougherty & Drumheller, 2006).

- **Politics** is the conflicting interpretations that occur at different levels of organisational hierarchy because of different skills/expertise (Weick, 1995).
- **Technology** refers to the various ICTs that influence organisational sensemaking (Korica & Molloy, 2010; Orlikowski, 2000).

3.4 Information Systems Development Life Cycle

Figure 3.3 Information Systems Development Life Cycle



The ISDLC is also referred to as the software development life cycle and refers to the framework that is used to plan, analyse, develop, and implement IS (Sommerville, 2010; Avison & Fitzgerald, 2003). The ISDLC provides control over projects by dividing complex tasks into manageable sections of the project and how it should be developed (Ragunath *et al.*, 2010). As a guiding framework, the ISDLC is applied in various spheres of systems development, including software engineering, computer engineering, IS engineering and, computer science (Thayer & Christensen, 2005).

Over the years, the ISDLC has attracted several researchers and practitioners, many of whom have proposed different models of different strengths and weaknesses (Bassil, 2012). However, the ISDLC has become more sophisticated and unavoidable in the development of systems.

In the view of Avgerou and Cornford (1998), most models that have emerged from the revisions of researchers are closely related to the generic stages of the systems development life cycle which often emphasises the analysis and design stages. Similarly, Bocij *et al.* (1999) argue that the stages that have evolved only differ depending on the method or technique used in the development process. However, although different approaches have emerged, the generic life cycle is viewed as a *'four (4)-phase'* sequence of activities, namely problem definition, analysis, development, and implementation (Ragunath *et al.*, 2010; Avison & Fitzgerald, 2003), as illustrated in Figure 3.3 and Table 3.1.

Table 3.1 Information Systems Development Life Cycle Activities

Phases	**Activities**	**Activities**	**Activities**
Problem Definition	1. Realisation of need 2. Preliminary analysis of need 3. Feasibility	1. Identifying problems, opportunities, and objectives	1. Systems request which describes problems or desired changes to be done 2. Preliminary investigation to evaluate opportunities or problems. 3. Feasibility study on costs and benefits
Analysis	4. Requirement analysis 5. Logical design 6. Specification	2. Determining human information requirements 3. Analysing system needs 4. Designing the recommended system	4. Systems analysis phase to build a logical model of the new system 5. Requirements modelling to investigate the business processes of the new system 6. Requirements documentation

Phases	Activities	Activities	Activities
Development	7. Detailed design/system design 8. System build/programming 9. Testing	5. Developing and documenting software 6. Testing the system	7. System design specification which is presented to management and users for review and approval. 8. Develop a prototype that includes all deliverables
Implementation	10. Installing 11. Training 12. Review and maintenance	7. Implementing and evaluating the system	9. The new system is constructed 10. Systems evaluation and assessment 11. Perform maintenance and security 12. Scaling and expanding design to accommodate new business requirements and volumes
	Adapted from Angell & Smithson (1991); Bocij *et al.* (1999, p. 254); Avison & Fitzgerald (2003, p. 27)	Adapted from Kendall & Kendall (2010)	Adapted from Shelly & Rosenblatt (2012)

Source: Author's Illustration

3.4.1 IS Project Participants or Stakeholders

ISD activities are undertaken by a project team that comprises IS professionals and users. IS professionals include system analysts and programmers who analyse the business requirements for the intended IS as well as develop and implement the IS. The users communicate the requirements or needs for the intended IS and guide the specification, development, and 'signing-off' of the final system as meeting the defined requirements. IS professionals work internally in an IS department or externally, where they are viewed as IS vendors or technology providers. Depending on the competence, skill set, or experience of in-house IS personnel and the nature of the required IS solution, the services of an IS vendor may be procured. In some

scenarios, consultants may be hired to manage or coordinate the ISD activities. The consultant may be external to both the firm and IS vendor and be brought in by the firm to steer the process in working with the IS vendor. These IS project participants may be considered as stakeholders for the intended IS project. A stakeholder is defined as a "person or group with a vested interest in the outcome of an ISD effort" (Sambamurthy & Kirsch, 2000, p. 401). Typically, stakeholders of an IS project include project managers; system analysts; programmers; and user liaisons who are members of the development team that performs activities such as testing, quality assurance, and training of users (Sambamurthy & Kirsch, 2000; Robey *et al.*, 1993). However, Beath (1987) is of the view that researchers' definition of stakeholders should be more expansive to include those individuals who finance the system, access the data, design databases, and maintain the system.

Further, the firm as a client consists of stakeholders who may play diverse roles that can influence the outcome of the project. For example, some stakeholders (Boateng & Hinson, 2008) have a direct influence on the project, and they are

1. the sponsor——provides financial resources for the project;
2. the champion—opinion leader who can advocate for the project;
3. project owner—final authority concerning the use of the IS;
4. business users—direct users of the IS who may have different access levels to the IS, depending on their role in the business process; and
5. external users—users who are not directly part of the business but may benefit from information outputs from the system: these may include consumers, third party firms/operators, and regulatory agencies; some of these users may periodically access the IS to provide information or feedback to the owner (firm) of the IS which may be critical to the business process of the firm.

The phases of the ISD process thus serve as a guide for the above IS project stakeholders to execute the project.

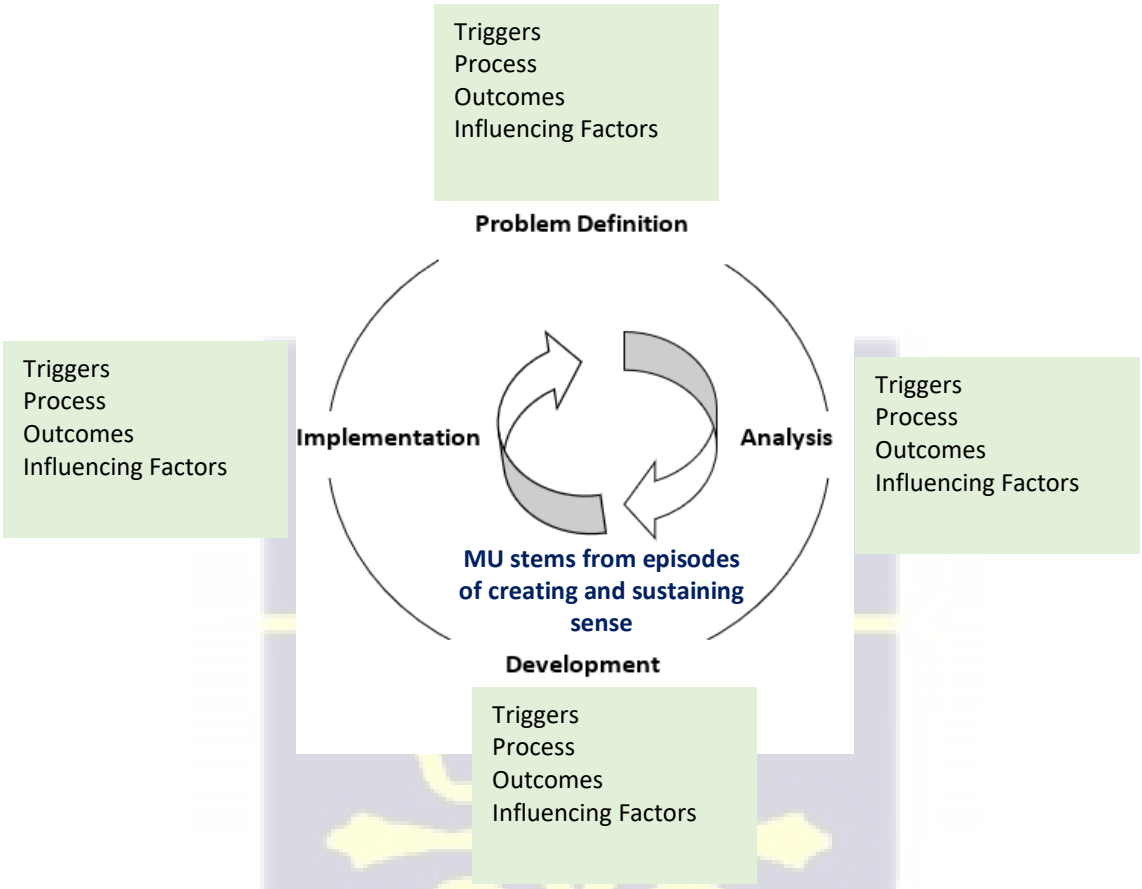
3.5 Conceptual Framework

The above theoretical discussions present a basis to propose a conceptual framework that can be examined in this study. The proposed conceptual framework stems from the application of the organisational perspective of sensemaking to understand how MU occurs in the development of IOFMS. Based on the ISD cycle, it is proposed that the development of IOFMS will undergo four phases: problem definition, analysis, development, and implementation. In Chapter 2, interoperability was defined as the ability of two or more systems, components, or elements to exchange information among themselves and to use the information (IEEE, 2000). This understanding presupposes that to achieve interoperability, independent systems or components must be able to exchange information among themselves and to use that information. In terms of systems development, there could be several paths to interoperability, three of which are highlighted here as examples. First, there is a possibility for individual systems to be developed through distinct processes sequentially or concurrently, after which they are made interoperable. Second, there is a possibility that a need may arise to make existing systems which are not interoperable to become interoperable. Third, interoperability may be achieved through a mix of the two approaches mentioned above. In this mixed scenario, new systems may be developed to work with existing systems to achieve interoperability.

In relation to the real-world phenomenon under study in this doctoral research, the payroll add-on systems consisted of three independent interoperable modules, namely, the electronic salary payment voucher (ESPV), electronic payslip (e-payslip), and the third-party referencing system

(TPRS). These systems where developed sequentially; the ESPV was first developed while the remaining two systems were subsequently developed (see Chapter 5). However, the three systems had to be interoperable to achieve the optimum benefit to the government workers and Accountant General department (who is principal owner of the systems).

Figure 3.4 Conceptual Framework of Achieving Mutual Understanding within the Information Systems Development Cycle



In this respect, achieving MU was critical during the ISD phases of each system. Unearthing the sensemaking process in the ISD process for each system is fundamental to understanding how MU was achieved between these three payroll add-on systems. Drawing on the sensemaking perspective of Sandberg and Tsoukas (2014), we proposed a model (illustrated in Figure 3.4) which postulates that to achieve MU in the interoperability of these payroll add-on

systems, sensemaking must commence from the ISD phases of each system. Hence, MU is achieved in each phase and transferred within and across each system for interoperability to occur. For each ISD phase of the three systems, the constituents of sensemaking are unearthed (triggers, process, outcomes, and influencing factors) to establish how MU was created, transferred, and sustained throughout the ISD process for interoperability to occur.

3.6 Achieving MU in the Phases of the ISDLC

3.6.1 Problem Definition Phase

The problem definition phase is the stage where the purpose of the project and its understanding are spelt out (Jirava, 2004; Sommerville, 2010; Ragunath *et al.,* 2010). Defining the purpose of a project is critical to meeting the targets of successive activities and the overall success of the project (Pinto & Slevin, 1987).

The need for a new IS may stem from the need to solve a specific IS-related problem, a response to pressure, or an opportunity to create value (Avgerou & Cornford, 1998, p. 21). The firm in need of the IS solution will need to conduct a preliminary analysis which will yield a broad statement of objectives of the new IS in line with the business objectives. Ideally, this broad statement should consider the interests of key stakeholders—owner, sponsor, champion, and users (business and external). Subsequently, a feasibility study that evaluates the project's viability and alternative solutions in terms of the technical, legal, economic, organisational, and social feasibility will guide management's decision-making (Avison & Fitzgerald, 2003).

As argued earlier, MU is the focal cognitive outcome of sensemaking and sensegiving. Sensemaking and sensegiving, as cognitive activities require conversation and artefacts (Gioia

& Chittipeddi, 1991). In this phase, a **conversation mechanism and artefacts are clearly established to define the problem and explore the project's feasibility.**

- **Conversation Mechanisms**:
    1. One of the conversation mechanisms at the problem definition phase involves project meetings with in-house IS professionals (analysts), external professionals (vendors or technology providers), and clients (may be primarily senior management—owner, sponsor, and champion). This conversation is critical at this stage to avoid wasting time in addressing the wrong problem (Kendall & Kendall, 2010).
    2. Another conversation mechanism occurs at the feasibility stage of defining the project where the users, analysts, and systems managers coordinating the project meet to discuss whether the needs of the business will be met by the system to be developed or implemented (Kendall & Kendall, 2010). The conversations occur through interviewing users and management, summarising the responses obtained to scope the project, and documenting the results into what is known as a feasibility study report (Kendall & Kendall, 2010).

- **Artefacts**:
    1. Contracts/letters of engagement: These are the formal agreements or documents that are signed between the contracting authority or client and the developers of the system. These documents contain the terms and conditions of the engagement between the two parties. The contents of the agreement usually include the timelines for the deliverables of the system, payment terms, and intellectual property rights.

2. Broad statement of objectives: This is a document listing the high-level performance outcomes and objectives of procuring the system (Boateng & Hinson, 2008) rather than how the work is to be done. It typically accompanies a request for proposal.

3. Feasibility study report: Feasibility study reports are the outputs of the problem definition stages (Sommerville, 2010; Boateng & Hinson, 2008). They are usually documented in softcopy or print and handed to the contracting authority or client. With this report, the contracting authority can decide on whether to proceed or rescind its decision to continue with the proposed project (Kendall & Kendall, 2010).

4. Alternative solutions on the markets: This is a document detailing the cost-benefit analyses of alternative solutions on the market (if any) (Kendall & Kendall, 2010). The analyst compares the feasibility study report to the alternative solutions and proceeds in the direction of what the contracting authority accepts.

5. IS audit report: This is a report detailing how the existing systems have performed over time. The report ensures that the IT systems are protected adequately, provide reliable information to users, and are managed properly to achieve their intended benefits. The report can cover the administrative and legal regulations as well as security of the system, including the financial, operational, and ethical well-being of the organisation.

6. Documented stories and minutes of project meetings: These are recordings (usually in writing) of stakeholder meetings held to present and discuss the activities surrounding the development of the software.

3.6.2 Analysis Phase

At the analysis phase, the detailed requirements of the system are captured, usually through project managers who enquire from customers or end-users what the systems must do (Sommerville, 2010; Ragunath *et al.,* 2010). Subsequently, a functional specification of the system is also developed at this stage to inform the design of the system (Jirava, 2004; Sommerville, 2010). Compared with the previous phase, a more thorough investigation of the current system is required to define the business needs and develop functional requirements and specifications for the new system. Hence, these facts should be obtained from various of users.

In this phase, the **conversation mechanisms and artefacts that are employed to gather information from various users and define the business and functional requirements (including system specification)** include the following.

- **Conversation Mechanism**:
    1. At this stage, project meetings occur between in-house IS professionals (analysts), external professionals (vendors or technology providers), and clients (may be primarily senior management—owner, sponsor, and champion) (Kendall & Kendall, 2010; Boateng & Hinson, 2008).
    2. The analysts also interact with users through interviews and questionnaires within the context of their work environment to understand their needs for the

intended system (Kendall & Kendall, 2010). Direct observation or experience and searching through organisational reports are also used as means of a "thorough investigation of the current system and defining the requirements and specifications for the new system" (Boateng & Hinson, 2008, p. 19).

- **Artefacts**:

1. At this point in the ISDLC, the system analyst prepares the proposal of a system that summarises the findings about the users, usability, and usefulness of current systems; provides cost-benefit analyses of alternatives; and makes recommendations on what (if anything) should be done (Boateng & Hinson, 2008).
2. Different tools are also produced at this stage to guide the development process. These tools include data flow diagrams that describe the input, processes, and output of the business functions or activity and sequence diagrams that show the sequence of events or illustrate systems in a structured, graphical form (Kendall & Kendall, 2010; Boateng & Hinson, 2008; Dennis *et al.*, 2018). A data dictionary can also be developed to list all the data items used in the system, including their specifications.

3.6.3 Development

At the development phase, the actual building of the system occurs where the functional requirements are translated into the expected required system (Jirava, 2004; Sommerville, 2010). Testing and documentation also occur in this phase (Ragunath *et al.* 2010; Jirava, 2004).

The **conversation mechanism and artefacts to support the development of the system** in this phase include the following.

- **Conversation Mechanism**:

    1. The stage is characterised by communication via meetings among the development team that usually comprises programmers. The meetings are to ensure that members of the development team are abreast with the codes used for developing the system (Kendall & Kendall, 2010). This is achieved when other programmers perform a code walkthrough to explain complex portions of the programme to other members of the development team (Kendall & Kendall, 2010).

- **Artefacts**:

    1. A prototype of the system is a version that has the essential features of the final version. Through prototyping, user inputs and activities can be demonstrated before the release of the final system (Aveson & Fitzgerald, 2006).
    2. The artefacts produced at the development stage of the life cycle include the actual or original needed software (Sommerville, 2010; Kendall & Kendall, 2010; Ragunath *et al.* 2010; Boateng & Hinson, 2008).
    3. During this phase, effective documentation for software, including users guides, online help, and websites featuring frequently asked questions (FAQs) are developed in consultation with users of the system (Kendall & Kendall, 2010). FAQs are a list of questions and answers relating to the implemented software or system subject.
    4. Test scripts are also developed at this stage to verify that the system performs as expected (Kendall & Kendall, 2010).

3.6.4 Implementation

This is the final phase of the life cycle where training, installation, signing-off, and handing over of the system to its owner are performed and followed by maintenance activities on the system (Jirava, 2004; Sommerville, 2010).

In this phase, the **conversation mechanism and artefacts to the implementation of the system** include the following.

- **Conversation Mechanism**:

    1. The conversation mechanism in this phase of the project development involves user training and user acceptance meetings to verify that the system meets the requirements and that the test suite has been executed with satisfactory results (Boateng & Hinson, 2008). The software is then signed-off when all requirements have been met (Boateng & Hinson, 2008).

- **Artefacts**:

    1. After the contracting authority (through its users) verifies that the software meets its intended requirements and accepts the software, a formal sign-off document is signed, and copies are kept by both parties (developers and contracting authority).
    2. Additional artefacts produced in support of the system implementation include training and user manuals, either in print or soft copy, to guide future and further training and usage of the system. The soft copy of the training and user manual can also be in video format.

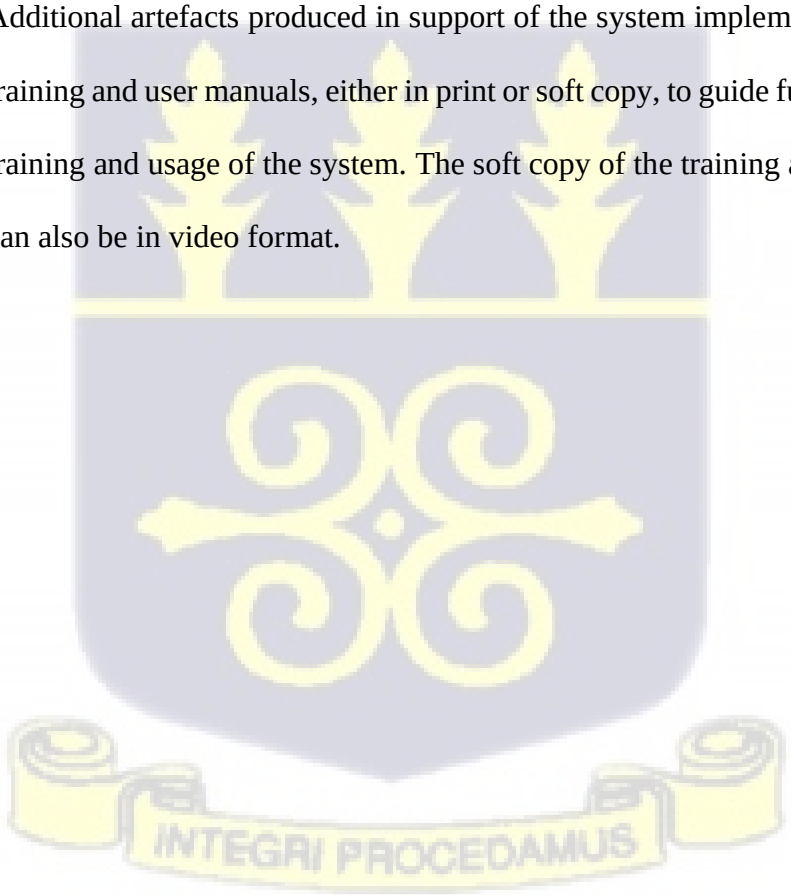


Table 3.2: Sensemaking Mechanisms During Information Systems Development

Phases of ISDLC/ Trigger Events	***Conversation Mechanism and Artefacts***		***Potential for Sensemaking or Sensegiving?***	
	Conversations Mechanism	**Artefacts**	**Sensemaking**	**Sensegiving**
Problem Definition 1. Realisation of need 2. Preliminary Need 3. Feasibility	1. Meetings with ISD Project Team - User representatives, & IS Professionals 2. Meetings with ISD Project Team & Management (Project Champion, Owner & Sponsor	Previous ISD reports and Business plans	✓	✓
		Broad Statement of Objectives	✓	✓
		Documented stories and minutes of project meetings	✓	✓
		Contract/letters of engagement	✓	✓
		Feasibility study reports	✓	✓
		Alternative solutions on the markets	✓	✓
Analysis 4. Requirement Analysis 5. Logical Design 6. Specification	3. Meetings with IS Professionals & Management (Project Champion, Owner & Sponsor)	Proposal of the system	✓	✓
		Tools such as Data flow diagrams (DFD), Use case and sequence diagrams.	✓	✓
Development 7. Detailed design / System design 8. System Build / Programming 9. Testing	4. Meetings among development team Professionals	System prototype that has the essential features of the final version of the system.	✓	✓
		Actual or original software that is needed	✓	✓
		Documentation for software, including users guides, online help, and FAQs	✓	✓
		Test scripts	✓	✓

Phases of ISDLC/ Trigger Events	*Conversation Mechanism and Artefacts*		*Potential for Sensemaking or Sensegiving?*	
	Conversations Mechanism	**Artefacts**	**Sensemaking**	**Sensegiving**
Implementation 10. Installing 11. Training 12. Review and Maintenance	5. Feedback gathering through interviews with users.	User training and acceptance meetings.	✓	✓
		New user trainings	✓	✓
		Support and maintenance contract documents	✓	✓
		Systems training and user manuals, FAQ documents	✓	✓
		Scalable designs and upgrade patches	✓	✓
		Sign-off document	✓	✓

Legend:

✓ (Yes) – there is a potential

× (No) – there is no potential

Source: Author's Illustration

3.7 Contribution to MU and the Sensemaking Theory in Information Systems

An example of previous IS research which employed the sensemaking theory is that of Jenkin *et al.* (2019). The study examined sensemaking across IT projects within firms involved with IT products and services as well as sensemaking in IT projects from a planning and project management mechanisms perspective. The study also highlighted influencing factors of sensemaking which include depth and timing of stakeholder engagement, disagreements between stakeholders (which is an opportunity for learning at an individual level but disruptive at the project level), and introduction of new project elements (new requirements). While the contributions are welcomed, the authors advocate for future studies to explore other mechanisms beyond planning and project management. Hence, the attempt by this present study to rather employ the ISD cycle and examine all the constituents of MU (triggers, process, outcomes, and influencing factors) is a novel opportunity to add to existing knowledge and extend the application of the sensemaking theory in IS. Further, as Jenkin *et al.* (2019) focused on an IT firm, the authors advocate for future research to examine whether the findings, some outlined here, apply to projects from non-IT organisations. By focusing on government payroll add-ons, this present study explored MU in a non-IT organisation. As noted by Sandberg and Tsoukas (2014), context is a critical factor of sensemaking. A study of this kind is arguably of significance to the IS literature, academia, and practitioners.

Further, the roots of the two main approaches to sensemaking—the science studies (cognitivist) and organisational studies (discursive) perspectives have been discussed in this chapter. Although both perspectives have their roots in the work of Weick *et al.* (2014), our review noted that the science studies or cognitivist understanding of sensemaking is still predominant, whereas that of the discursive or organisational studies is growing steadily. Nevertheless, there is room for enhancing the understanding by applying the discursive perspective in research

from different disciplines. This doctoral research contributes to addressing the imbalance by applying this discursive or organisational studies perspective in ISD in a public sector institution.

3.8 Chapter Summary

In this chapter, we discussed the concept of MU and the sensemaking theory to establish how sensemaking is created in organisational activities. The review covered two perspectives of sensemaking—the science studies (cognitivist) and organisational studies (discursive) perspectives. It also presented an overview of the ISD cycle and conceptualised how MU and sensemaking can be achieved in the development of IOFMS. The chapter concluded with a conceptual framework, as illustrated in Figure 3.4, which postulates that to achieve MU in the interoperability of the three payroll add-on systems, sensemaking should commence from the ISD phases of each system. MU is achieved in each phase and transferred within and across each system for interoperability to occur. As noted, for each ISD phase of the three systems, the constituents of sensemaking would be unearthed (triggers, process, outcomes, and influencing factors) to establish how MU is created, transferred, and sustained throughout the ISD process for interoperability to occur.

Subsequently, we will describe the review and reconceptualization of the conceptual framework through data collection and analysis in this research. The next chapter presents the methodological underpinnings of this study.

CHAPTER 4: METHODOLOGY

4.1 Chapter Overview

In the previous chapter, we reviewed the sensemaking theory as theoretical lenses in creating 'sense' or MU in ISD projects. Some gaps in the sensemaking theory and concept of MU as used in IS research were also identified. These gaps echoed the need for further research in the use of these theoretical lenses in IS research. Based on those research gaps and the objectives of this work, a conceptual framework was proposed for this research. The research paradigm and methodology for this research are discussed in this chapter. First, the various research paradigms in IS are examined, and critical realism (CR) is highlighted as the selected paradigm for this research. Second, the research design, selection of case institution, sampling of respondents, and data collection methods are presented. Finally, the data analysis techniques used in the research are described.

4.2 Research Paradigms in Information Systems

In research, a paradigm refers to "a set of beliefs, values and techniques which is shared by members of a scientific community, and which acts as a guide or map, dictating the kinds of problems scientists should address and the types of explanations that are acceptable to them" (Kuhn, 1970, p. 175). On the other hand, a philosophy in research is a viewpoint of researchers that shapes their thoughts and practice (Saunders *et al.*, 2019). As sets of beliefs, values, and techniques, paradigms entail the philosophical assumptions which define what 'valid' research is and the appropriate methods that can be applied in that research (Myers & Avison, 2002, p. 5). Thus, the application of a paradigm or set of philosophical assumptions influences methodological choices and strategies (Brooke, 2002).

The philosophical assumptions that constitute a paradigm are classified as four fundamental elements, namely, ontology (nature of reality), epistemology (views on knowledge), methodology (systematic principles of inquiry), and axiology (opinions on value) (Burrell & Morgan, 1979; Guba & Lincoln, 1994; Creswell, 1994). Generally, researchers agree that within a paradigm, the ontological assumptions determine the nature and form of reality, that is, what constitute 'legitimate' researchable questions; epistemological assumptions determine what constitutes acceptable knowledge or what counts as knowledge; and methodological assumptions refer to the procedures and framework used to conduct research or investigate what can be known within a paradigm (Guba & Lincoln, 1994; Orlikowski & Baroudi, 1991; Sarantakos, 1998; Schnelker, 2006; Lincoln *et al.*, 2011). Research methodology may be quantitative, qualitative, or mixed.

In IS research, as well as social science research, the dominant paradigms which underpin research are the positivistic, interpretive, and critical paradigms (Orlikowski & Baroudi, 1991; Myers & Avison, 2002). Other authors, such as Chua (1986), outline these main groups with subgroups, namely positivism (neo-functionalism, post-positivism), interpretivism (ethno-methodology, hermeneutics), and critical (social theory, Marxism, and realism).

Comparing the three paradigms, the ontology of positivism is that reality is objective, single, and concrete. Knowledge about social phenomena or reality is instrumentally acquired to discover and explain the general laws that govern these social phenomena to describe, predict, and control the phenomena (Kaplan & Duchon, 1988). Positivists employ deductive reasoning which entails the formulation of research questions and hypotheses and then testing them empirically to confirm, refute, or modify them concerning a phenomenon. Interpretive researchers consider that multiple realities exist and are subject to human experiences and

interpretation. For interpretive researchers, the knowledge generated in research is time-bound and context dependent. These researchers seek to transcend the observable actions of people in the context of social phenomena and understand the subjective meanings people assign to their actions, thereby interpreting and understanding the reasons behind those actions (Klein and Myers, 1999, p. 69; Walsham, 2006). In this respect, reality is socially constructed; hence, knowledge is also value-laden and constructed through the interaction of the researcher and objects of enquiry. Interpretivists use a inductive reasoning approach which entails collecting and analysing data (various interpretations and constructions of reality that exist) to see if any patterns emerge that suggest relationships between variables (Creswell, 2013).

Lastly, the critical research paradigm critiques the status quo, exposes deep-seated structural contradictions in social systems, and helps to transform alienating and restrictive social conditions (Orlikowski & Baroudi, 1991). While positivism and interpretive paradigms are viewed as entrenched opposing scientific views, CR from the family of critical research paradigms has been argued to be a practical alternative for IS researchers (Mingers *et al.*, 2013). CR researchers hold the view that there are two worlds of reality—transitive and intransitive (Dobson, 2002). The transitive is what we observe and learn with our minds; it embodies our perceptions of reality. However, there exists a reality totally independent of our perceptions of reality—the intransitive world which embodies the reality that is independent of what the mind thinks. Hence, while the transitive world is value-laden and changes continually, the intransitive world has the underlying structures and the mechanisms are 'relatively enduring', that is, what we want to study. Critical realist researchers seek to expose the reality of social phenomena and examine and explain the events and discourses that exist within them (Carlsson, 2003, p. 12). They argue that the ability to understand and change social phenomena lies in the identification of the structures at work that generate *observable* events and discourses

(Bhaskar, 1989; Wikgren, 2005, p. 14). It adopts a retroductive reasoning approach in which researchers start from an empirical observation of events and arrive at a conceptualisation of transfactual conditions (Easton, 2010). CR researchers embraces both qualitative and quantitative research methods in their investigation. However, the choice of a research method is dependent on the nature of the study and its objective (Sayer, 2000).

CR enables an IS researcher to "get beneath the surface to understand and explain why things are as they are, to hypothesise the structures and mechanisms that shape observable events" (Mingers, 2004, p. 100). As CR involves the unearthing of the relatively enduring structures and mechanisms, it seeks not to predict but to explain a phenomenon (Elster, 1998). In relation to the research purpose and objectives of this present research, CR was adopted to examine the mechanisms and structures which underpin the creation and sustenance of MU in the implementation of interoperable/integrated financial management systems. As discussed in the previous chapter, the structures and mechanisms which underpin the creation of 'sense' or MU are characterised by some complexity and therefore not readily apparent in observable event patterns. CR is the path to the detailed unearthing of structures and mechanisms of a reality (Mingers, 2004)—MU—within a complex process such as the implementation of interoperable/integrated financial management systems.

4.3 The Choice of Critical Realism in this Research

4.3.1 Justification for Critical Realism

CR as an approach to research stems from the work of Bhaskar (1978; 1979), and in IS it has continued through several scholarly advocates (Dobson, 2001; Brooke, 2002; Mutch, 2002; Carlsson, 2004; Mingers, 2004; De Vaujany, 2008; Boateng, 2016). Based on its ontological and epistemological assumptions explained above, CR believes that the description of the

world through the eyes of social actors is insufficient; hence, researchers need to go further to explore whether these actors have an adequate understanding of their world (Manicas, 1998). In doing so, researchers need to unearth the causally effectual mechanisms and structures that underlie perceived events (Dobson, 2002).

Comparing the paradigms discussed above, a choice was made for the critical realist approach as being a more appropriate philosophical paradigm for addressing these research questions. Arguably, in conducting research, the choice of a particular research paradigm can be based on a combination of interrelated factors, namely, the researcher's philosophical beliefs/views of the world, the level of existing knowledge pertaining to the research topic, the nature of the research question of interest, and the range of skills the researcher may have in terms of methodological approaches (Krauss, 2005; Dill & Romiszowski, 1997). First, a researcher's ontological and epistemological beliefs may influence the choice of any of the paradigms discussed above (Dill & Romiszowski, 1997). In this doctoral research, the researcher's view of the world lends to that of CR. Second, where there is scarcity of literature, or research pertaining to the topic is yet to gain maturity, the researcher may begin with qualitative interpretive approaches and later progress to quantitative positivist approaches as research on the topic gains maturity (Krauss, 2005). IS development and implementation is a well-researched area of IS research (Jenkin *et al.*, 2019). However, the concept of MU and the application of the sensemaking theory is yet to gain maturity in IS research. As discussed in the previous chapter, sensemaking is enshrouded in a complex interaction of triggers, processes, outcomes, and influencing factors. Thus, recognising the developing nature of this complex phenomenon, the researcher has defined an appropriate research purpose and questions that can be adequately addressed in the paradigm. Third, although CR embraces both quantitative and qualitative research approaches and analytical techniques, this study adopted

a qualitative approach to employ empirical processes designed to illustrate, interpret, and unearth the experiences of research participants in a context-specific setting. By CR principles, establishing an understanding of social reality lies in the description of events generated from mechanisms, actions, and structures pertaining to a particular context (Fletcher, 2017) to provide a plausible explanation of visible effects. Qualitative research offers the opportunity of such rich descriptions of events, such as sensemaking, in their natural settings of occurrence (Boateng, 2020).

Overall, the selection and application of the CR research paradigm in this thesis was informed by the above arguments.

4.3.2 Applying CR in this Research: The Retroduction Research Methodology

To unearth the constituents of sensemaking and create and sustain MU in the implementation of IFMIS, CR adopts a retroduction research methodology (Boateng, 2016; Bhaskar & Hartwig, 2010; Mingers, 2004). Retroduction is "advancing from one thing (empirical observation of events) and arriving at something different (a conceptualisation of transfactual conditions)" (Danermark *et al.*, 2002, p. 96). Transfactual conditions are conditions required for a social phenomenon to be "what it is and not something completely different" (Danermark *et al.*, 2002, p. 78). For the CR researcher, retroduction facilitates the basic conditions for a phenomenon, such as sensemaking, to exist. Hence, without these conditions, sensemaking will not exist. The use of retroduction as a research strategy involves three main steps. The first step requires the CR researcher to examine the observed events and connections between/in a social phenomenon. In response, as seen in Chapter 2 and in the research problem in Chapter 1, a thorough review of previous research on interoperability was conducted to explore the different research issues as well as theoretical and conceptual approaches which explain interoperability.

Further, research gaps in interoperability research and IFMIS research in developing economies were examined. These gaps informed the choice of research objectives, questions, and theories.

The second step requires the CR researcher to postulate the existence of real structures and mechanisms and how they describe and explain the observed relationships, if they exist (Boateng, 2016; Easton, 2010). The CR researcher "theorises a model of an underlying mechanism which might have produced patterns seen in the data, and then works backwards from the data towards verifying or otherwise that model" (Mason, 2002, p. 181). In response, as seen in Chapter 3, two perspectives of the sensemaking theory in relation to the creation of MU were reviewed. Thereafter, the ISDLC in relation to sensemaking activities was discussed. The chapter concluded with a conceptual framework that explains the triggers, processes, outcomes, and influencing factors which shape the creation and sustenance of MU in the implementation of IFMIS. This research utilised the sensemaking theory (Odden & Russ, 2017; Sandberg & Tsoukas, 2014).

The last step requires the CR researcher to attempt to demonstrate the existence and operation of the structures and mechanisms postulated in the conceptual model. Thus, the researcher selects the appropriate data collection methods which fit the research paradigm and support the research purpose. As explained above, a qualitative approach was adopted in this research. According to Mingers *et al.* (2013), the use of qualitative methods in CR research provides a more proficient way in which a phenomenon can be described, propositions can be constructed, and structured interactions between complex mechanisms in the phenomenon can be identified. Further, a qualitative strategy, such as a case study which was used in this study, can help

unearth the details of a phenomenon—sensemaking in ISD projects—whose boundaries and context are not well delineated (Yin, 2013). The data collection and analysis also followed analytical techniques acceptable by CR. The findings culminated in the development (refinement) of the conceptual model which explains the creation and sustenance of MU in the implementation of interoperable/integrated financial management systems.

As the research paradigm has been determined, the research approach used in conducting this research is discussed in the next section.

4.4 Case Study as a Research Strategy

While CR embraces the plurality of research methods, case study as a research strategy has been recommended by several CR researchers for exploring the interaction of structures, events, actions, and context to identify and explain causal mechanisms (Miles *et al.*, 2014; Wynn & Williams, 2012; Ackroyd, 2010; Easton, 2010; Mingers, 2004). A case study is a study of a bounded system (Yin, 2013). The system can be bounded by time, an event, an entity, an issue/phenomenon, etc. It facilitates the empirical unearthing of the details of a phenomenon in its natural settings, especially when the boundaries and context are not well delineated. A case study explains how and why complex events—sensemaking—occur rather than describe and test theories, or it provides a framework to predict possible outcomes (Wynn & Williams, 2012). In using a case study, CR researchers can use theories to extensively explain research phenomena (Grover *et al.*, 2008). It "involves investigating one or a small number of social entities or situations about which data are collected using multiple sources of data" (Easton, 2010, p. 119).

Case studies can be categorised as descriptive, exploratory, or explanatory (Yin, 2013). Exploratory case studies are used for exploring a phenomenon where little research has been conducted or in which the phenomenon under investigation has no clear single set of outcomes; explanatory case studies are appropriate for performing causal investigations; and descriptive case studies are used for describing a phenomenon and the context within which it occurs. A case study requires a theory to guide data collection, and the theory should be clearly stated in advance. Researchers can develop a holistic case, and subcases can be embedded within an overall holistic case.

Researchers also have the option of selecting between single and multiple case studies. Danermark *et al.* (2002) argues that "the comparison of different cases provides an empirical foundation for retroduction, a foundation to sort contingent differences in order to arrive at the common and more universal" (p. 77). Other researchers have emphasised that multiple case studies offer the advantages of supporting research-focused theory building (Galliers, 1992; Benbasat *et al.*, 1987) or explanation (Dobson, 2001, p. 203; Dobson, 2002, p. 9) and replication—literal or theoretical (Yin, 1994, pp. 45–46). Comparisons among multiple cases can aid the development of a rich theoretical framework and enhance the explanations of phenomena to become relatively more compelling and robust.

Given that this research sought to explain the creation and sustenance of MU as guided by the sensemaking theory (involving trigger, processes, outcomes, and influencing factors), the study adopted an explanatory case study dimension. Additionally, multiple subcases within one institution were used to enhance the explanatory processes. The study examined the development and implementation of three modules to enhance the government payroll add-on systems. The three modules are ESPV, electronic payslip, and third-party referencing system.

4.4.1 Case Design

A case design is the organised structure that provides a link between gathered data, study questions, case study analysis, and conclusions (Yin, 2009). A multiple embedded case design was adopted for this study. The design was based on a government institution which had experienced the development and implementation of three new systems that were interoperable with an existing payroll management system. Thus, the multiple nature of the case design stemmed from studying the three different projects as independent but related instances of interoperable systems development. Further, the embeddedness of the case design stems from the occurrence of the three cases within a single organisation. The case design also aided the definition of the case boundary as presented in the next section.

4.4.2 Case Boundary

The boundary of a case delineates the scope of the case by preventing a consideration of outliers (Baxter & Jack, 2008). The boundary helps to set inclusion and exclusion criteria to avoid deviation from the core objectives of a study. In case study research, boundaries separate a case from what it is not. There are three ways to specify a case boundary: based on definition and context (Miles & Huberman, 1994), time and activity (Stake, 2008), and time and place (Creswell, 2017). In this study, the case boundary comprised the definition (i.e., of interoperable systems), context (i.e., public sector), activity (i.e., sensemaking for MU during ISD), and place (i.e., Ghana).

4.4.3 Case Sampling

The researcher invited heads of public sector organisations for a roundtable discussion on interoperability and interoperable systems. Thirty (30) heads out of the sixty-three (63) invited heads attended the discussion. The remaining heads cited clashing official duties for their inability to attend, even though they had agreed to attend. The attendees provided information about the number and nature of interoperable systems in their respective organisations. This information was evaluated according to prior case selection criteria which were a necessary part of the theory-based sampling (Paré, 2004) used in this study to select the case public sector organisation. Theory-based sampling occurs when sampling for case information in a focused manner, based on a priori theory that is being evaluated or modelled. To implement theory-based sampling, the research framework of this study served as a guide to formulate a case selection criterion (Benbasat *et al.*, 1987) at two levels i.e., organisational and project levels. At the organisational level, the criteria dictated that the organisation should be a public sector organisation and must have developed and implemented at least two interoperable IS within the past ten (10) years to facilitate a study of sensemaking/sensegiving and MU over time. For instance, the Public Services Commission was excluded from the sample of this study because it had not developed any new interoperable systems over the set period. Similarly, other public institutions were excluded because they had only one interoperable system, thereby limiting the study of sensemaking mechanisms over time across different projects.

At the project level, the theory-based criteria dictated that the case project should have produced an interoperable system with clearly identifiable stakeholders—both internal and external—who input data into the system and generate outputs. The outputs generated should incorporate data from at least two other interoperable systems. For instance, within the

Controller and Accountant-General's Department (CAGD), the electronic payslip system calls data from the payroll system and electronic payment voucher system. Therefore, it has internal users—both management and staff of CAGD and government employees outside CAGD, e.g., teachers nationwide.

Further, the case interoperable system should be a bespoke system developed over time for the case organisation. The system should not have been purchased off-the-shelf or be a packaged software. This criterion was to ensure the availability of longitudinal data in reflecting the sensegiving and sensemaking to pursue and achieve MU over time. The CAGD was selected because it had more than the two interoperable IS projects within the past ten (10) years.

4.5 Data Collection

As case study research demands, the primary data were collected from multiple sources of (Benbasat *et al.*, 1987), i.e., face-to-face interviews with the past and previous CAGD management and staff, the developer of the interoperable systems, end-users of the systems, and artefact examination (Yin, 1994, p. 78). The secondary data were collected by examining documents, reports, and print outputs related to the interoperable systems in this study.

Eighteen (18) individuals were interviewed using the interview guide shown in Appendix A. On the client side, the respondents included the former Controller and Accountant-General, current Deputy Controller in charge of Finance, and Head of Payroll at CAGD. On the developer side i.e., KariTech Limited, the respondents, included the managing director, head of operations, and head of customer service. On the user side, the respondents included five public sector workers, five heads of government units who used the e-payment voucher, and two third-party vendors who used the third-party referencing system. Table 4.1 presents the

full breakdown of the interviewees. The potential interviewees were identified in two rounds. In the first round, heads of public sector organisations were invited for a roundtable discussion on interoperability and interoperable systems, and thirty (30) out of the sixty-three (63) invited heads attended the discussion. The attendees provided information about the number and nature of interoperable systems in their respective organisations.

A semi-structured interview protocol was used for interviewing the management and staff of the case organisation i.e., CAGD. The protocol included questions regarding the sensegiving/sensemaking processes to achieve MU during the problem definition, analysis, development, and implementation of the three case systems i.e., e-payslip, e-payment voucher, and third-party referencing system. The remaining interviews sought to corroborate, verify, or obtain more in-depth insights into the responses of CAGD. The interviews lasted between thirty (30) minutes and one hour and were all conducted in-person. Further, the interviews were recorded and transcribed, leading to twenty-one (21) pages of notes. Following an in-depth review, the transcribed data were expanded into a case description (see Chapter 5), which was further coded manually in the analysis stage of this study.

4.5.1 Sampling of Respondents

Upon selection of the case organisation, a purposive sampling technique was used to select the respondents. Purposive sampling is a qualitative method for indicating and choosing suitable participants in a research (Emmel, 2013), and it targets persons and groups with proficiency and practice in an issue of interest (Creswell & Plano Clark, 2011). Purposeful sampling also considers the availability and willingness of participants and their communicative aptitude (Yazan, 2015). The names of respondents interviewed in the case are anonymised in Table 4.1.

Table 4.1: Detailed Data Collection Methods, Timelines, and Durations

Data collection method	Respondent	Date and Duration
Interview	Madam Melani, former Controller and Accountant-General	1 August 2020; 2 hours
	Deputy Controller and Accountant-General (Finance)	5 August 2020; 1 hour
	Head of Payroll (CAGD)	7 August 2020; 30 minutes
	Anderson, Managing Director, KariTech	10 August 2020; 2 hours
	Jayson, Head of Operations, KariTech	10 August 2020; 2 hours
	Adoley, Head of Customer Service, KariTech	10 August 2020; 1 hour
	Five public sector workers who use the various interoperable systems	20 August 2020; 1 hour
	Five heads of government units who use both e-payment voucher and e-payslip	22 August 2020; 1.5 hours
	Two third-party vendors who use the TPRS	31 August 2020; 1 hour
Email correspondence		
Artefact examination	Examination of system functionalities i.e., e-payslip, e-payment voucher, and TPRS	10 August 2020; 1 hour
Online Video	KariTech's Explainer video for e-payslip system	Accessed 10 August 2020

Source: Author's Illustration

4.5.2 Reliability

A case study protocol was designed and used to enhance the reliability of the case study. The protocol included an interview guide for data collection. The collected data included semi-structured interviews, artefact examination, email correspondence, and examination of an

online explainer video. Following the recommendation of Yin (1994) for increasing the reliability of case studies, an initial draft of the interview guide was developed and handed to two independent IS academics and one IS developer to assess the comprehensiveness of the questions. Consequently, the interview guide was modified based on their suggestions.

The questions were organised into four sections arranged according to the research objectives of this study. Section 1 contained questions about the background of the respective CAGD respondents and their specific roles in the development of the interoperable systems documented in this study. Section 2 contained questions about the triggers and processes for achieving MU. Section 3 enquired about the effect of project mechanisms on sensemaking processes and outcomes. Finally, Section 4 presented questions about enablers and constraints of MU. The interview guide is shown in Appendix B. Notes were taken during the interviews and were further recorded and transcribed. The data analysis followed standard procedures for qualitative data (Miles *et al.*, 2014). Section 4.6 presents the detailed analysis procedure for each research question.

4.5.3 Construct Validity

Construct validity is the degree to which we can infer legitimately from the operationalisation of a study to the theoretical constructs on which those operationalisations were based (Trochim, 2020). Two strategies were used to enhance the construct validity of this study. First, evidence was gathered from several sources to enable a triangulation of the data (Wynn & Williams, 2012; Yin, 2014). The information gathered through interviews was corroborated with data obtained, artefact examination, and email correspondence. For instance, the problem necessitating the development of the e-payslip system was corroborated between CAGD management, staff, and government employees. Data validity was ascertained by the

consistency between interview data and other sources, e.g., another interview, a document, or an examination of a case system. Second, the findings were submitted as a journal article, a scholarly book chapter, and conference papers. The feedback from reviewers confirmed the results validity and soundness of this study.

4.5.4 Internal Validity

Internal validity is the degree of the justifiability of a study's conclusions about the causality of the observed relationship (Boateng, 2020). Qualitative research is particularly useful in determining how phenomena operate (i.e., processes) and in developing preliminary causal hypotheses and theories. In this study, two strategies were used to enhance the internal validity of the case study. First, causal links based on the sensemaking theory were established to explain the creation and sustenance of MU between stakeholders in the development of IOFMS in a developing economy. The sensemaking theory enabled the explanation of the process mechanisms, outcome mechanisms, and influencing factors that affect the creation and sustenance of MU between stakeholders in the development of IOFMS in a developing economy. This explanation is illustrated in Section 3.5. Second, the consistency between patterns predicted by the theory and those in the case study was observed, and the plausible causes for any observed differences were identified.

4.5.5 External Validity

External validity is the extent to which research findings that are primarily drawn from a case study are transferable to or fit other contexts (Miles *et al.*, 2014). To enhance transferability in this study, a predefined selection criterion was used to obtain a theoretical sample from different potential public sector institutions. The same procedure used for sampling the case

organisation can be used to obtain a case organisation for the public sector from other countries. The case organisation thus fosters the external validity of the data of this study. Similarly, this study used Miles and Huberman's qualitative data analysis method which involves three levels of coding, i.e., open, axial, and selective coding (Miles *et al.*, 2014). The general usability of this coding and analysis method also lends external validity to the findings of this study.

4.6 Mode of Data Analysis

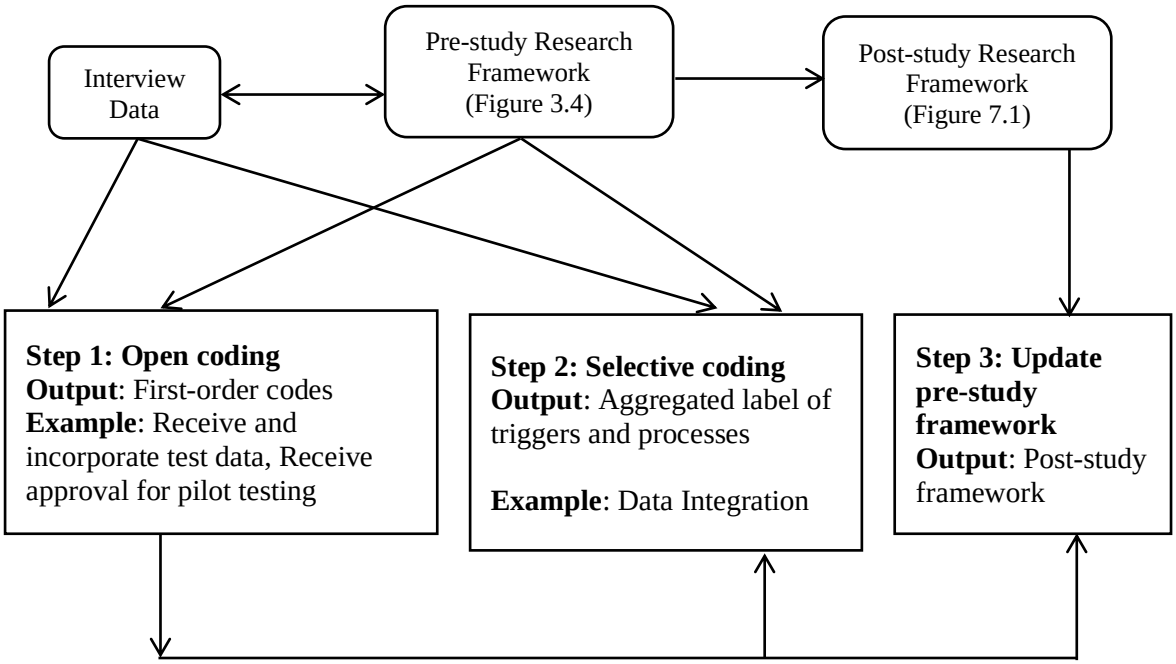
Data analysis was performed through Miles and Huberman's qualitative data analysis method which involves data collection, condensation, and display as well as drawing and verifying conclusions (Miles *et al.*, 2014; Boateng, 2020). From the perspective of Miles and Huberman, data analysis begins from the data collection phase as the recording and documentation of data from respondents occur. The questionnaire aids the researcher in segmentation and categorisation with respect to the items on the questionnaire; thereafter, data condensation follows. This entails the coding of data using labels drawn from theory and directly from the data. Data display entails the use of diagrams, tables, visual illustrations, and models to summarise data and draw out relationships and comparisons. Lastly, based on the first three steps, the researcher draws out and verifies conclusions or findings to explain or define the phenomenon being studied. Miles and Huberman presented guidelines for performing these steps. The application of these guidelines in drawing and verifying answers for the research questions are explained as follows.

4.6.1 Mode for Research Question One

The data analysis performed in this study aimed to provide answers to the research questions. Research question one aimed at explaining the triggers and processes of creating and sustaining

MU in the development of IOFMS in a developing economy. To answer this research question, the study followed established procedures, as illustrated in Figure 4.1, in analysing the qualitative data resulting from the interviews. The first step involved open coding and comprised breaking and naming interview data into discrete conditions (Miles *et al.*, 2014). The main output of this step was first-order codes which offer descriptive labels for various interview responses about the triggers and processes of sensegiving for MU in IS projects. Some mechanisms identified within the e-payslip project include 'Senior management interaction', 'Receiving and incorporating test data', and 'Distribution of access codes'. Similarly, some of the mechanisms identified in the e-payment voucher project included 'Senior management interaction', 'Receiving approval for pilot testing', and 'Communication'. The second step was selective coding which involved combining similar first-order mechanisms across the three case projects to obtain aggregate mechanisms. Thus, 'Receive and incorporate test data' from the e-payslip project, 'Receive approval for pilot testing' from the e-payment voucher project, and 'Receive and incorporate test data' from the third-party referencing system project were abstracted as 'Data Integration'. Tables 6.3, 6.4, and 6.5 illustrate the actual results for research question one.

Figure 4.1: Data analysis method for Research Question One



Source: Adapted from Tzeng (2018, p. 639)

4.6.2 Mode for Research Question Two

Research question two aimed at explaining how ISD project mechanisms affect the sensemaking process and outcomes during the development of IOFMS in a developing country. The data were analysed in two steps to answer this research question. The first step involved identifying and coding the MU outcomes for each of the three case projects. In other words, the interview data were broken down and named into discrete mechanisms (Miles *et al.*, 2014). The main output of this step was first-order output mechanism codes which offer descriptive labels for various interview responses about the MU outcomes achieved through the sensemaking process during the development of IOFMS in a developing country. The second step was selective coding which involved combining similar first-order outcome mechanisms across the three case projects to obtain aggregate outcome mechanisms. It emerged that the

level of abstraction observed in the MU increased as the project progressed. The observed progression led to developing a stepwise and incremental set of mechanisms that characterise MU in IS projects. Figure 6.1 illustrates the actual set of outcome mechanisms in incremental order.

4.6.3 Mode for Research Question Three

Research question three aimed at explaining the factors that influence (enable or constrain) the creation and sustenance of MU in the development of IOFMS in a developing economy. The data were analysed in two steps to answer this research question. The first step involved identifying and coding the factors that either enabled or constrained the creation and sustenance of MU in each of the three case projects. The main output of this step was first-order codes which offer descriptive labels for various interview responses about the factors that enable or constrain the creation and sustenance of MU.

The second step was selective coding which involved combining similar first-order outcome mechanisms across the three case projects to obtain aggregate influencing factors. The resulting aggregate factors were categorised under factors identified in the literature (Sandberg & Tsoukas, 2014). The aggregate factors used include context, cognitive frame, emotions, technical availability, language, and politics. Table 6.6 illustrates the actual set of influencing factors.

4.7 Ethical Considerations

In this study, a qualitative case study that embedded ISD projects was conducted to understand the creation and sustenance of MU during such projects. The focus was on the sensegiving and sensemaking mechanisms used in achieving MU and the influencing factors. The interviewed respondents participated in this study willingly and without coercion. Therefore, the ethical or privacy concerns of no one were breached during this study.

For the primary sources of data, permission was obtained from the selected institution before engagement with participants who were also informed of the essence of the research as a way of appealing to their good intentions. Willingness to participate was at the discretion of participants. No coercive measures were used on participants. Respondents' anonymity was assured. Periods that were convenient to participants were respected to ensure unbiased responses and a relaxed atmosphere during interview sessions. Data collected were presented and analysed objectively in line with the principles of CR research. Findings were impartially reported.

Furthermore, ethical clearance was also obtained from the Ethical Review Board for the Humanities at the University of Ghana. To apply for the ethical clearance, the required documents, including a proposal, new protocol submission form, and consent form, were submitted. After the first round of the ethical review, the researcher was asked to provide the study's inclusion and exclusion criteria for interview respondents in the study's proposal. After submitting the revised proposal, the study was granted ethical clearance. The official clearance letter is shown in Appendix B.

4.8 Chapter Summary

The philosophical assumptions and research methodology used in this doctoral research were discussed in this chapter. First, the various research paradigms in IS were examined, and CR was adopted as the research paradigm for this research. Second, the chapter presented the research design, selection of case institution for the study, sampling of respondents, and data collection methods. Finally, the data analysis techniques used in the research were discussed. The next chapter presents the case phenomenon under study to facilitate analysis in a subsequent section.

CHAPTER 5: CASE STUDY ON DEVELOPING UNDERSTANDING IN INTEROPERABLE SYSTEMS DEVELOPMENT IN THE PUBLIC SECTOR: EVIDENCE FROM THE GOVERNMENT PAYROLL ADD-ON SYSTEMS IN GHANA

5.1 Chapter Overview

This chapter presents a case study which explores the structures and mechanisms that underpin the creation and sustenance of mutual understanding in the development and implementation of the government payroll add-on systems in Ghana. According to Yin (2013), explanatory case studies are appropriate for causal investigations or determining cause-and-effect relationships to develop explanatory theories. Given that this doctoral research seeks to explain the creation and sustenance of mutual understanding as guided by sensemaking theory (involving triggers, processes, outcomes and influencing factors), an explanatory case study approach was employed. In addition, multiple subcases within one institution were used to enhance the explanatory processes. Case studies on each of the three modules are presented in this chapter: first, the Electronic Payslip; second, the Electronic Salary Payment Voucher; and third, the Third-Party Referencing System. This chapter begins with an overview of the Controller and Accountant General's Department (CAGD) of Ghana, which is the governmental agency that oversees the payroll add-on systems. Subsequently, the three case studies are presented. The chapter concludes with a chapter summary.

5.2 Overview of the Controller and Accountant-General's Department

The Controller and Accountant General's Department (CAGD) of Ghana is a governmental agency that is mandated to oversee accountancy matters of all governmental agencies and departments and to promote the development of efficient accounting systems within departments. The department was established under the Ghana Civil Service Act, 1960 (CA.5). The constitution and the administration that established the department (Act, 2003, Act 654) provide the legal framework that governs how the department operates and functions. The department is headed by the Controller and Accountant-General, who is the Chief Accounting Officer and the Chief Advisor to the Government of Ghana; this individusl offers advice on accounting matters to government. As head of the department, the Controller and Accountant-General is responsible for overseeing six divisions within the department, each of which is headed by six Deputy Controllers and six Accountants. The divisions are as follows: (1) Finance and Administration; (2) Treasury; (3) Financial Management Services; (4) Information, Communication, and Technology Management; (5) Payroll Management; and (6) Audit and Investigation. The mandate of CAGD as defined in the Financial Administrative Act, 2003 (Act 654) is outlined in Exhibit 1.

Exhibit 1 Mandate of CAGD

Under the Financial Administrative Act, 2003 (Act 654), the department is mandated to perform the following duties specifically:

- Be solely responsible for the opening of bank accounts for any government department.
- Approve accounting instructions for Government Departments.
- Receive all Public and Trust monies payable into the Consolidated Fund (done through its staff stationed in all government departments including the revenue collecting ones).
- Provide secure custody of Public and Trust monies (with the support of the Ministry of Finance and Ghana's central bank (Bank of Ghana)).
- Make disbursements on behalf of the Government (includes the payment of monthly salaries to government employees inactive service; pension gratuity and monthly pension payment to those on retirement; and releases of funds to prosecute government projects and development throughout the country).
- Pay all Government Workers' wages, salaries and allowances.

- Process and pay all Pension gratuity for the Civil Servants.
- Keep, prepare, render and publish financial statements on the Consolidated Fund of Ghana both monthly and annually (not later than three months after the end of the financial year.
- Promote the development of efficient accounting systems in all Government Departments.

5.3 General Problem Background

The Controller and Accountant-General's Department (CAGD) manages the payroll as a national database, gathering and processing data to facilitate salary payment to public sector employees. According to Madam Melani, a former head of CAGD from 2009 to 2014, '80% of government workers are paid by the controller system in collaboration with the various government ministries, departments, and agencies'. She describes CAGD as a bureau for the processing of information. CAGD's preparation of salaries for government employees is intended to 'achieve efficiency, cost-savings, and central control of information and salary processes'. Madam Melani recalled the following:

> 'Years ago, I am told, all these payroll processes were manual. When I joined in 1995, it was automated, but it is the degree of sophistication and control that has improved going along; not all the processes were automated, e.g. sending of information to controller and back to recruiting agency for verification was hardcopy and manual.'

The manual payroll processes created inefficiencies, data redundancies and delays in processing the government payroll. The former CAGD boss described a typical challenge pertaining to the payroll during her tenure:

> 'So, you get someone being recruited at the district level, and it could take three to four months for the person to be processed. It could even take a year for that paperwork to get to CAGD. When you have a situation like that, you

> have public servants being recruited but not paid, or paid but [with] salary in arrears. The manual processes were inefficient and generated "surprises" on the payroll.'

Consequently, CAGD had difficulty in generating accurate reports even for planning purposes. As Madam Melani noted,

> 'As we are here, we don't even know the salary arrears in the system; it is only when they come to the centre that you know, and it has implications on planning and budgeting.'

Further, the process for sending information back for verification can also be delayed.

> 'So, you are processing payroll for November, and you are finding corrections that should have been effected in March, coming now.'

As CAGD manages the government payroll, Madam Melani, her deputies and directors had been looking for ways to improve on the system, until KariTech appeared. The remainder of the case illustrates how CAGD and KariTech gave sense and made sense with each other to successfully implement three related solutions to the problems enumerated earlier.

5.4 The E-Payslip Project

5.4.1 Problem Definition Phase

In 2006, KariTech Limited, a third-party hire purchase company, sought to sell consumer products to government employees on credit and receive monthly reimbursements deducted at source from beneficiaries' salaries by CAGD. Anderson Mensah, the CEO, described the idea as follows:

> 'So, I had a third-party company, and then I launched this [idea of] one laptop per household, and the idea was to sell laptops to teachers on credit, and then we would do the deduction at the end of the month at [the] accountant general.'

When KariTech started the delivery, it soon discovered several manipulations in the CAGD systems. As Anderson described:

> 'If you make an input and you are expecting a deduction, you don't get it. So at the end of the day, you have taken a loan from a bank, you watch your computer (or the product) you have supplied, you have a monthly deduction that you are collecting to pay the bank, and the account receivable is unable to meet your loan repayment.'

The problem of not receiving timely monthly reimbursements forced KariTech into bankruptcy. 'I went completely bankrupt; I sold my houses and [a] couple of other things to pay the bank, because the teachers' deductions were not coming', Anderson said. However, his diagnosis of the root cause of the bankruptcy led him to discover the vulnerabilities of the CAGD's systems, as well as the manipulations that the system was susceptible to. These manipulations were a result of some third-party institutions establishing and institutionalising informal relationships and agreements with system operators so that their reimbursements would be prioritised. Anderson and KariTech's ordeal revealed two main problems regarding government employee payroll management.

First, CAGD could not deliver payslips on time to employees. Second, CAGD systems were manipulated in favour of some third-party companies, and to the detriment of others—a situation which affected employees negatively, because they sometimes suffered incorrect payslip deductions which they did not see on time, and hence forfeited. Anderson described the effect of these problems as such:

> 'A lot of companies went bankrupt because of that. The level of institutionalizing your relationship to stay relevant on the payroll wasn't cheap, so I said "okay, I will go behind and solve that problem before I come back into the laptop business."'

These informal relationships had created barriers around the payroll. Thus, Anderson realised that instead of modifying the payroll, more innovative ways of modernising the payslip delivery process should first be invented, so that a proof of concept could be shown to the head of payroll and Accountant General as evidence of being able to address the payroll issues.

To solve the problem generated by the highly institutionalised processes surrounding payroll running and payslip distribution, Anderson decided that it would not be prudent to address the human manipulation directly. 'They will fight you', Anderson cautioned. 'The people were not used to that level of change, so we started off by offering a free e-payslip project.' It seems that Anderson was able to understand two levels of change: the change the people were ready for, and the change that had to be introduced. Therefore, Anderson, through KariTech, a newly registered company, started discussions with CAGD about the e-payslip system. 'Myself and him, we saw that we could give them a system where you will have your payslips, and you do not need to print papers. … yes, we saw the need', as John Jayson, Anderson's business partner, remembered. In a presentation to CAGD directors, KariTech promised to use the system to cut printing and distribution costs. 'You will not need to print it; if anybody needs to print his or her payslips, they go to the café or whatever and print, so you [CAGD] don't have to print again, you don't have to transport it again, and most of it all, you will be able to give them their

payslip on time', Jayson said, describing their value proposition. To help understand the presentation and provide input, CAGD also invited their technical computing staff, some management unit heads, and other people who had a deep understanding of payroll by virtue of how long they had been in the public sector. 'We brought our suggestions to the table, and we discuss whether they are feasible IT-wise. Sometimes for about three to four times, they go and add and bring it back for presentation', Madam Melani recalled.

5.4.2 Analysis Phase

To better understand the nature of the problem at CAGD, Anderson presented the following user story:

> 'The payroll system has priority deductions which are set by human beings. So, at CAGD, the highest priority deduction on the payroll is statutory payments like SSNIT (social security) and PAYE (income tax). The second priority on the system was normative association dues. Then, the third priority was insurance. After all these deductions, 50% of your salary must get to you. So if you are taking GHS 1000, GHS 200 goes to statutory; of the 800, 50% goes to you, which is 400, and then the other 400 is what you can play with your dues, or life insurance and then other third party payments. So if the person had taken a loan, he is paying dues, paying insurance, and has taken from Bayport [a loans company], from Barclays bank from this and that you are now going to fight for the rest of the money [as a third party company]. And now the big boys at that time, they had institutionalised their friendship with those who work on the system, so they get more priority than an entrepreneurial company coming as a third party.'

The delay in government employees receiving their payslips cast further doubts and confusion about the existing payroll management system. Any given payslip would be so outdated that it

might not reflect the total current deductions on an employee's salary. The lack of transparency in payslip data caused third-party companies like KariTech to give credit facilities to high-risk customers.

KariTech's CEO described the situation:

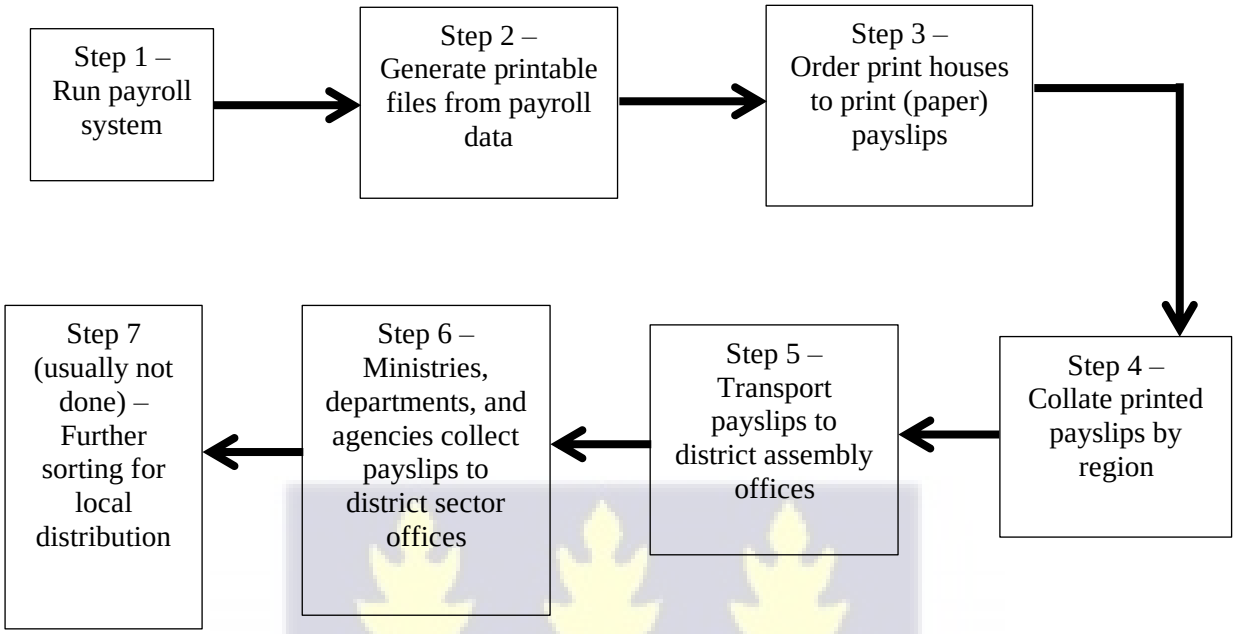
> 'You will see a payslip this month and there is no EZway loans from it, you will go and give that person a computer hoping to deduct; the next month will come [and] you get zero. Why, EZway has now found a position on the payslip. So, you get nothing. So, it means that you have to queue, so if EZway's loan will take 24 months to deduct, EZway will have to deduct for the 24 months before you have space on the pay slip for your deduction to start. At that time, your bank is also waiting for you.'

To understand the delay in distributing payslips, Jayson described the manual process, which involved CAGD running the payroll to generate payroll data, transferring printable files to printers to run on over 600,000 sheets of paper collated by region, and giving them to CAGD's transport department. The payslips were loaded into cars for distribution. Jayson cited an example as follows:

> 'When they get to the Eastern region, they start from maybe Nsawam and drop at district assembly offices from where every ministry, department, and agency collects their employees' payslips. So, let us look at the ministry of education. It gets to Nsawam district office, director of education will pick for the ministry of education, and then they will also sort it out and then make sure it goes to the schools for them to have their payslips, but usually, they do not do it. They remain at the director of education's office. So anytime you need your pay slip, you come to that office for it. We went round to find out that in many of the district offices, you have a bunch of payslips. They don't come for their payslip.

Why should I run from, say, Dokrochua, my head office is at Volta, how do I pick a car and come for my payslip unless I need it for something?'

Figure 5.1: Manual Process for Payslip Production and Distribution



Source: Author's illustration

At this stage, Anderson leveraged his previous dealings as a third-party supplier to introduce his solution to Melani, the then-current Accountant-General. Melani saw the solution as a 'brilliant idea'. Other important personnel, such as the head of payroll, agreed on the proposed solution's usefulness, and invited KariTech to implement an e-payslip system.

5.4.3 Development Phase

Anderson, therefore, decided to use a 'surgical approach', as he described it, to introduce a potential solution without making his purpose too obvious. 'So, I started off by first doing the

electronic payslip (e-payslip) whereby you take control of the affordability; you know you work out the 40%, and you make sure that somebody who is on the pay slip cannot be removed and somebody put on. So, I took control of that.' In other words, the first part of the approach sought to introduce transparency into employees' payroll deductions. To achieve this, Anderson made a proposal to solve CAGD's seemingly innocuous inability to provide payslips to employees on time. Asked how he accomplished this, Anderson said:

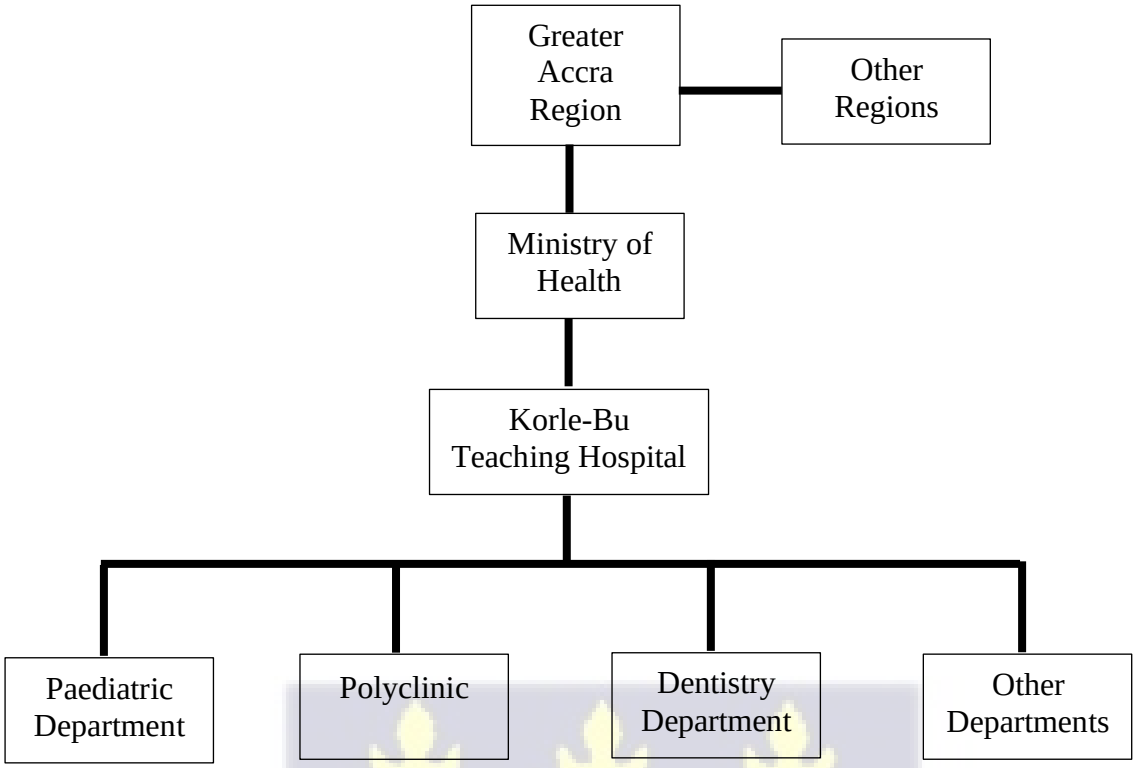
> 'Well, I said government workers are not getting their payslips and then people's payslips are being used for identity theft, so I am offering a free solution to solve that problem.'

To start implementing the solution, KariTech's business partners offered a conceptual design of the project to the technical team, who developed the entire system's functionality. Jayson described the proposed system's components as follows:

> 'The key components were the central database and the application, which allows ubiquitous access using one's staff ID and password generated by them, and all departments were loaded. We did this on regions, districts, and the management units. So, every region has districts, and every district has management units (any group of employees with a functional head, e.g. head of department).'

The e-payslip system would connect and share final payroll information with the budgeting module of CAGD's Ghana Integrated Financial Management Information System. This link would allow management to assess budgetary performance.

Figure 5.2: Sample Structure of Management Units for a Government Teaching Hospital



Source: Author's illustration

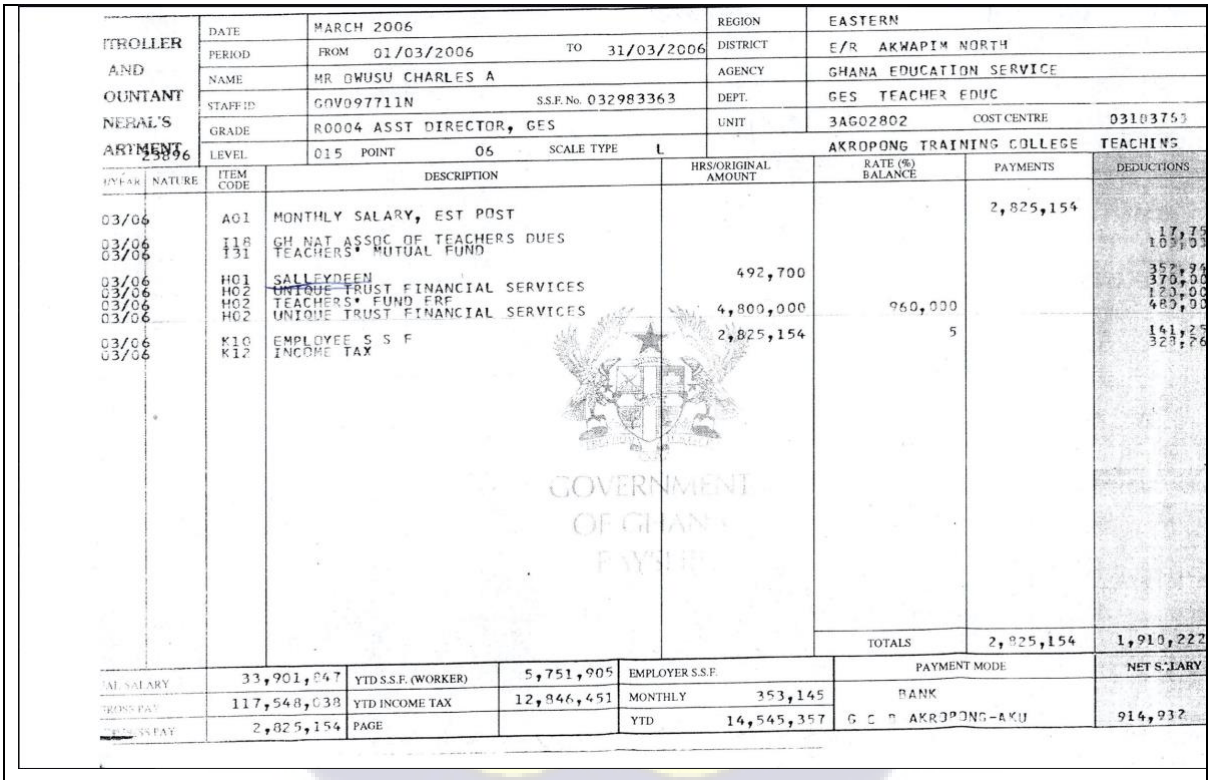
Further, KariTech requested the payroll system's output file to feed the new e-payslip system. 'Because it (the payroll data) is coming from Oracle, if they do not change it to text [files] we would have a problem; we will have to have an Oracle system', Jayson explained:

> 'When we got the raw text file, and we wrote a script to transform from raw text into a MySQL database readable files. So, we had built the database structure, so you pick a payslip, you know that the district is here, the district code is that the staff ID is here, the name is here, so all the elements are correctly captured… they (CAGD) gave the database fields to us, and we wrote a script to fill those fields.'

KariTech also studied the structure of the government payroll from the Oracle-based system CAGD uses and decided not to copy the same database structure, as it was a very large and old system. Jayson explained further:

> 'So, if you want to do new web applications and stuff, then you need to go away from Oracle as a database, but you need to fall on a new database like SQL or MSQL. Today we are moving higher to a better database. At that time, [using] SQL, we had to restructure the Oracle database and transform [it] into mySQL data structure, all of them by us.'

Figure 5.3: Sample Old Payslip



ITROLLER AND OUNTANT NERAL'S ARTMENT

DATE	MARCH 2006		REGION	EASTERN	
PERIOD	FROM 01/03/2006	TO 31/03/2006	DISTRICT	E/R AKWAPIM NORTH	
NAME	MR OWUSU CHARLES A		AGENCY	GHANA EDUCATION SERVICE	
STAFF ID	GOV097711N	S.S.F. No. 032983363	DEPT.	GES TEACHER EDUC	
GRADE	R0004 ASST DIRECTOR, GES		UNIT	3AG02802	COST CENTRE 03103753
LEVEL	015 POINT 06	SCALE TYPE L		AKROPONG TRAINING COLLEGE	TEACHING

YEAR	NATURE	ITEM CODE	DESCRIPTION	HRS/ORIGINAL AMOUNT	RATE (%) BALANCE	PAYMENTS	DEDUCTIONS
03/06		A01	MONTHLY SALARY, EST POST			2,825,154	
03/06		I18	GH NAT ASSOC OF TEACHERS DUES				17,79
03/06		I31	TEACHERS' MUTUAL FUND				10,90
03/06		H01	SALLEYDEEN	492,700			352,9
03/06		H02	UNIQUE TRUST FINANCIAL SERVICES				370,0
03/06		H02	TEACHERS' FUND FRF				120,0
03/06		H02	UNIQUE TRUST FINANCIAL SERVICES	4,800,000	960,000		480,0
03/06		K10	EMPLOYEE S S F	2,825,154	5		141,2
03/06		K12	INCOME TAX				328,7
					TOTALS	2,825,154	1,910,222

AL SALARY	33,901,847	YTD S.S.F. (WORKER)	5,751,905	EMPLOYER S.S.F.		PAYMENT MODE	NET SALARY
ROSS PAY	117,548,038	YTD INCOME TAX	12,946,451	MONTHLY	353,145	BANK	
SS PAY	2,825,154	PAGE		YTD	14,545,357	G C B AKROPONG-AKU	914,932

Source: KariTech Archives

Until this point, KariTech had not received any payment for the work done regarding the e-payslip because, even though CAGD saw promise in the project, they also Needed To Undergo

A Full Consultation to confirm the project's viability and necessity. Unfortunately, the project faced some opposition. According to Jayson, 'there were people there who did not want the IT to work'. Nevertheless, KariTech continued working on the system. They developed the e-payslip system and offered to give it to the CAGD for a free trial if they could be given some test data. Melani realised the promise in the offer and allowed one month's payroll data to be given to KariTech. Jayson recalled that:

> 'They did not give us the data. They went and entered the data. We had to download the text file. We allowed them to upload the data unto our system, so that our system will now structure it.'

At this point, KariTech was constrained by a non-disclosure agreement. 'We should not disclose whatever is given by us to any third party, because this is government data. They came and loaded the data for us. So, we did everything with that one-month data and realised that this thing would work. So, we did many demonstrations to CAGD', Jayson recalled. During project meetings and demonstrations, four or five KariTech staff (from a total of twenty-two) would meet CAGD representatives, including the Controller and Accountant-General, Deputy Controller, Head of Payroll, Deputy Head of Payroll, and Payroll Coordinator.

5.4.4 Implementation Phase

'So, we developed and launched the e-payslip', Anderson said. 'The whole idea is that, once pay roll is run, within two hours you have your payslip using your username and password.' In September 2013 when all pending issues had been resolved, KariTech published its first live digital payslip and sent mobile text messages to government workers (see sample new digital payslip in Figure 5.4).

Figure 5.4: Sample of New Payslip

	DATE	October 2019	REGION	Northern	
	PERIOD	FROM 01-OCT-19 TO 31-OCT-19	DISTRICT	Bole	
	NAME	Mr. Maxwell Acheampong-Twumasi	AGENCY	Min Of Health	
CONTROLLER AND ACCOUNTANT GENERAL'S DEPARTMENT	STAFF ID	904407 XXXXXXXXXX S.S.F. No E108705070018	DEPT.	Ghana Health Service	
	GRADE	.Physician Assistant..HSS	UNIT	0801 GHS: Bole Hospital Nursing Admin. COST CENTRE	
	LEVEL	SS.PSL18 POINT 1 SCALE TYPE SS			

MONTH/YEAR	NATURE	ITEM CODE	DESCRIPTION	HRS/ORIGINAL AMOUNT	RATE (%) BALANCE	PAYMENTS	DEDUCTIONS
31-Oct-19			SS Market Premium			645.12	
31-Oct-19			Single Spine Monthly Salary			2,090.00	
31-Oct-19			Social Security Contribution Employ				114.95
31-Oct-19			Income Tax				393.60
31-Oct-19			Gh Medical Asst Association Dues				50.00
31-Oct-19			IZWE Loans Ltd Deduction		7,256.00		97.00
31-Oct-19			Bayport Financial Services Ded		63,524.24		934.18
					TOTALS	2,735.12	1,589

ANNUAL SALARY	25,068.44	YTD S.S.F. (WORKER)	1,251.30	EMPLOYER S.S.F		PAYMENT MODE	NET SALARY
YTD GROSS PAY	29,828.04	YTD INCOME TAX	4,351.56	MONTHLY 271.70		Ghana Commercial Bank, Bole	1,145
MONTHLY GROSS PAY	2,735.12	PAGE	1	YTD 2,957.64			

Page 1/1

Source: KariTech

Even though some did not receive the text message, this marked the dawn of a new era of payslip distribution. However, the new system faced challenges beyond the scope of what KariTech could solve. Jayson explained: 'It is not our fault, but the mobile telecom companies';

sometimes the person has switched off the phone for a long period, and you know the messages can hang around for a certain number of hours. However, we sent emails too, automatically.' Jayson added:

> 'When the text messages went, and government workers were like "wow"… you could see your salary for November is this, your deduction is this, your net to bank is this, it goes in a short text message, and then we say you can log onto [your] […] payslip and check. So, […] in a matter of three hours, our server was being hit like 30,000 times per second, so we were like "wow".'

Despite the enthusiasm the new system generated, the switch to electronic payslips was a difficult one. KariTech, therefore, had to engage the trade unions. 'We went anywhere we hear the unions are doing something', Jayson reminisced. 'We demonstrated the system to them, so they knew what was going on. We engaged mainly with four unions; GNAT, NAGRAT, CLOSAG and the Nurses' and Midwives' Union and other smaller unions and ministries', he adds. KariTech also had discussions and demonstrations with the Head of the Civil Service, Chairman of the Public Service Commission and his team.

> 'We knew we were going to get the general public to get buy-in. We sent people to go and sensitise the schoolteachers and other workers about the need to have e-payslip. So, when CAGD went out there to do his sensitisation, people were throwing this same question that this thing must come. "We need this thing because if you can put it on a digital platform for us, it makes it easy."'

Further, the company had to determine how to get all of the government workers to sign up to receive their payslips online or their mobile phones.

> 'We had a challenge to get people to register because first, we need to collect your data, though we know we have your staff ID and bio-data, we have to match it. So, we developed a coding system and said […] "OK, let everybody

> go and register and create their login credentials." So you go input […] your staff ID, then it will go and fetch your data and show you whether this is yours, when it fetches your data, you go ahead to confirm and do your own password then you are registered on the system. So, you can check your payslip.'

KariTech also trained CAGD staff in each region to be the first line of support for people who faced challenges with the new system. The trainees were also used to deploy the login codes. Unfortunately, giving the login codes to specific officers led to another challenge, which Jayson described as follows:

> 'The strange thing was that it became a hotcake because everybody wanted it. We developed and sent the login codes to every district office for onward distribution to all government staff. However, people will pick the code, sit in an Internet café, and charge people GHS 5 per code to access their electronic payslip.'

This extortion was a problem which KariTech had to resolve. However, it was not enough to attract direct opposition, because the system was solving a general problem; every government employee suffered the same plight of not receiving their payslips on time. In early 2014, considering the amount of work KariTech had done on the project, CAGD agreed and accepted KariTech's electronic payslip system through a restrictive tender. 'So, when we got that we knew that was OK, and that we were on the right path with what we are doing, we did more engagement', Jayson explained. CAGD gave KariTech a retrospective contract to develop and maintain the system to ensure that the system remained effective. 'Within a month, when we got approval, 300,000 more people registered', Jayson said.

Meanwhile, word of the new system was spreading, but CAGD was still producing paper payslips alongside the new system. 'So, we tested for about three months before the contract

signing', Jayson said. Nevertheless, CAGD officially notified government employees about the new system, and directed them to register via URL to access their payslips online. Overall, the implementation of the e-payslip system was successful. Anderson added:

> 'If you look at the tracker (analytics), the first week of launch of e-payslip, we were hitting about thousand five hundred new registrations every day, and there are about six hundred thousand people on the payroll. But [after] about two months' time, we were hitting about ten thousand new registrations a day. So, it told us the level of interest as the word got out that now you can get your pay slip through this form; everybody was registering. So, within six months we had registered about 450,000 people and they had done it themselves.'

Table 5.1 summarises the activities and artefacts used to give and make sense over the phases of the e-payslip project.

Table 5.1: Sensegiving and Sensemaking Activities and Artefacts in E-Payslip Project

Phases	**Activities**	**Artefacts**
Problem Definition	1. Presentations to Controller, Directors and CAGD technical staff 2. Demonstration of initial prototype	1. Presentation slides 2. Initial prototype for proposed system
Analysis	1. Informal consultations to further understand payroll functions	1. Analysis documents, e.g. use case diagrams and sequence diagrams
Development	1. Receive test data from CAGD 2. Initial runs of electronic payslip system	1. Non-disclosure agreement 2. Sample electronic payslip
Implementation	1. Training of CAGD trainers of trainers who will implement further training 2. Distribution of access codes across districts 3. Monthly review meetings between KariTech and CAGD payroll staff	1. New payslips accessible online (see Figure 5.4) 2. SMS notifications sent to government employees 3. User manual 4. Explanatory video on e-payslip website

Source: Author's Illustration

5.5 The E-Voucher Project

The purpose of this project was to create an online solution to send payment vouchers to management units for verification and return them to CAGD for further payroll processing. According to the then-Controller and Accountant General, this system 'enabled them to make corrections early enough in payroll and [enabled] the resolution of salary issues raised by management unit head'.

5.5.1 Problem Definition Phase

When CAGD finally decided to stop printing the paper payslips, KariTech realised the need for another electronic system for salary payment voucher validation, another payroll-related process. As explained by Jayson:

> 'Now that we have come to have a close relationship with them (CAGD), we come back and say "you have this problem, your salary payment voucher by law is supposed to come back from the districts to tell you that pay this person, do not pay this person before you run payroll". However, some of the vouchers will go through the same process (referring to the paper payslip production and distribution process); they will print the vouchers after the payroll is run, they will print next month's payment vouchers; the payment voucher is actually […] information to the head of the department that "this is what am going to pay your staff next month. Please confirm or otherwise plead before I pay." So, the vouchers will be printed immediately [when] payroll is run [in] say September, immediately payroll is run and then through the same process […] drivers will drop it at various district, and you have to manually go through and check that, "no, this person is dead or this person is on leave"… by the time they will come back to correct, the payroll had already been run.'

The manual salary payment voucher validation created a lot of 'ghost names' on the payroll. Anderson explained that 'about 99% of the ghost names are not a result of people wanting to steal'. 'It is not people stealing the money; it is just people sitting there and the money coming free', Anderson noted. On the other hand, KariTech realised that some integrity issues existed with the data received from CAGD's payroll system. Anderson described the integrity issues as follows:

> 'Government employees were not complaining about information on their payslips; all they were interested in was their net salary amount. Once the net is correct, even if the name is Mrs. Prof. Atsu instead of Mr., they don't care. So, you will see that Edward Boateng is teaching at PRESEC, but his region is Ashanti region, his district is Lora East, his name is Mrs. instead of Mr., and his date of birth is 1902, meaning he will never go on retirement. So, we then realised that there were data integrity issues.'

KariTech's access to payroll data allowed them to retrieve these issues and presented government with a business case. When asked what they did about the problems with data integrity, Anderson answered 'We told government, "listen, the source of your ghost names is because you do not have an accountability, because 60% of your data is corrupted."' Consequently, CAGD asked whether KariTech could fix the problem. 'We said "why not"', Anderson replied.

5.5.2 Analysis Phase

This is how KariTech understood CAGD's salary payment voucher validation processes, as identified from interviewing payroll personnel:

> 'Now this is what happens, the voucher is printed on the first. The voucher must come back before the tenth of the month. It is printed on the first, it is sent to your regional

> office in a truck which breaks down on the road for three four days. It goes to the regional office on the third, it's sent to the district, and it can sit in the district office for three months, and then it's sent to the school headmaster, who does not understand what he is doing. And even [if] the headmaster validates, it has to now come back to the district office, to regional office, to [the] accountant general. Most of the [time], it ends up with the groundnut seller and the plantain seller. So, the headmaster has communicated that "brother Acheampong is dead, remove him from the payroll"; that information never gets to [the] accountant general. The accountant general cannot see an obituary and go and remove you from the payroll. He needs the instruction from […] what we call the unit head.'

During an interview of staff members at Korle Bu Teaching Hospital, an accountant said:

> 'Guys, I hope this thing works, because there is a doctor here who has been dead for three years. I have written to [the] controller; I have done the payment voucher several times. But I have written to the ministry; in my last letter I attached the obituary just to let them know that the guy is dead. Still, last month the guy got paid.'

5.5.3 Development Phase

KariTech's experience with the e-payslip system gave them the forethought to start developing an electronic salary payment voucher system. As Jayson recalled:

> 'When we were doing the e-payslip, we knew the problem of ESPV should come into the picture, so we started developing the ESPV, we started around 2012 thereabout. We started to build the data to make it possible for management unit heads to respond or return their vouchers within the same month before salaries are paid. We were doing that hand in hand with controller, and then we started to tell them "this is what we can do. You do not need to wait

> six months before you can receive your vouchers. You can make sure all your management units are structured so that your people can electronically give you responses within the same month […] because we have [achieved] some success with e-payslip", they said "why not; if you guys can continue it without a penny, let us see".'

The first step to the payment voucher problem was to 'to put on the e-payslip a self-correcting mechanism where employees can log on and effect basic corrections like names, date of birth, and SSNIT number. So, it also became an HR tool to do the correction', as Anderson described. Further, KariTech provided this solution for free 'because that was not in the target'. The second step was to create an electronic salary payment voucher on a trial basis for selected management units in the Greater Accra region. In effect, the company was using prototyping to build interest in a future system.

5.5.4 Implementation Phase

In 2008, KariTech received approval to implement ESPV. Even though e-payslips and ESPV are different platforms, they depend on each other and run from the same database. 'ESPV is input and e-payslip is an output', Jayson explained. The ESPV was piloted at the Korle-Bu Teaching Hospital, because as Jayson described, 'their structure was messed up; one doctor had […] died and was being paid for five years'. The hospital was a good staging area because it was a microcosm of the salary payment voucher problem that plagued the country. Jayson detailed the situation:

> 'Korle-Bu was using the Oracle payroll system. One management unit, like "*Child Health, Korle-Bu*", had about 100 members under it. And then you will see another "*Child Health Korle-Bu*", with 25 or 30 members, and another, and

> another—just one management unit split into three or four, and the unit head knows neither those other three units' existence [nor] the people in them. When the salary payment voucher comes, they print it. Because it is manual, they will only give the one to you being corrected and send it back, but the system will be paying all the management units. So, somebody will be "working" at Korle-Bu Child Health, but he is staying at home because his name never appears on the manual voucher, so you will never know. Only the hundred people (in the main Child Health unit) will come to work, but the others will not come, but they will be paid. So, the thing had manually been corrected, but in the system in terms of the payment, that must be paid.'

Such duplications result from changes that CAGD staff make in the payroll system upon receiving instructions to add new employees. Sometimes, they create duplicate management units inadvertently. Such situations also breed ghost names, whose eradication became ESPV's core interest, a pursuit which received indirect backing from the World Bank. KariTech started to clean up these problems when CAGD asked for help. 'It was a huge task', Jayson conceded.

> 'We did the clean up only for Korle-Bu. So, we pick up a management unit and say that "OK, if these people do exist, those that exist, let us put them in here." So, we asked a chunk of the people, "do you know this person?", they say no. So [we] merged duplicate management units and cleared off the excess. The first payroll after that was serious, because we brought the output of what we did and gave it to payroll and they corrected it, and when it came, many people did not receive their salaries. Those who people who did not receive their salaries were people who were not working in that department. Some of them were genuinely working for Ghana Health Service, but they had been

> transferred elsewhere, [while still] on Korle-Bu's payroll. So, they were placed under the proper management unit.
>
> The pilot with Kore-Bu was successful; every month, Korle-Bu comes in to certify their payment voucher, and we cleared all the duplicates. So they (CAGD) thought that we should help them to clean the payroll, and that work we did that was the results, at that time the Minister of Finance, aligned budget to management units, and today if your ministry budget for emolument is exhausted, your people will not be paid. That was the work we did. It was cleaned up such that they can now say that "OK, your budget that you prepared should be aligned to your payroll."'

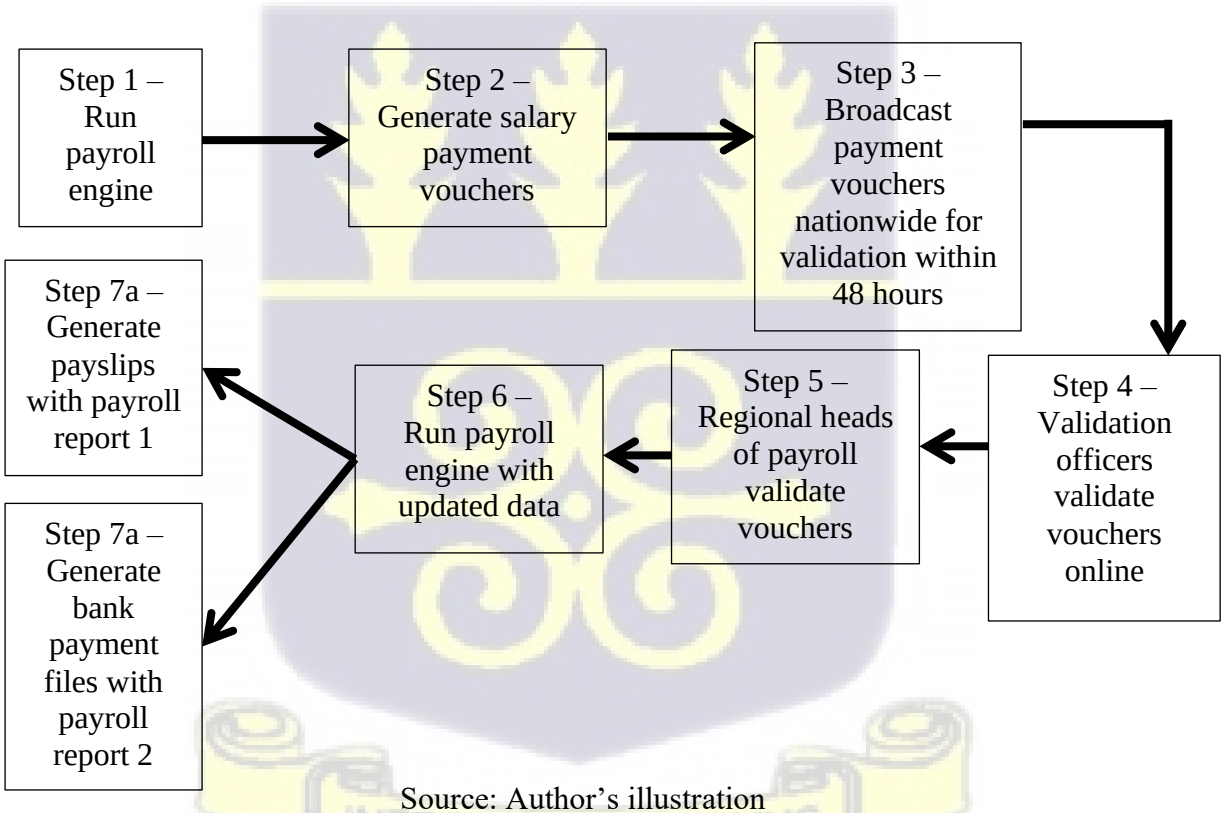
In the first month, two thousand people were reported as either ghosts, absent, or terminated. CAGD then realised this system would be beneficial. Thus, they added ESPV into the e-payslip contract. However, during the Korle-Bu pilot, CAGD introduced another system, the Integrated Payroll Processing Department III (IPPD3), to handle some payroll for the Ghana Education Service (GES) specifically, in order to reduce the load on the central Oracle payroll database.

> 'They thought that the payroll was too heavy, sometimes it took about five days to finish running the payroll; the Oracle was bulky. Therefore, they wanted to take out GES into another payroll system and run it separately. They brought the GES …. So, at that time, there were many errors, [because] moving in between [the] Oracle platform, IPPD3, and our system's MySQL was a hell of a problem.'

For six months, IPPD3 could not generate salary payment vouchers because it did not have that functionality. As Jayson said, '[…] that compounded the problem and also brought us another opportunity. CAGD expected us to generate payment vouchers from IPPD3, as we did from

the central Oracle payroll system. So, we wrote another code to receive and structure the data from IPPD3 and so that we can generate payment vouchers for GES, and it went well.' KariTech made several further improvements to ESPV. Jayson explained that, first, 'we have merged ESPV and e-payslips such that one who wants to register for e-payslip must go to his head of department, who would generate a code on the ESPV for the fellow. It is a mechanism to verify [whether] that person is government staff and whether his head knows him or not.' Second, KariTech was able to link up with financial service providers who give credit facilities to government employees. Jayson further noted that 'we are linking up with those who take facilities and loans. We have another platform called the TPRS, which is now in Africa very well known.'

Figure 5.5: Electronic Salary Validation Process using ESPV



Source: Author's illustration

Table 5.2 summarises the activities and artefacts used to give and make sense over the phases of the e-salary voucher project.

Table 5.2: Sensegiving and Sensemaking Activities and Artefacts in E-Payment Voucher Project

Phases	**Activities**	**Artefacts**
Problem Definition	1. Meeting with Controller 2. Presentation of solution to CAGD directors 3. CAGD's evaluation of solution 4. CAGD's inclusion of solution in budget plan 5. CAGD preparation of proposal to Minister of Finance 6. Budget justification workshops with Ministry of Finance 7. Parliamentary scrutiny and approval	1. Initial system prototype 2. Budget plan and proposal
Analysis	1. Management unit clean-up at Korle-Bu 2. Restructuring of government management units 3. Incorporation new suggestions into system design	1. Report of Korle-Bu management unit clean-up
Development	1. Creation of final system	
Implementation	1. Justification to Public Procurement Authority (PPA) 2. Obtaining approval from PPA 3. Tendering of processes	1. Budget plan and proposal 2. Tendering of documents

Source: Author's Illustration

5.6 The Third-Party Referencing Project

5.6.1 Problem Definition Phase

Two problems necessitated the creation of TPRS. First, companies offering loan facilities and people taking facilities did not know their thresholds, but now 'they walk into a bank, and the bank knows how much they earn'. Second, some people impersonated others, which was made possible by easy accessibility to paper payslips. Unfortunately, the victim might only realise this from the net salary she receives, but would not have a payslip to verify this from.

5.6.2 Development Phase

KariTech developed the TPRS such that a loan applicant must generate some mandate authorising a third-party company to access their financial information on the e-payslip system. With the mandate, KariTech can check your personal and credit information. The system will also automatically link up through an Application Programming Interface (API) onto the payroll, so that all deductions will go onto the payroll. This solved the problem in which, through the use of third parties, people could take out multiple loans without observing regulations.

5.6.3 Implementation Phase

The Auditor-General's Department was pleased because they were able to take significant quantities data from KariTech's systems through a purpose-built interface. 'We have an interface for the auditors; they can pick any management unit, pull out the data, walk to that management unit, and say "Kwesi, where are you, Kwame, Akos, where are you?"' Jayson said. Similarly,

> 'The Ministry of Finance can also quickly go online and generate a report on what happened last month. Before the ESPV, you could not do that. You can

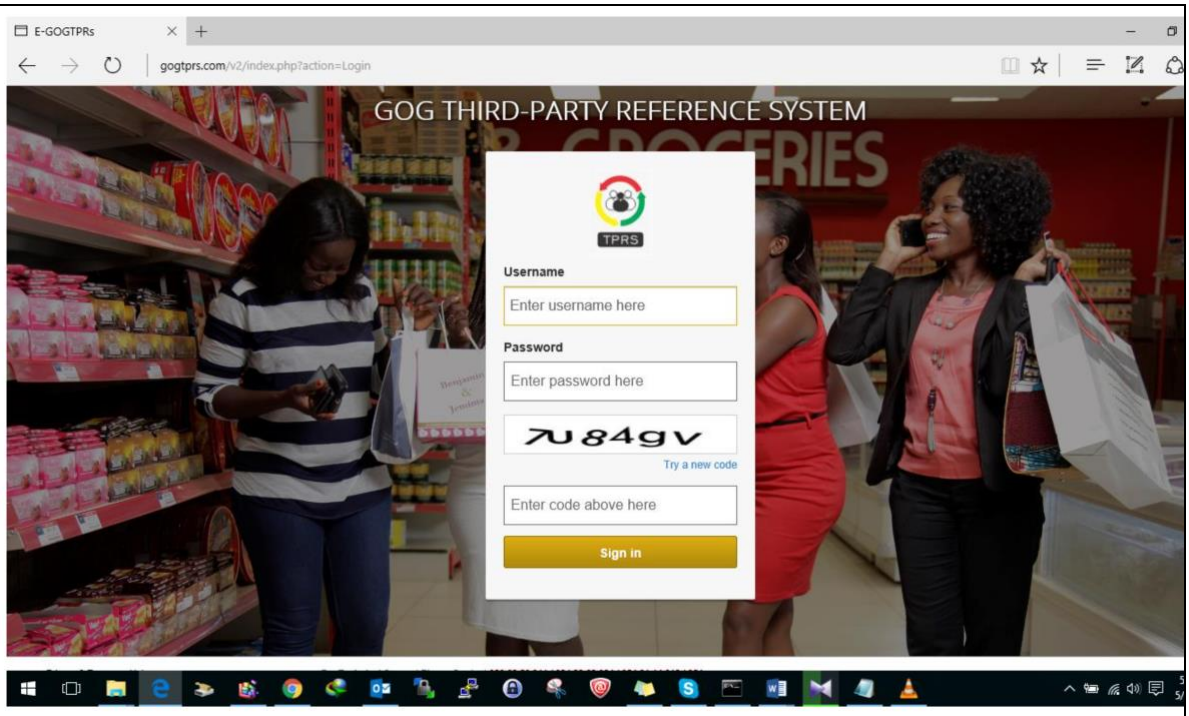
> now go through what we call the ministerial port, and it can tell you how many people were paid in, say, Ashanti region, so that you can know government expenditure on the payroll just by one click of a button. Management can log in and know the payroll structure and drill down to every management unit.'

In short, ESPV is now able to hand out the real cost of paying employees, and that information is communicated back to GIFMIS so that the appropriate budget can be allocated. One can easily make monthly financial predictions and prepare accordingly. Through the addition of this feature, 'we saved government [a total] of over 100-and-something million Ghana cedis', Jayson noted.

> 'Assuming I go on retirement, [by] the time the data comes to me, that this man is retired or a person dies in a particular management unit and stays on the payroll for six months before the voucher will come back to the controller and say "You have lost six months of salary." If that person is taking GHS 1,000, that is GHS 6,000; multiplied by 100 people, that is GHS 600,000. So that is the calculations we did, and the first year we realised that over 100-and-something million Ghana cedis were saved [by the] government. That could have been about 13 million dollars. Every month, the ESPV could churn out 800, 1,000 people as people who are either dead or have abandoned their posts.'

KariTech is also bracing itself to accommodate the newly created regions. 'Our system is built such that it is modular. So, we do it such that if today we need to create a new region, [we] go in there and create a new region.'

Figure 5.6: TPRS Login Page



Source: TPRS website

Table 5.3 summarises the activities and artefacts used to give and make sense over the phases of the TPRS project.

Table 5.3: Sensegiving and Sensemaking Activities and Artefacts in TPRS project

Phases	**Activities**	**Artefacts**
Problem Definition	1. Meeting with Controller 2. Presentation of solution to CAGD directors 3. CAGD's evaluation of solution 4. Meeting with third-party service providers	1. Initial system prototype 2. Budget plan and proposal
Analysis	1. Incorporation of third-party's suggested needs into system design	
Development	1. Creation of final system	
Implementation	1. Training workshops for third-party providers 2. Sensitisation of government employees	3. TPRS user manual (see Appendix)

Source: Author's Illustration

In summary, two main factors helped KariTech unify the interests of multiple stakeholders: the first is political, and the second is technical. Technically, the previous government saw that KariTech's proposed system was sound and could save the government money. Therefore, they had no good reason to discontinue it. Politically, KariTech has some affiliation with the current government. Moreover, it may have been difficult for the other political party to cancel the contract, as this project was started when they were in power. Further, several foreign companies and donor agencies that have attempted to wrest the contract from KariTech have failed because, as Jayson explained,

> 'We had incubated the system in our minds and went through a long process to implementation; if you want to come, you will take even more, because you will find it challenging to get [the] controller to assist you because there is no justification why they should procure a new system to do what an existing one already does.'

Table 5.4: Summary of Sensegiving and Sensemaking Activities and Artefacts of CAGD Case Studies

Projects / Phases	**E-payslip project**		**E-voucher project**		**TPRS project**	
	Activities	**Artefacts – Evidence of MU**	**Activities**	**Artefacts**	**Activities**	**Artefacts**
Problem Definition	1. Initial interaction with project owners to establish mutual objectives (planned and unplanned) 2. Demonstration of initial prototype 3. Presentations to Controller, directors, and CAGD technical staff	1. Presentation slides 2. Initial prototype for proposed system	1. Meeting with Controller 2. Presentation of solution to CAGD directors 3. CAGD's evaluation of solution 4. CAGD's inclusion of solution in budget plan 5. CAGD preparation of proposal to Minister of Finance 6. Budget justification workshops with Ministry of Finance 7. Parliamentary scrutiny and approval	1. Initial system prototype 2. Budget plan and proposal	1. Meeting with Controller 2. Presentation of solution to CAGD directors 3. CAGD's evaluation of solution 4. Meeting with third-party service providers	1. Initial system prototype 2. Budget plan and proposal
Analysis	1. Review of old payslip 2. Informal consultations to further understand payroll functions	Old payslip	1. Management unit clean-up at Korle-Bu 2. Restructuring of government management units 3. Incorporation new suggestions into system design	1. Report of Korle-Bu management unit clean-up	1. Incorporation of third-party's suggested needs into system design	
Development	1. Receive test data from CAGD 2. Initial runs of electronic payslip system	1. Non-disclosure agreement 2. Sample electronic payslip	1. Creation of final system		1. Creation of final system	
Implementation	1. Training of CAGD trainers of trainers who will implement further training 2. Distribution of access codes across districts 3. Monthly review meetings between KariTech and CAGD payroll staff	1. New payslips accessible online (see Figure 5.4) 2. SMS notifications sent to government employees 3. User manual 4. Explainer video on e-payslip website	1. Justification to Public Procurement Authority (PPA) 2. Obtaining approval from PPA 3. Tendering of processes	1. Budget plan and proposal 2. Tendering of documents	1. Training workshops for third parties 2. Sensitisation of government employees	1. TPRS user manual (see Appendix)

Source: Author's Illustration

5.7 Chapter Summary

This chapter has presented the case description and analysis to illustrate the structures and mechanisms that underpin the creation and sustenance of mutual understanding in the development and implementation of the GIFMIS payroll add-on systems in Ghana. These elements aim to answer the questions posed by this research in order to meet its objectives. The cases were explored as multiple subcases within one institution (GAGD). In all, three sub-cases were presented: the electronic salary payment voucher, electronic payslip, and the third-party referencing system.

A summary on findings of this chapter (sensegiving and sensemaking activities, and artefacts of the CAGD cases) is presented in Table 5.4 in this chapter.

5.7.1 Preliminary Findings from the Case Study

The client needs to make sense of the project before an IT team is engaged. This is an ideal state; usually, a client can have a partial sense of what is needed, but requires interaction with external consultants or experts to develop a better picture of the required solution. Thus, the client's ability to give sense about needs and the consultants' ability to make sense of the client's needs influence the creation of mutual understanding.

It is likely that the client may not have a full understanding of the overall needs for the system, but through sensegiving/sensemaking with the IT team (consultants) and other stakeholders, the project may better be understood, and this may be communicated through a broad statement of objectives.

Analysis of system requirements in consultation with users becomes a mechanism for the sensegiving/sensemaking needed to develop a system requirements document.

Artefacts or codified documents such as a broad statement of objectives, contract for development, systems requirement document, user guides, training documents, and others are potential evidence of formal creation of mutual understanding within a collective or an organisation. These items can also serve as a control mechanism to ensure that specific goals concerning the project are met.

Project meetings, user engagement workshops, and prototype demonstrations are examples of conversational mechanisms and/or activities which facilitate episodic moments where sense is made by different actors, both at the individual level and at the team or organisational level.

CHAPTER 6: DISCUSSION OF FINDINGS AND CONTRIBUTIONS TO LITERATURE

6.1 Chapter Overview

The purpose of this study is to develop a framework to explain the creation and sustenance of mutual understanding between stakeholders in the development of IOFMS in a developing economy. This chapter draws on sensemaking theory to analyse the three case projects presented in Chapter Five in order to unearth the triggers, processes, outcomes, and influencing factors that underpin the creation and sustenance of mutual understanding in IOFMS. The case projects are the electronic salary payment voucher, electronic payslip, and the third-party referencing system. This chapter opens with a presentation of evidence from the case projects to verify the occurrence of interoperability, both definitionally and thematically. Following the verification, the sensemaking mechanisms, i.e. the triggers, processes, outcomes, and influencing factors, observed in the case projects are unearthed.

6.2 Phenomenon Verification

This section presents a recap of interoperability concepts and definitions. The recap provides a structure to guide the verification of the empirical evidence that was collected during the field work conducted as part of this study in order to demonstrate the occurrence of interoperability. The verification consists of two parts: definitional and thematic verification. The definitional verification uses the empirical evidence to illustrate concepts in existing definitions of interoperability, whereas the thematic verification uses the empirical evidence to illustrate the key characteristics and meanings of interoperability.

6.2.1 Definitional Verification

In Section 2.2, the concept of interoperability was discussed from three main definitional perspectives: technology, organisation, and techno-organisation. From the technological perspective, interoperability is viewed as the ability of **two or more systems or elements to exchange information** among themselves and **to use the exchanged information (**IEEE, 2000). From the organisational perspective, interoperability is defined as the capacity of **equipment units to work together** to accomplish **useful functions**. The techno-organisational perspective tends combine both the technological and organisational perspectives of interoperability. In the empirical evidence presented in Chapter Five, interoperability is manifested between the Ghana Integrated Financial Management System (GIFMIS) and the three newly developed systems, i.e. the e-payslip, e-voucher, and third-party referencing systems. First, in terms of the technological perspective, the three newly developed systems receive data from and share data with an existing database managed by GIFMIS. Second, in terms of the organisational perspective, the three different systems are hosted on different servers (hardware). These servers work together to accomplish the functions of the Controller and administer the payroll of the managing government. Third, in terms of the techno-organisational perspective, GIFMIS is supplied and maintained by Oracle, whereas the three new add-on systems run on the Microsoft Navision platform. The ability of different systems from difference vendors to work together suggests their interoperability.

Table 6.1 summarises the three perspectives on interoperability and the illustrative evidence gathered during field data collection activities of this study.

Table 6.1: Perspectives on Interoperability: Definitions and Empirical Illustrations

Definition of Interoperability	Empirical Illustration from the Case Studies
Technology Perspective	
The ability of two or more systems or elements to exchange information among themselves and to employ the exchanged information	Three new systems were developed in this study: the e-payslip, e-voucher, and third-party referencing system. These systems receive data from and share data with an existing database managed by GIFMIS.
The ability of two or more systems or components to exchange information in a heterogeneous network and to use the information	The three newly developed systems exchange information seamlessly with GIFMIS even though the information is generated heterogeneously.
Organisational Perspective	
The capacity of equipment units to work together to accomplish useful functions	The three different systems are hosted on different servers (hardware). The servers work together to accomplish the functions of the Controller and administer the payroll of the managing government.
Techno-organisational Perspective	
The capacity, which is promoted but not guaranteed by the adhesion to a set of standards, that enables heterogeneous equipment, usually manufactured by several suppliers, to work together in network environment	GIFMIS is supplied and maintained by Oracle, whereas the three new add-on systems run on the Microsoft Navision platform. The ability of these different systems from difference vendors to work together suggests their interoperability.
Interoperability occurs when heterogeneous or independent information systems of different agencies, jurisdictions, departments, administrations, or external partners work together (exchange information) efficiently and effectively in a predefined or agreed-on fashion (Tripathi *et al.*, 2012)	The input data for the e-voucher system comes from multiple government ministries, departments, and agencies (MMDAs) when their head or directors validate the payroll information. The E-payslip system then uses the validated information to generate the payslips of all the employees in the various MMDAs. The three systems work with GIFMIS to ensure efficient and effective data input, verification and processing.

Source: Author's Illustration

6.2.2 Thematic Verification

The previous section illustrated definitions and perspectives of interoperability with references to the empirical case study evidence. This section extends the illustration based on meanings of interoperability posited by various scholars, which form the themes in interoperability research (see Table 2.1). In reference to Chapter 2, the identified themes include *dimensions*, *perspective*, *levels of attainment*, and *domains and applications*. The *dimensions* theme relates to the technological adoption space of studies on platforms. The sub-themes of *dimensions* are **data** integration, which refers to the combination of data from different sources and the provision of a unified view of this data to users (Halevy, 2001); **process** integration, which refers to the integration of different processes that are developed for respective government

organisations (Tripathi *et al.*, 2012) or the different processes that are developed to facilitate interoperability (Halevy, 2001); **communication** integration, which refers to the use of electronic computers, computer software, and computer networks to convert, store, protect, process, transmit, and securely retrieve information (Vernadat, 2010); and **multi-dimensionality**, which refers to papers that discuss more than one technological adoption space.

The *perspective* theme relates to the perspectives on the solutions that have been developed. Its sub-themes are the **service orientation** and **database** perspectives (Rezaei *et al.*, 2014; Weichhart *et al.*, 2018). The former focuses on processes and functions developed as serviceable resources, while the latter considers the contribution of interoperable platforms to the provision of services based on the storage and manipulation of data.

The *levels* theme relates to the levels at which interoperability can be attained and at which it requires resolution (Morris *et al.*, 2004; Munk, 2002). It has four sub-themes: technical, syntactic, semantic, and organisational interoperability. **Technical interoperability** refers to hardware or software components, systems, and platforms that enable machine-to-machine communication and that are focused on communication protocols and the infrastructure required for those protocols to function (Rezaei *et al.*, 2014; Van der Veer & Wiles, 2008). **Syntactic interoperability** refers to the ability of two systems or platforms to exchange data, and it is usually associated with message transfer by communication protocols as well as defined syntax and encoding (Rezaei *et al.*, 2014; Van der Veer & Wiles, 2008). **Semantic interoperability** is normally related to the definition of content, and it deals with the interpretation of this content by humans rather than machines. **Organisational interoperability** refers to the capability of organisations to effectively communicate and

transfer information despite using a variety of information systems across significantly different types of infrastructure and possibly across various geographic regions and cultures.

Table 6.2: Themes and Sub-themes of Interoperability - Empirical Illustration

Interoperability Theme	Sub-Themes	Empirical Illustration from the Case Studies
Dimensions	Process integration, i.e. different processes that are developed to facilitate interoperability (Halevy, 2001)	Automation of the payment voucher validation process
	Data integration, i.e. the combination of data from different sources and the provision of a unified view of this data to the users (Tripathi *et al.*, 2012)	Integration of the ESPV data directly into the payroll
	Communication integration, i.e. the use of electronic computers, computer software, and computer networks to convert, store, protect, process, transmit, and securely retrieve information (Vernadat, 2010)	Creation of an API to delete unverified personnel
Perspective	Service-oriented perspective, i.e. processes and functions developed as serviceable resources (Rezaei *et al.*, 2014; Weichhart *et al.*, 2018)	Access to payslips via an online portal
	Database perspective, i.e. the contribution of interoperable platforms to the provision of services based on the storage and manipulation of data (Rezaei *et al.*, 2014; Weichhart *et al.*, 2018)	Unified database to access historical information, e.g. loan transactions – TPRS, across platforms; payslip information and validated payroll data
Levels of Attainment	Technical interoperability, i.e. hardware and software, systems, and platforms that enable interoperability (Rezaei *et al.*, 2014; Van der Veer & Wiles, 2008).	ORACLE and Microsoft Navision
	Syntactic interoperability, i.e. communication protocols, syntax, and encoding that enable two platforms to exchange data (Rezaei *et al.*, 2014; Van der Veer & Wiles, 2008)	APIs for interoperability
	Organisational interoperability, i.e. the capability of organisations to effectively exchange information across diverse information systems and various geographic regions and cultures (Rezaei *et al.*, 2014; Van der Veer & Wiles, 2008)	Realigning the manual business process to the automated business process
	Semantic interoperability, i.e. the definition of content and the interpretation of this content by humans rather than by machines (Rezaei *et al.*, 2014; Van der Veer & Wiles, 2008)	User manuals, explanatory videos
Domains & Applications	e-Government, i.e. heterogeneous or independent information systems of different government agencies, jurisdictions, departments, administrations, and external partners work together (exchange information) efficiently and effectively in a predefined or agreed-on fashion (Tripathi *et al.*, 2012)	Public sector payroll management

Source: Author's Illustration

6.3 Unearthing Sensemaking for Mutual Understanding

The purpose of this study is to develop a framework to explain the creation and sustenance of mutual understanding between stakeholders in the development of an IOFMS in a developing economy. Sensemaking theory is employed to explore the structures and mechanisms that underpin the creation and sustenance of mutual understanding in an IOFMS, in particular, the payroll add-on systems in the public sector of Ghana. According to sensemaking theory, sensemaking is comprised of specific episodes, is triggered by ambiguous events, occurs via specific processes, generates specific outcomes, and is influenced by situational factors (Sandberg & Tsoukas, 2014). Using the sensemaking theory, the study proposed a conceptual framework of achieving mutual understanding within the information systems development cycle (Figure 3.4). Based on this framework, the analysis in this study therefore aims to unearth the triggers, processes, and influencing factors in the creation and sustenance of mutual understanding between stakeholders in the development of IOFMS in a developing economy.

6.3.1 Triggers for Creating and Sustaining Mutual Understanding

Triggers are the first aspect of creating and sustaining mutual understanding. They are conditions that motivate organisational actors to engage in sensegiving (Maitlis & Lawrence, 2007). Conditions such as ambiguity, insecurity, and contradictions thus create a need for sensegiving (Weick, 1995). Contradictions, for instance, are conditions with at least two opposing, consistent descriptions. In the presence of contradictions, opposing parties need to engage in sensegiving to comprehend each other. Other triggers include the perception or anticipation of a sensemaking gap, discursive ability, and process facilitators (Maitlis & Lawrence, 2007). According to Sandberg and Tsoukas (2014), these triggers may be a major planned event, major unplanned event, minor planned event, minor unplanned event, or a hybrid of these types of events.

In this study, we observed minor and major planned events across three information systems development case projects whose success hinged on sensemaking and mutual understanding. The triggers varied with respect to the two parties, i.e. the developer and the client. For instance, defining the need for the e-payslip system was a minor planned event for the developer but proved to be a major unplanned event for the client. For the developer, this project was a minor event because as a first project, it was an opportunity to demonstrate their capacity to develop a more comprehensive system for the client in the future. That is, the developer viewed this project an audition for a larger project. Moreover, the e-payslip project was planned in that the developer saw it as the first step in an larger, overall goal: the developer reasoned that if he could address challenges of e-payslip system (for which he considered minor), he could continue pitching projects until the projects he actually wanted to develop were awarded to him. While Sandberg and Tsoukas (2014) identify the severity of triggers as major or minor, they are silent on the possible interactions between these types of triggers. For example, in the e-payslip case study, what started out as a minor trigger in the problem definition stage became a major planned trigger as the project matured in the analysis, development, and implementation stages. This change may have resulted from the developer's need to deliberately plan and deliver the intended outcomes of those stages of ISD. Moreover, the need became a more apparent, more immediate organisational priority through the engagement and interface between the client and the developer. This observation suggests the following findings:

> ***Finding 1a:*** *In the development of an IOFMS in the public sector, a mix of major planned and unplanned events tends to trigger organisational actors to engage in sensemaking and sensegiving activities. These events may originate from either internal*

contradictions and ambiguities or an external stimulus. This finding echoes the arguments of Sandberg and Tsoukas (2014).

Finding 1b: *In the development of an IOFMS, the triggers of sensemaking and sensegiving activities may not become apparent until an interface or engagement occurs between the organisation and the external stimulus, activity, or actor.*

Finding 1c: *Although triggers of sensemaking and sensegiving activities may already be major at the inception of a project, they nevertheless tend to increase in severity as the project progresses to meet the demands of later stages/phases of the interoperable systems development process.*

Findings 1b and 1c draw out the relationships between sensemaking triggers—the visibility of triggers and the influence of time on the severity of triggers. Some triggers only become apparent when an organisation interfaces with an external entity, and the severity of triggers tends to increase over time. Though the sensemaking literature has not emphasised these findings, extant IS studies have shared related findings. In a study on the development of e-commerce capabilities, from a critical realist perspective, Boateng (2016) demonstrated how triggers of the development of three different capabilities changed over time, yielding benefits of higher value.

Further, Findings 1a–1c suggest that the expected deliverables that emanate from the sensemaking in a previous ISD stage tend to trigger the need for new sensemaking with higher severity in subsequent ISD stages. That is, if an ISD stage triggered by a major planned event is completed, the subsequent stage must necessarily be *planned* so that the actors' expectations

can be met. The new expectations can only be met if all parties share a common understanding, i.e. if sensemaking occurs and mutual understanding is obtained. Hence, this observation suggests the following finding:

> ***Finding 1d:*** *In the development of an IOFMS, project stages/phases and their mutually agreed deliverables serve as triggers for sensemaking in subsequent phases of the project.*

Project phases and mutually agreed deliverables can serve as triggers because of their use as project control mechanisms. The relevance of project control mechanisms in ISD has been echoed by Jenkin *et al.* (2019). Artefacts or codified documents such as broad statements of objectives, contracts for development, systems requirement documents, user guides, and training documents serve as potential evidence of the formal creation of mutual understanding within a collective or an organisation. Such documents can serve as control mechanisms for subsequent activities and can ensure that specific goals concerning the project are delivered or met. This understanding of ISD project phases as control mechanisms is distinct from the findings of previous studies, which identified triggers such as ambiguity, insecurity, and contradictions (Weick, 1995) or the perception or anticipation of a sensemaking gap, discursive ability, and process facilitators (Maitlis & Lawrence, 2007).

Unlike for the developer, the problem identification of the e-payslip project was a major event for the client because the proposed project had the potential to solve an enormous problem in the CAGD. Through such a programme, government employees would receive their payslips punctually and confidentially, without the cost of physically transporting them and thereby adding to existing piles of documents in district government offices. Even though the initiation

of the project was a major event, it was unplanned and unexpected. The department actor had recognised the existence of the payslip problem but had not allocated any resources to resolve it because no solution was apparent. Interestingly, the subsequent project stages were nevertheless major *planned* events. This observation provides further internal corroborating evidence for Finding 1, project stages and their mutually agreed deliverables serve as triggers for sensemaking in ISD projects.

To further explore Findings 1a–1d, we pursue an explanation of why and how unplanned events (or triggers) mutate into planned events. As intimated earlier, an event is considered planned when the planner has allocated specific resources for it. For instance, if Controller and Accountant-General's Department had planned to develop the E-payslip system, they would have budgeted for it and even sought parliamentary approval, possibly even before the problem identification. According to the case description in this study, such initial planning and resource allocation did not occur; instead the Department *marshalled* the necessary resources over the course of the project to achieve its successful implementation. Two findings emerge from this observation. First, the initial presentation ('a form of sense') that the developer gave to the Department offered or became a *golden trigger* for sensemaking of the Department and its action in marshalling the necessary resources. The trigger was golden in that the initial sense presented an opportunity to solve a lingering problem. Second, there were not any insecurities, any contradictions (Weick, 1995), or a sensemaking gap (Maitlis & Lawrence, 2007); rather there was pure positive anticipation that a back-breaking burden could be lifted from the Department. This observation leads to Finding 1e:

> ***Finding 1e:*** *Sensegiving that promises to solve another actor's problem has the potential to be a golden event that mutates unplanned events into planned events, as the receiving actors allocate needed resources for the success of the project*.

The next section analyses and discusses the processes of creating and sustaining mutual understanding.

6.3.2 Processes for Creating and Sustaining Mutual Understanding

Processes are the second aspect of creating and sustaining mutual understanding. The reported processes include noticing, bracketing, labelling, retrospection, presumption, and action (Weick *et al.*, 2005), and defining, explanation, developing, and demonstration (Stigliani & Elsbach, 2018). The analysis in this study is based on three aggregate processes involved in sensemaking that create and sustain mutual understanding. The first process is *creation*, which involves grouping, noticing, and extracting cues from the lived experience of an interrupted situation (Weick, 1995). For instance, some non-profits are reported to have *created* sense by using outcome-oriented creation strategies and symbolic strategies to attract funding from governments and private donors (Levine Daniel & Eckerd, 2019). Analysis of the case projects in this study reveals three aggregated creative mechanisms for creating and sustaining mutual understanding in interoperable systems development projects in government settings: *Sense Integration*, *Data Integration*, and *Developing and Distributing New Data/Information for Use*. This revelation underlies the following finding:

> ***Finding 2a:*** *During sense creation in interoperable systems development projects, the sense of the actors is integrated, existing data is integrated into the newly developed system, and new data or information is developed and distributed for use. The creation mechanisms are thus Sense Integration, Data Integration, and Developing and Distributing New Data/Information for Use.*

To better understand the creation mechanisms, it is necessary to explain their occurrence. First, Sense Integration describes how project stakeholders or actors give and receive sense from one another, eventually obtaining a unique blend of sense that is acceptable to all sides. In the three case projects, the developer and client generally divulge their ability and expectations, respectively, during the problem definition stage. In this initial stage, the primary first-order sensemaking mechanism observed in the three case projects is the interaction between the developer and the senior management. Only the third-party referencing system project created a need for other stakeholders, i.e. the vendors who provide services to government employees. The interaction and meeting sessions create an avenue for all stakeholders to group, notice, and extract cues from the lived experience of an interrupted situation (Weick, 1995). Here, the interrupted situation is the existing way of producing and dispatching payslips and government payment vouchers and of receiving and processing third-party vendor deduction claims. As each stakeholder may have distinct expectations and understanding or *senses* of the project, such interactions and meetings are necessary to achieve the *integration* of the senses. This observation informs the sub-finding that

> *In the course of interoperable systems development projects, different stakeholders tend to share their peculiar senses to achieve an integrated sense that leads to the creation of mutual understanding.*

In this study, no Creation mechanism was observed in the Analysis stage. One plausible explanation for the absence of a Creation mechanism is that this ISD activity is quite technical and would often be undertaken by the developer. The outcomes of the analysis provide information about the modules, users, and data structures that should be included in the upcoming system for the client. Hence, there is little room for the exchange and merging of senses.

In the second aggregated Creation mechanism, Data Integration, we include activities intended to incorporate existing client data into the system that has been newly developed by the developer. This aggregated mechanism was observed in the development stage during the systems development cycle of the projects. In this stage of ISD projects, a developer *integrates* existing *data* into the new system to verify compatibility. For instance, some existing employee data was fed into the new e-Payslip system database to test its ability to generate electronic payslips for the listed employees. This was also the case for the other two projects. Hence, we aggregated these instances to obtain *Data Integration*. This observation and the aggregation of the cases inform the finding that

> *In the course of interoperable systems development projects, existing datasets tend to be integrated into upcoming systems to verify their compatibility and usability.*

The third Creation mechanism is Developing and Distributing for Use. It was observed at the project implementation stage. This mechanism comprises the formation and dispatch of data or information in a new form that is needed for the successful operation of the new system. For instance, access codes were created and distributed for government employees to access the e-payslip system. Similarly, government management unit heads were informed about the new e-voucher system, while the access of third-party vendors to the third-party referencing system was authenticated to ensure secured access. These new forms of information are the result of previous sensemaking and the established mutual understanding. In this way, this mechanism can function as a form of feedback that solidifies the initial mutual understanding among the project actors. This observation suggests the sub-finding that

> *In the course of interoperable systems development projects, new forms of data and information tend to be developed and distributed to clients for use purposes and to reaffirm the established mutual understanding.*

Table 6.3 illustrates the foregoing discussion of first-order mechanisms and aggregated mechanisms for the creation of sensemaking for mutual understanding during interoperable systems development.

Table 6.3: First-order and Aggregated Codes for Creation Mechanisms

ISD Stage	First-order Creation Mechanisms			Aggregated Creation Mechanisms
	e-Payslip Project	*e-Payment Voucher Project*	*Third-Party Referencing System Project*	
Problem Definition	Senior management interaction	Senior management interaction	• Senior management interaction • Meeting with Third-party service providers	Integration
Analysis	–	–	–	–
Development	Receive and incorporate test data from CAGD	Receive approval for pilot testing	Receive and incorporate test data from CAGD	Data Integration
Implementation	Distribution of access codes across districts	Communication of new electronic voucher system to government management unit heads	Authentication of access to Third-party service providers	Developing and Distributing for Use

Source: Author's Illustration

The process following Creation is Interpretation. The Interpretation process involves elaborating on the initial sense generated in the creation process and developing it into a more complete, narratively organised sense of the interrupted situation. For instance, during the development of a new product, prototypes can be developed to increase customer involvement and achieve higher success for the product (Tih, Wong, Lynn and Reilly, 2016). In this study, five Interpretation mechanisms—*prototyping, joint reviewing, consultation, testing,* and *training*—were observed across the systems development lifecycle stages. This informs the following finding:

Finding 2b: *In the course of interoperable systems development projects, actors tend to use interpretation, through prototyping, joint reviewing, consultation, testing, and*

training, to elaborate on the initial sense in order to achieve an organised sense of the project situation.

We further discuss each of these aggregated mechanisms. First, Prototyping was observed in the problem definition stage of all three case projects. Prototyping allows for the rapid development of a virtual model of the proposed system that possess attributes, aesthetics, usability, and quality almost identical to that of the finished product (Wang, 2002). In the problem definition stage in information systems development projects, when a non-technical client is less knowledgeable about system requirements, the developer may present either a working or non-working prototype to solicit the client's requirements (Kendall & Kendall, 2010). The prototype invariably reflects the developer's *sense* of the client's expectations, thereby also eliciting any further sense that the client wants to convey to the developer. The sensegiving and sensemaking that ensue in response to presented prototype are more organised and help the actors to make meaning from the project situation, which is expected for Interpretation. Without a prototype, sensegiving and sensemaking may be less organised and even unstructured and haphazard. A prototype presents issues around which actors can give, take, and make sense, leading towards a mutual understanding of how the final product should be. This observation informs the sub-finding that

In the course of interoperable systems development projects, actors tend to use prototyping in the problem definition phase to elaborate on the initially made sense.

Joint Reviewing and Consultations were observed jointly as mechanisms used in the analysis phase of the case study interoperable systems development project. During Joint Reviewing, project actors co-examine the existing artefacts and data and especially the business processes to determine how to account for them in the new system. Sometimes improved versions are

introduced into the new system. For instance, paper payslips were formerly dispatched by road to government employees across Ghana. This business process was reviewed and improved to instead utilize Electronic Payslips that can be readily accessed electronically by government employees. The developer consulted the client's payroll department to gain a deeper *sense* of the function of the payroll department and of the specific departmental expectations for the proposed e-payslip system. These observations suggest the sub-finding that

> *In the course of interoperable systems development projects, actors tend to use joint reviews and consultation in the analysis phase to elaborate on and develop the initially established sense.*

Testing was observed as the third Interpretation mechanism and was used in the development phase of the case study interoperable systems development project. During the development phase, the developer finalises the actual system and prepares to make it available to the client. The Testing mechanism observed here thus involves a trial of the system by actual users from the client side; this typically occurs after the developer has also completed an in-house trial. The Testing mechanism confirms the senses established in the previous systems development phases. After testing, the developer obtains clarity regarding the client's satisfaction, while the client provides feedback about the acceptability of the project. Here, the sensegiving and sensemaking are more concrete and are nearing completion. This observation forms the basis of the sub-finding that

> *In the course of information systems development projects, the actors tend to use testing in the analysis phase to obtain feedback and establish satisfaction levels.*

Training was observed as the fourth Interpretation mechanism and was used in the implementation phase of this interoperable systems development project. In this stage, the

sense that is given and made is oriented toward equipping the end-users with the skills and knowledge needed for proficient use of the newly implemented system. Training is an important Interpretation mechanism because it enables subordinate users to acquaint themselves with the senses that were given and made between the developer and senior management throughout the systems development cycle. The end-users also have the opportunity to give and make sense by asking questions, soliciting help, and receiving instructions from the training facilitators. We thus obtain the sub-finding that

> *In the course of information systems development projects, training is used to pass on the established high-level senses to the end-users on the client side.*

Table 6.4 illustrates the foregoing discussion of the first-order mechanisms and aggregated mechanisms for interpretation in sensemaking to create mutual understanding during information systems development.

Table 6.4: First-order and Aggregated Codes for Interpretation Mechanisms

ISD Stage	**First-order Interpretation Mechanisms**			**Aggregated Interpretation Mechanisms**
	e-Payslip Project	*e-Payment Voucher Project*	*Third-Party Referencing System*	
Problem Definition	Prototyping	Prototyping	Prototyping	Prototyping
Analysis	• Review of old pay slips • Informal consultations to further understand payroll functions	• Review of old payment vouchers • Consultations to further understand payment voucher processes and procedures	• Review of old third-party business processes • Gathering requirements from third-party service providers and CAGD management	• Joint Reviewing • Consultations
Development	Initial runs of the electronic payslip system	Pilot testing at the microcosmic management unit	Initial runs of the third-party referencing system	Testing
Implementation	Training of CAGD trainers of trainers who will implement further training	• Training of CAGD staff • Training of third-party service providers • Training of government employees	• Training of CAGD staff • Training of third-party service providers • Training of government employees	Training

Source: Author's Illustration

The final process is Enactment. It involves acting on the more complete sense made of the interrupted situation in order to determine the extent to which it restores the interrupted activity. During this process, individuals interactively undertake actions that constitute a "collective reflection-in-action" cycle through which an information systems design emerges as the result of actors producing, sharing, and reflecting on explicit objects. Further, the actors use available means to either "add to," "ignore," or "challenge" the work produced by others (Levina, 2005). Hence, there is the need to consolidate the newly implemented systems; otherwise they may be abandoned, especially when they challenge the status-quo. In this study, four enactment mechanisms that were identified across the information systems development lifecycle inform the main finding that

> ***Finding 2c:*** *In the course of interoperable systems development projects, actors tend to use enactment, through formalisation and institutionalisation, the establishment of consent, illustration/demonstration, and documentation to reduce or remove the potential for actors to revoke, undermine, subvert, or weaken the sense has been made or the mutual understanding that has been established.*

Formalisation, which happens in the problem definition stage, involves making initial presentations to actors such as senior management to formally inform them about and seek their consent for an intended project. Clearly, no project can be initiated without the consent of the senior management on the client side. This mechanism establishes the project as a formal endeavour within the client's premises. Next, in the development stage the developer presents the completed system to the client to demonstrate the technical completion of the project in anticipation of the final delivery. When illustration and demonstration are at play, both parties may sign non-disclosure agreements to protect their data, investments, and intellectual property. Demonstration of the final system also allows the client to experience the output of

the new system, e.g. an employee payslip in the e-Payslip project or an electronic voucher in the e-Payment Voucher project.

Third, documentation involves codifying project knowledge in accessible form for future reference and providing instructional guidelines for system operations, advisory information, and a legal record of the events or agreements. This mechanism was observed in the implementation stage during which the new system was deployed and put into production. Therefore, the client was given training manuals and user manuals to guide the system operations. For documentation, regular review meetings may also be organised to familiarise the developer with any client-side system problems that they can subsequently solve. In the case of the third-party referencing system, electronic notifications—a form of advisory documentation—are sent to government employees so that they can authorise intended deductions by third-party vendors from their salary. In sum, documentation helps actors give and make sense around the new ways of operating with the new system. Actors can thereby settle on a mutual understanding of the new system as a replacement for the interrupted situation, i.e. the old business processes.

Table 6.5 illustrates the foregoing discussion of the first-order mechanisms and aggregated mechanisms for enactment in sensemaking to create mutual understanding during information systems development.

Table 6.5: First-order and Aggregated Codes for Enactment Mechanisms

ISD Stage	First-order Enactment Mechanisms			Aggregated Interpretation Mechanisms
	e-Payslip Project	*e-Payment Voucher Project*	*Third-Party Referencing System*	
Problem Definition	Senior management consent	Senior management consent	• Senior management consent • Presentation to third-party service providers	• Formalisation and Institutionalisation • Establishing Consent
Analysis	–	–	–	–
Development	• Non-disclosure agreement • Sample electronic payslip	• Pilot testing report • Testimonial of successful pilot test	Non-disclosure agreement	Illustration / Demonstration
Implementation	• Monthly review meetings between KariTech and CAGD payroll staff	• Integrated control mechanisms • SMS prompts sent to the heads of the management units • Training manuals	• Monthly review meetings between KariTech and third-party service providers • SMS notifications sent to government employees • User manual	Documentation

Source: Author's Illustration

6.3.3 ISD Sensemaking Outcomes

Sensemaking outcomes form the third aspect of creating and sustaining mutual understanding. The outcome of sensemaking and mutual understanding is a specific sense that serves as a springboard for actors to act to reinstate an interrupted activity. In this study, we observed the interruption of existing inefficient business processes, e.g. the delayed dispatch and return of paper payslips and payment vouchers across the country. Newly developed systems interrupted these business processes, creating the need for a new sense and mutual understanding concerning the new business processes to be formed. Sensemaking outcomes range from material outcomes, such as demos and reviews of demos (Jenkin *et al.*, 2019), to cognitive outcomes, such as an organisational identity (Stigliani & Elsbach, 2018).

This study uncovered more nuanced sensegiving outcomes in the context of interoperable systems development. These outcomes inform the following finding.

Finding 2d: *The sensemaking and sensegiving that occur in the course of interoperable systems development projects result in four levels of mutual understanding across the project lifecycle:*

i. *Problem definition stage:*

   Shared understanding of intended achievements at the senior management level;

ii. *Analysis stage:*

   Broader consensus beyond the senior management;

iii. *Development stage:*

   Technical expression of focal cognitive outcomes or shared understanding and protection and control mechanisms for the focal cognitive outcomes; and

iv. *Implementation stage:*

   Communication of the focal cognitive outcomes / shared understanding using means / media that are more institutionalised, formalised, and frequent and that have a wider reach and depth.

These outcomes have two main characteristics. First, the actor base expands as a project progresses. The outcomes begin with a small actor base, i.e. the developer and the senior management team on the client side (in the problem definition stage), and then extend to other management members, e.g. heads of departments (in the analysis stage). In the development and implementation stages, the end-users are included when testing the final system, and they are trained to adopt and use the system. The expansion of the actor base reflects how previously formed sense and mutual understanding can be translated to newly onboarded actors as the systems development progresses. This observation informs the following finding:

Finding 2e: *In the beginning of an interoperable systems development project, mutual understanding may manifest as shared understanding between the developer and the senior management on the client side; as the project progresses, it expands to include other organisational members, thereby institutionalising the new understanding.*

This finding contrasts with previous research asserting that other organisational members are recruited only when the management faces complex strategic problems that exceed their individual sensemaking capacities (Seidl & Werle, 2018). Previous research thus suggests that the recruitment of the new actors serves to pool different perspectives, allowing the problem at hand to be understood more comprehensively. Conversely, this study demonstrates how recruitment of other organisational members serves to express the previously achieved mutual understanding of the project, which needs to be institutionalised within the organisation. Moreover, recruiting more organisational members can help the actors to transcend knowledge differences, avoid interpersonal conflict, and encourage continued creative engagement and flexibility in order to repeatedly modify ideas (Majchrzak, More, & Faraj, 2012).

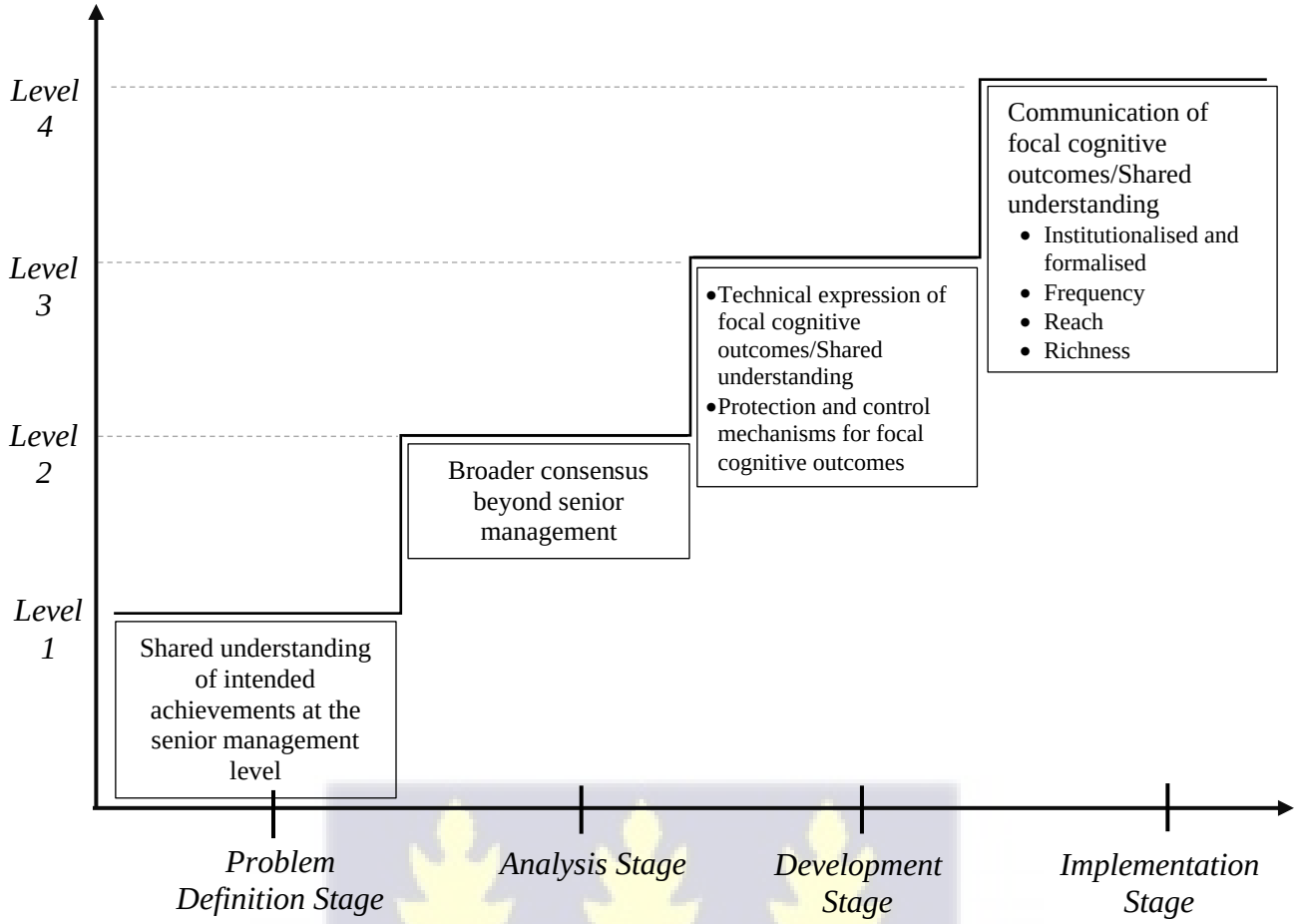
The second characteristic of the sensegiving outcomes is that they tend to increase in complexity, institutionalisation, formalisation, frequency, reach, and depth as a project progresses. The mutual understanding achieved in the problem definition stage may be quite informal and oral even though it involves senior management. Consider as an analogy the launch and reading of the manifesto of a political party. The manifesto is perceived as a contract between the party that professes it and the electorate, but it only takes effect if the party wins the election. In the problem definition stage, the developer and client may agree to pursue a project to solve a problem, but the project will only be executed if a contract is awarded and

signed. After the election of a political party, the electorate can demand accountability based on the promises in the manifesto. Similarly, the terms of the contract and the project specification can be used as metrics to assess the newly developed artefact, which is a technical expression of the mutual understanding achieved in the earlier project stages (Kendall & Kendall, 2010). If or when the delivered project meets the expectations, further engagements may be required to ensure the smooth operation of the new system. In the three case study projects, for example, the developer offered "after-sales" support and provided user and training manuals to ensure the adoption and continuous use of the system. The developer's continuous sensegiving and sensemaking with the client then generated sense of the need for the two other systems, i.e. the electronic salary payment voucher and third-party referencing systems. This observation suggests the following finding:

> *Finding 2f: Sensegiving and sensemaking that occur during the development of an IOFMS tend to increase in complexity, formalisation, frequency, reach, and richness as the project progresses through the system development lifecycle.*

Figure 6.1 illustrates the sensegiving and mutual understanding outcomes discussed in terms of the level of complexity, across the stages of the information systems development lifecycle.

Figure 6.1: Sensegiving and Mutual Understanding Outcome Mechanisms



Source: Author's Illustration

6.3.4 Influencing Factors

Influencing factors are contextual conditions that shape the achievement of mutual understanding through sensegiving and sensemaking in information systems development projects (Sandberg & Tsoukas, 2014). For instance, in the course of a project, individual actors may play political games to divert resources, deflect goals, and dissipate energy (Doolin, 2004; Lapointe & Rivard, 2005). Political games may involve subtle moves to withhold support, delay, or add personal goals to the project (Sabherwal & Grover, 2010). Examples of other influencing factors include the depth, scope, and timing of stakeholder engagement (Jenkin *et*

al., 2019). In this study, there was some uniformity in the influencing factors of the three projects. This may be because the projects were executed in a single setting and/or because they were all executed by the same developer for the same client. Nevertheless, the identified factors shed new light on the achievement of mutual understanding in information systems projects, especially within the government sector.

First, in the problem definition stage, the context and cognitive frame were the most influential factors. Context refers to the immediate environment that hosts the interrupted activity, especially how the actors bracket, notice, and extract cues from their lived experience as well as how the extracted cues are interpreted (Weick, 1995, p. 43–49). Regarding the context of the case study projects, the management and staff at CAGD had experienced the conditions surrounding the paper-intensive payroll processing every month. Government employees across the country had complained about their inability to access their payslips in a timely and secure manner. CAGD employees had received reports about identity thefts from the payroll and even witnessed thefts. These *context-based* experiences were congruent with the project proposal the developer submitted, thus creating mutual understanding about the problem at hand. Further, concerning cognitive frames—that is, abstract representations of things or events—the case projects show how the developer created prototypes of the proposed solution to frame the client's sense. These observations from the problem definition stage suggest the following finding:

> ***Finding 3a:*** *Sensemaking processes have the potential to create or affect the cognitive framing of interoperable systems development project actors. When the processes adequately address the context-based experiences of the beneficiary actors, mutual understanding is a more plausible outcome.*

In the analysis stage, emotions and the cognitive frame were the most influential factors. Emotions can manifest as positive or negative. Whereas positive emotions tend to occur when a change is planned, negative emotions, such as fear, desperation, anxiety, and panic, often occur when routine activities are interrupted (Sandberg & Tsoukas, 2014). In this study, both positive and negative emotions were observed. Whereas the senior management was delighted about the forthcoming effectiveness and efficiency, some staff members were adamant because of the potential transparency in the payroll data. The resistance stemmed from the fact that some people had been benefitting from "ghost names" in the database, whether deliberately or accidentally. The emotions experienced and the perceived outcomes of the projects also shaped the cognitive frames. For instance, thoughts of losing the "income" gained from ghost names shaped some employees' abstract representation or mental model of the project as unfavourable. Nevertheless, the sense developed by the senior management and the overall collective was more welcoming to the project, overwhelming the unfavourable framing and negative emotions held by a minority. This observation informs the following finding:

> ***Finding 3b:*** *Although negative emotions and unfavourable cognitive frames may exist, if a positive 'sense' is developed by the senior management and the majority shares this sense, the interoperable systems development project is most likely to progress.*

Third, in the development stage, the cognitive frame and technology are critical factors. From the case projects, we see that in the development stage, while the proposed system is being developed, the developer receives sample data from the client to conduct a test run. At this stage, the client's cognitive frame further influences and shapes the progress of the project: both the management and staff can clearly envision the project's completion and see that the paper plans are becoming a reality. At this point, lasting hope-based positive emotions and fear-based negative emotions may become established. Moreover, the introduction of the newly

developed system poses an influencing factor as technology (Sandberg & Tsoukas, 2014). This observation is in agreement with previous studies that show how the introduction of new technologies can influence actors' sensemaking of their "intra- and inter-professional relationships and professional identity (Korica & Molloy, 2010, p. 1879). Thus, based on the influencing factors observed in the development stage, the following finding emerges:

> ***Finding 3c:*** *Tangible outcomes, like a new system or its prototype, can influence and reinforce sensemaking processes as a demonstration of 'sense' [the cognitive frame] and provide a value benefit for actors to engage in sensemaking.*

In the implementation stage, (positive) emotion, language, and politics were influential factors. Even though some negative emotions were experienced at the inception of the project, it appears that primarily positive emotions remained in the end. This change may be attributable to the ability of the systems to deliver their intended objectives, prompting those with initial negative emotions to follow the positive majority. In the case projects, measures used to establish a positive majority included recruiting other organisational members into the 'sense made', avoiding interpersonal conflict, and encouraging continued creative engagement (Majchrzak *et al.*, 2012). Further, the language used to describe the project – in the form of narratives, rhetoric, tropes, and stories (Abolafia, 2010; Boudes & Laroche, 2009) – changed in the final project stage: when the system became a physical reality, it could no longer be described as a dream. The consistent reduction in complaints by government employees about identity thefts and payroll fraud, for instance, resulted in the use of positive language in reference to the new system and further enhanced the mutual understanding of the project actors. This account is congruent with assertions that sensemaking is performed via the production of discursive accounts by individuals (Cornelissen, 2012).

An analysis of the case projects cannot ignore the role of financial resources, even though finance is not reported as an influential factor (see Sandberg & Tsoukas, 2014). The analysis in this study uncovered the role of the financial resources that were made available by the client to pay for the developer's services. The financial resources served as *oil* in the developer's *system development machine*, enabling the developer to purchase the necessary licenses (e.g. for Microsoft Navision), pay employees, and travel across the country to conduct trainings for the client's regional staff and relevant government employees who needed to use the services provided by the newly developed systems. These findings are consistent with previous literature (discussed in Chapter 2) which emphasise power over resources (including financial resources) as one of the institutional influencing factors (Alsharari *et al.* 2015). These powers are also influenced by external political and economic systems at the macro-level and sometimes at the meta-level. Hence, a multi-institutional perspective exploring the effect of these powers is required.

From this discussion, this study draws the finding that

> ***Finding 3d:*** *Regardless of the efficiency of the developed sensemaking mechanisms, a lack of pertinent project resources, including financial resources, can stall interoperable systems development projects.*

Table 6.6 summarises all the influencing factors observed across the three case projects, over the course of their project lifecycles.

Table 6.6: Observed Influencing Factors across the Case Projects

ISD Stage	Influencing Factors		
	e-Payslip Project	*e-Payment Voucher Project*	*Third-Party Referencing System*
Problem Definition	• Context • Cognitive frame – senior level	• Context • Cognitive frame – senior level	• Context • Cognitive frame – senior level
Analysis	• Emotions (positive and negative) • Cognitive frame – middle and user level	• Emotions (positive and negative) • Cognitive frame – middle and user level	• Emotions (positive and negative) • Cognitive frame – middle and user level

Development	• Cognitive frame • Technology availability	• Cognitive frame • Technology availability	• Cognitive frame • Technology availability
Implementation	• Positive emotion • Language • Politics • Financial resources (sponsor)	• Positive emotion • Language • Politics • Financial resources (sponsor)	• Positive emotion • Language • Politics • Financial resources (sponsor)

Source: Author's Illustration

6.4 Chapter Summary

The purpose of this chapter was to reveal the triggers, processes, outcomes, and influencing factors that form a foundation for the creation and sustenance of mutual understanding in IOFMS. This chapter began by presenting evidence from the case projects to verify the occurrence of interoperability, both definitionally and thematically. The verification was followed by an examination of the sensemaking mechanisms, i.e. triggers, processes, outcomes, and influencing factors, that were observed in the case projects. Table 6.7 summarises all the triggers, processes (both first-order mechanisms and aggregated mechanisms), and outcomes of sensemaking for mutual understanding observed throughout the course of information systems development across the three case projects.

Table 6.7: Summary of Sensemaking Triggers, Processes, Outcomes, and Influencing Factors

Event	Triggers	Processes	Outcomes – Evidence of MU	Influencing Factors
e-Pay Slip				
Problem Definition	Minor Planned - Developer Major Unplanned - Client	**Creation** – Senior management interaction **Interpretation** – Prototyping **Enactment** – Senior management consent	**Level One** - Shared understanding of what is to be achieved at the senior management level	**Context** **Cognitive frame – senior level**
Analysis	Major Planned - Developer Major Planned - Client	**Interpretation** • Review of old pay slips • Informal consultations to further understand payroll functions	**Level Two** - Broader consensus beyond senior management	**Emotions (positive and negative)** **Cognitive frame – middle and user level**
Development	Major Planned - Developer Major Planned - Client	**Creation** • Receive and incorporate test data from CAGD **Interpretation** • Initial runs of the electronic payslip system **Enactment** • Non-disclosure agreement • Sample electronic payslip	**Level Three** - Technical expression of the focal cognitive outcome and shared understanding - Protection and control mechanisms for the focal cognitive outcome	**Cognitive frame** **Technology availability**
Implementation	Major Planned - Developer Major Planned - Client	**Creation** • Distribution of access codes across districts **Interpretation** • Training of CAGD trainers who then conducted further trainings **Enactment** • Monthly review meetings between KariTech and CAGD payroll staff • SMS notifications sent to government employees • User manual • Explanatory video on e-payslip website	**Level Four** - Communication of the focal cognitive outcome and shared understanding o Institutionalisation and formalisation o Frequency o Reach o Richness or depth	**Positive emotion** **Language** **Politics** **Financial resources (sponsor)**

Event	Triggers	Processes	Outcomes – Evidence of MU	Influencing Factors
Event	**Triggers**	**Processes**	**Outcomes – Evidence of MU**	**Influencing Factors**
e-Voucher Slip				
Problem Definition	Minor Planned - Developer Major Unplanned - Client	**Creation** – Senior management interaction **Interpretation** – Prototyping **Enactment** – Senior management consent	**Level One** - Shared understanding of what is to be achieved at the senior management level	**Context** **Cognitive frame – senior level**
Analysis	Major Planned - Developer Major Planned - Client	**Interpretation** • Review old payment vouchers • Consultations to further understand payment voucher processes and procedures	**Level Two** - Broader consensus beyond senior management	**Emotions (positive and negative)** **Cognitive frame – middle and user level**
Development	Major Planned - Developer Major Planned - Client	**Creation** • Receive approval for pilot testing **Interpretation** • Pilot testing at microcosmic management level **Enactment** • Pilot testing report • Testimonial of successful pilot test	**Level Three** - Technical expression of the focal cognitive outcome and shared understanding - Protection and control mechanisms for the focal cognitive outcome	**Cognitive frame** **Technology availability**
Implementation	Major Planned - Developer Major Planned - Client	**Creation** • Communication of the new electronic voucher system to government management unit heads **Interpretation** • Training of the government management unit heads **Enactment** • Integrated control mechanisms • SMS prompts sent to the heads of management units	**Level Four** - Communication of the focal cognitive outcome and shared understanding o Institutionalisation and Formalisation o Frequency o Reach o Richness or depth	**Positive emotion** **Language** **Politics** **Financial resources (sponsor)**

Event	Triggers	Processes	Outcomes – Evidence of MU	Influencing Factors
		• Training manuals		

Event	Triggers	Processes	Outcomes – Evidence of MU	Influencing Factors
Third-Party Referencing System				
Problem Definition	Major Planned - Developer Major Unplanned - Client	**Creation** – Senior management interaction, meeting with third-party service providers **Interpretation** – Prototyping **Enactment** – Senior management consent, presentation to third-party service providers	**Level One** - Shared understanding of what is to be achieved at the senior management level	**Context** **Cognitive frame – senior management**
Analysis	Major Planned - Developer Major Planned – Client Major Unplanned – Third-party service providers	**Interpretation** • Review of old third-party business processes • Gathering of requirements from the third-party service providers and CAGD management	**Level Two** - Broader consensus beyond the senior management	**Emotions (positive and negative)** **Cognitive frame – middle and user level**
Development	Major Planned - Developer Major Planned - Client	**Creation** • Receive and incorporate test data from CAGD **Interpretation** • Initial runs of the third-Party Referencing system **Enactment** • Non-disclosure agreement • First version of the third-party referencing system	**Level Three** - Technical expression of the focal cognitive outcome and shared understanding - Protection and control mechanisms for the focal cognitive outcome	**Cognitive frame** **Technology availability**
Implementation	Major Planned - Developer Major Planned - Client	**Creation** • Authentication of access by third-party service providers **Interpretation** • Training of CAGD staff • Training of third-party service providers • Training of government employees **Enactment** • Monthly review meetings between KariTech and the third-party service providers • SMS notifications sent to government employees • User manual	**Level Four** - Communication of the focal cognitive outcome and shared understanding ○ Institutionalisation and formalisation ○ Frequency ○ Reach ○ Richness or depth	**Positive emotion** **Language** **Politics** **Financial resources (sponsor)**

Source: Author's Illustration

CHAPTER 7: CONCLUSIONS, IMPLICATIONS, RECOMMENDATIONS, AND FUTURE DIRECTIONS

7.1 Chapter Overview

In Chapter Six, a discussion of the theoretical analysis conducted based on the conceptual framework and findings derived from the three interoperable payroll add-on systems was presented. This chapter concludes the doctoral research by summarising the study and its key research findings and by outlining the implications for research, practice, and policy. The chapter begins by restating the research purpose and objectives, followed by a summary of the research activities and findings. Subsequently, the contributions and implications of the study are reported. Finally, the limitations are discussed, and future research directions are proposed.

7.2 Summary of Research Activities

The purpose of this research was to develop a framework to explain the creation and sustenance of mutual understanding between stakeholders in the development of an IOFMS in a developing economy. The interoperability of a payroll add-on system in the public sector of Ghana was the real-world phenomenon examined in this research. The payroll add-on system consists of three independent, interoperable modules: the Electronic Salary Payment Voucher, the Electronic Payslip, and the Third-Party Referencing System.

Mutual understanding (MU), as used in this doctoral research, refers to "the extent to which stakeholders have a shared conception of a project regarding, for example, its goals and processes, and stakeholder roles" (Gregory *et al.*, 2013, cited in Jenkin *et al.*, 2019, p. 650). The literature explains that MU is a focal cognitive outcome that stems from episodes of cognitive activities—sensegiving and sensemaking—during the ongoing dialogue among the

diverse stakeholders of a project (Gioia & Chittipeddi, 1991; Stigliani & Ravasi, 2012). Thus, during the course of information systems development projects, such as interoperable finanical management systems, there is continuous dialogue involving episodes of sensegiving and sensemaking between the IT and business stakeholders. To understand how sensemaking occurs within the institutional context of the public sector, where the payroll add-on system was developed and implemented, this doctoral research adopted an organisational perspective on sensemaking, as posited by Sandberg and Tsoukas (2014).

Sandberg and Tsoukas (2014) conceptualise sensemaking as a constructive practice, which is not purely cognitive, that entails how people with knowledge and concern about their identity in a social context (including other actors) engage in ongoing events (planned or unplanned; minor or major), from which they extract cues and make plausible sense retrospectively while contributing to or detracting from the order of those ongoing events. The practice of sensemaking can be influenced by a myriad of factors, which may be individual/social, organisational, technological, or political. The process of sensemaking, therefore, involves triggers, processes, outcomes, and influencing factors.

In relation to the sensemaking theory, three main objectives were outlined. In the context of the development of an IOFMS in a developing economy, the three main objectives were

1. To explore the triggers and processes of creating and sustaining mutual understanding in the development of an IOFMS in a developing economy;
2. To determine how ISD project mechanisms (the problem definition, requirement analysis, development, and implementation) affect the sensemaking process and its outcomes (the mutual understanding and actions of stakeholders) during the development of an IOFMS in a developing economy; and

3. To explore the factors that enable or constrain the creation and sustenance of mutual understanding in the development of an IOFMS in a developing economy.

In relation to three objectives, three questions were formulated. The related discussion is presented in Chapter One of this study.

In Chapter Two, key concepts in interoperable information systems were discussed, and a literature review of extant interoperability research was presented. Notably, in the literature, interoperability enjoys a plurality of definitions, which tend to emphasise a technological, organisational, or techno-organisational perspective. Studies that focus on interoperability in an organisational context, such as in government, tend to favour the techno-organisational perspective. For example, Santos and Reinhard (2012) explain that interoperability occurs "when heterogeneous or independent information systems of different agencies, jurisdictions, departments, administrations or external partners work together (exchange information) efficiently and effectively in a predefined or agreed-on fashion" (p. 73). This study employs the techno-organisational perspective.

To achieve the research objectives and address the research questions, in Chapter Three, a conceptual model is proposed, as illustrated in Figure 3.4. The model postulates that to achieve MU in the interoperability of the three payroll add-on systems, it was necessary for sensemaking to occur in the ISD phases of each system. The model proposes that MU must be achieved in each of the phases and transferred within and across each of the systems for interoperability to occur. As noted, for each of the ISD phases of the three systems, the components of sensemaking (triggers, process, outcomes, and influencing factors) are uncovered in order to establish how MU is created, transferred, and sustained throughout the ISD process, leading to the occurrence of interoperability.

In Chapter Four, the philosophical and methodological underpinnings of the study were presented. Critical realism was selected as the appropriate research paradigm for this study. Based on critical realism, a qualitative methodological approach was adopted in this study. This approach is often well suited for capturing the ways in which phenomena such as mutual understanding can be described, propositions can be constructed, and structured interactions between complex mechanisms in the phenomenon can be identified (Mingers *et al.*, 2013). Furthermore, an explanatory case study strategy was adopted as this approach is appropriate for determining cause-and-effect relationships in order to explain the creation and sustenance of mutual understanding as guided by the sensemaking theory. Moreover, multiple subcases within a single institution were used to enhance the explanatory process. Theory-based sampling (Paré, 2004) was used to select the public sector organisation, first at the institutional level and then at the project level, for the case study. Theory-based sampling is the sampling of case information in a focused manner, based on a priori theory that is being evaluated or modelled – sensemaking theory, in this instance. At the organisational level, the criteria dictated that first, the organisation should be a public sector organisation and that second, the organisation must have developed and implemented at least two interoperable information systems within the past ten (10) years to facilitate the study of sensemaking, sensegiving, and mutual understanding over time. At the project level, the theory-based criteria dictated that the case project should have produced an interoperable system with clearly identifiable stakeholders—both internal and external—who input data into the system and generate outputs from it. Moreover, the generated outputs needed to incorporate data from at least two other interoperable systems. The Controller and Accountant General's Department (CAGD) was selected based on these criteria. The study examined the development and implementation of

three modules developed to enhance the government payroll add-on systems that had been deployed by CAGD. The three modules are the Electronic Salary Payment Voucher, Electronic Payslip, and Third-Party Referencing System. Data was collected through interviews with current and previous CAGD management and staff, the developer of the interoperable systems, and the end-users of the systems and through artefact examination of the payroll add-on systems. The data analysis was conducted using Miles and Huberman's qualitative data analysis method, which involves data collection, data condensation, data display, and drawing and verifying conclusions (Miles *et al.*, 2014).

Chapter Five began with an overview of CAGD followed by a presentation of the case studies of the three modules: the Electronic Payslip, Electronic Salary Payment Voucher, and Third-Party Referencing System. The ISD cycle was used to examine the process of developing the three modules. At the end of the chapter, a summary of sensegiving and sensemaking activities and of artefacts in the CAGD case studies was provided in Table 5.4. Two of the preliminary findings suggested the following:

> Artefacts and Codified documents like broad statements of objectives, contracts for development, systems requirement documents, user guides, and training documents serve as potential evidence of the formal creation of mutual understanding within a collective or an organisation (Weick *et al.*, 2005). They can also serve as a control mechanism to ensure that specific project goals are met.

> Project meetings, user engagement workshops, and prototype demonstrations are examples of conversational mechanisms and/or activities that facilitate episodic

moments in which sense is made by different actors both at the individual and team or organisational levels (Kendall & Kendall, 2010).

In Chapter Six, the findings and contributions of this study were discussed. The chapter opened by verifying the phenomenon of 'interoperability'. The definitional and thematic concepts discussed in Chapter 2 were employed to guide the verification of the occurrence of interoperability in the data collected. The techno-organisational definition of interoperability was found to be evident in the study data. There was also evidence of interoperability as the occurrence of heterogeneous or independent information systems of different agencies, departments, and external partners working together efficiently and effectively in a predefined or agreed-on fashion (Tripathi *et al.*, 2012). From the thematic perspective, among other themes, there was evidence of the three dimensions of integration—process, data, and communication—and of the four levels of attainment—technical, syntactic, organisational, and semantic (Van der Veer & Wiles, 2008).

The verification was followed by an unearthing of the sensemaking mechanisms, i.e. the triggers, processes, outcomes, and influencing factors, observed in the case projects. Six findings were determined, and the findings were discussed in the ensuing sections in terms of the research objectives, implications, and contributions of the study. Chapter 7, as the concluding chapter, summarises the research activities, provides responses to the research objectives and questions, illustrates a post-study framework, lists the contributions to and implications for research, practice and policy, and discusses the limitations of the research and future research directions.

7.3 Response to the Research Objectives and Questions

Table 8.1 summarises the relevant findings for each research objective.

Table 7.1: Summary of Findings for Each Research Objective

Research Objective	Findings	Gaps Addressed	Core Contributions
To explore the triggers that help create and sustain mutual understanding in the development of an IOFMS in a developing economy.	Finding 1a: In the development of an IOFMS in the public sector, a mix of major planned and unplanned events tends to trigger organisational actors to engage in sensemaking and sensegiving activities. These events may originate from either internal contradictions and ambiguities or an external stimulus. Finding 1b: In the development of an IOFMS, the triggers of sensemaking and sensegiving activities may not become apparent until an interface or engagement occurs between the organisation and the external stimulus, activity, or actor. Finding 1c: Although triggers of sensemaking and sensegiving activities may already be major at the inception of a project, they nevertheless tend to increase in severity as the project progresses to meet the demands of later stages/phases of the interoperable systems development process. Finding 1d: In the development of an IOFMS, project stages/phases and their mutually agreed deliverables serve as triggers for sensemaking in subsequent phases of the project. Finding 1e: Sensegiving that promises to solve another actor's problem has the potential to be a golden event that mutates unplanned events into planned events, as the receiving actors allocate needed resources for the success of the project.	The first objective responds to the need for more theorisation in interoperability research and the call for more non-deterministic or social theories in IFMIS research (Naya & Beldona, 2010; Jenkin *et al.*, 2019; Nuhu *et al.*, 2018). This objective draws on sensemaking theory to examine mutual understanding in the development and implementation of the government payroll add-on systems in Ghana. The concept of mutual understanding and the application of sensemaking theory to information systems development processes are discussed in Chapter Three (theoretical foundation) and Chapters Five and Six (case study findings, analysis, and discussion).	The need for more theorisation in interoperability research and social theories in IFMIS research has been addressed through the use of sensemaking theory in this study. Per the research framework illustrated in Figure 7.1, an understanding of how triggers tend to change in each phase of the development of an interoperable system or an information system has been gained. This knowledge is currently lacking in the existing literature. This study established that even though the triggers of sensemaking and sensegiving activities may be minor at the inception of a project, they tend to increase in severity as the project progresses to meet the demands of the later stages/phases of the interoperable systems development process. This knowledge is also absent in the current literature.

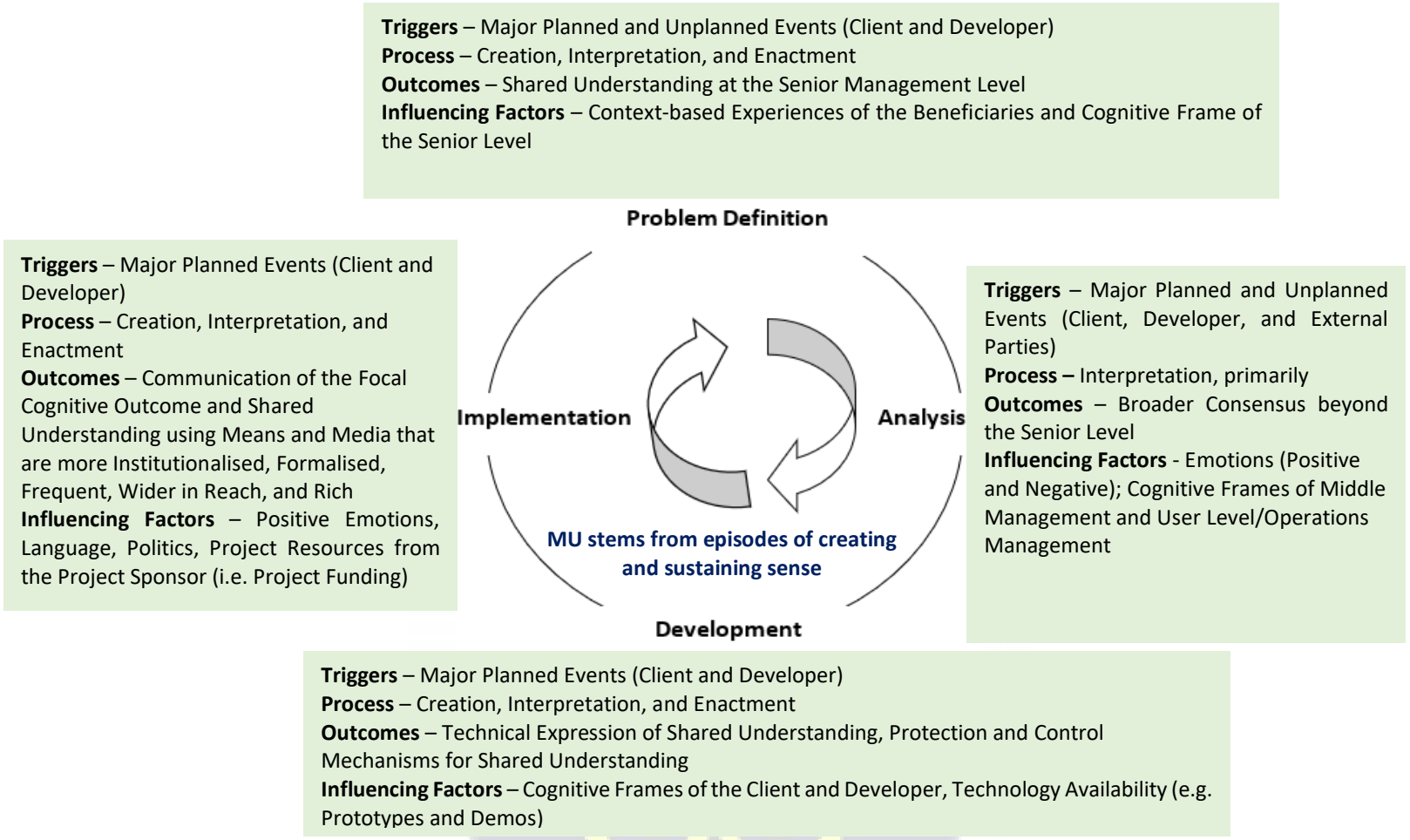
Research Objective	Findings	Gaps Addressed	Core Contributions
To determine how information systems development project mechanisms (problem definition, requirement analysis, development, and implementation) affect the sensemaking process and outcomes (the mutual understanding and actions of the stakeholders) during the development of an IOFMS in a developing economy.	Finding 2a: During sense creation in interoperable systems development projects, the sense of the actors is integrated, existing data is integrated into the newly developed system, and new data or information is developed and distributed for use. The creation mechanisms are thus Sense Integration, Data Integration, and Developing and Distributing New Data/Information for Use. Finding 2b: In the course of interoperable systems development projects, actors tend to use interpretation, through prototyping, joint reviewing, consultation, testing, and training, to elaborate on the initial sense in order to achieve an organised sense of the project situation. Finding 2c: In the course of interoperable systems development projects, actors tend to use enactment, through formalisation and institutionalisation, the establishment of consent, illustration/demonstration, and documentation to reduce or remove the potential for actors to revoke, undermine, subvert, or weaken the sense has been made or the mutual understanding that has been established. Finding 2d: The sensemaking and sensegiving that occur during interoperable systems development projects result in four levels of mutual understanding across the project lifecycle: i) Problem definition stage: Shared understanding of intended achievements at the senior management level; ii) Analysis stage: Broader consensus beyond the senior management; iii) Development stage: Technical expression of focal cognitive outcomes or shared understanding and protection and control mechanisms for the focal cognitive outcomes; and iv) Implementation stage:	The second objective responds to the need to explore the effects of the relationships between project management mechanisms and mutual understanding (and sensemaking processes) on ISD project outcomes (Jenkin *et al.*, 2019). In this doctoral research, the information systems development process was conceptualised as consisting of four key phases: problem definition, requirement analysis, development, and implementation. In each of the phases, the research examined the interrelationships between the ISD activities and the sensemaking process and outcomes (Chapters Five and Six).	Per the research framework illustrated in Figure 7.1, an understanding of how sensemaking processes and outcomes tend to change in each phase of the development of an interoperable system or an information system has been gained. This knowledge is missing in the existing literature. The study continued to explain how the mechanisms of sensemaking processes affect MU in interoperable systems development. For example, enactment mechanisms have the ability to serve as protective mechanisms that reduce or remove the potential for actors to revoke, undermine, subvert, or weaken the 'sense' made or the MU that has been established. These perspectives are not found in the existing literature but are provided in this study. This study established that sensemaking activities tend to increase in their level of complexity, formalisation, frequency, reach, and richness as a project progress along the system development lifecycle. These characteristics of sensemaking outcomes – the increase in actor interaction and in the level of complexity, formalisation, frequency, reach, and richness – are also absent in the existing literature but offer an

Research Objective	Findings	Gaps Addressed	Core Contributions
	Communication of the focal cognitive outcomes / shared understanding using means / media that are more institutionalised, formalised, and frequent and that have a wider reach and depth. Finding 2e: In the beginning of an interoperable systems development project, mutual understanding may manifest as shared understanding between the developer and the senior management on the client side; as the project progresses, it expands to include other organisational members, thereby institutionalising the new understanding. Finding 2f: Sensegiving and sensemaking that occur during the development of an IOFMS tend to increase in complexity, formalisation, frequency, reach, and richness as the project progresses through the system development lifecycle.		opportunity for new research directions.
To explore the factors that enable or constrain the creation and sustenance of mutual understanding in the development of an IOFMS in a developing economy.	Finding 3a: Sensemaking processes have the potential to create or affect the cognitive framing of interoperable systems development project actors. When the processes adequately address the context-based experiences of the beneficiary actors, mutual understanding is a more plausible outcome. Finding 3b: Although negative emotions and unfavourable cognitive frames may exist, if a positive 'sense' is developed by the senior management and the majority shares this sense, the interoperable systems development project is most likely to progress. Finding 3c: Tangible outcomes, like a new system or its prototype, can influence and reinforce sensemaking processes as a demonstration of 'sense' [the cognitive frame] and provide a value benefit for actors to engage in sensemaking.	A myriad of barriers or constraints to interoperability in government (Scholl *et al.*, 2012) and enterprises (Chen, 2006; Rezaei *et al.*, 2014) have been espoused in the literature. This third objective also responds to the need to examine how these barriers and constraints shape the implementation of interoperable platforms in government. This objective also afforded the opportunity to explore the technological and non-technological (process, administrative, and structural) changes that governmental institutions undergo to achieve interoperability (Tripathi *et al.*, 2012). The influencing factors of interoperability and the respective organisational responses were also analysed in this doctoral research.	Per the research framework illustrated in Figure 7.1, an understanding of how the factors influencing MU tend to change in each phase of the development of an interoperable system or an information system has been gained. This knowledge is lacking in the existing literature. We identify factors that can stall a project [inhibitors] – financial resources, context-based experiences, and negative emotions and factors that reinforce the need for sensemaking or demonstrate its value [enablers] – technology [prototypes] and cognitive frames. This categorisation of influencing factors is not mentioned in literature, but it is relevant. This study establishes that in

Research Objective	Findings	Gaps Addressed	Core Contributions
	Finding 3d: Regardless of the efficiency of the developed sensemaking mechanisms, a lack of pertinent project resources, including financial resources, can stall interoperable systems development projects.		addition to identifying the influencing factors, understanding their relationships is also important.

Source: Author's Illustration

Figure 7.1: Revised Framework for the Achievement of Mutual Understanding in Interoperable Financial Management Systems Development Projects



The revised framework, illustrated in Figure 7.1, attempts to explain how mutual understanding is created and sustained throughout an information systems development project cycle. In this study, our focus was the development of an IOFMS, which is an instance of the development of an information system in the real-world. By studying the creation and sustenance of MU in a real-life project, we hoped to abstract mechanisms that facilitate MU in information systems development that may be applicable and adaptable to future related projects in which MU is needed (Sandberg & Tsoukas, 2014; Weick, 1995).

Per the revised framework, in the **problem definition phase**, the triggers for MU are major planned or unplanned events. In a public sector institution, ISD is more likely to start as a major activity involving senior management, especially because the approval and resources needed for the projected are to be allocated by senior management. This commonly occurs in interoperable systems development in which different government agencies may be the stakeholders of the intended interoperability. The sensemaking processes is thus likely to entail all three process mechanisms, namely, creation – the senior management interacts with developers and meets with external service providers about the problem or solution; interpretation – prototyping; and enactment – the senior management consents, and there is a presentation to the third-party service providers. The outcome of these processes is a shared understanding at the senior management level of what is to be achieved. Per these activities, the influencing factors tend to be the context-based experiences of the beneficiaries of the project (the client's employees or users of the proposed solution) and the cognitive frame of the senior management. The ability of a developer to address the context-based experiences of the beneficiaries and the cognitive frame of the senior management can determine if enough MU is achieved to enable the project to progress to the next phase.

In the **analysis phase**, the focus of the project is to solicit expectations and then interpret them as a potential solution. As a result, the triggers of MU are major planned events for the client and the developers of the project. However, the triggers may also include unplanned events for the external parties who are stakeholders of the proposed system or interoperable project. Hence, the sensemaking processes is likely to primarily entail interpretation—reviews of existing business processes and the gathering and understanding of requirements from the client and external stakeholders. At this stage, the middle management and user or operations management are consulted. The outcome of the sensemaking processes is, therefore, a broader consensus beyond the senior management. Per these activities, the influencing factors tend to be emotions (positive and negative) and the cognitive frames of the middle management and user or operations management. The potential for old systems to be lost and new ones to be gained generates emotions that can influence the development of MU. The prospect of the benefits of the new system or interoperability thus needs to be well communicated by the senior management and developer to the middle management and user or operations management.

In the **development phase**, the focus of the project is to develop a solution or new system based on the obtained requirements. As a result, the triggers of MU are major planned events for the client and developers of the project. The sensemaking processes are likely to entail all three process mechanisms, namely, creation—developing prototypes and incorporating real-life data into new systems; interpretation—testing or initial runs of new systems; and enactment—signing of non-disclosure agreements, producing sample output reports from the new systems, and presenting the first version of the systems to the client. The outcomes of these processes are the technical expression of shared understanding (installation guides, testing, and initial runs of the system) and protection and control mechanisms for the shared understanding (non-disclosure agreements and related legal documentation for the use of the client data). Per

these activities, the influencing factors tend to be the cognitive frames of the client and developer and technology availability (e.g. prototypes, demos, and testing systems).

In the final phase, **implementation**, the focus of the project is to install systems for use by the client and to formally deliver the system to the client. The triggers of MU are therefore major planned events for the client and developers of the project. The sensemaking processes are likely to entail all three process mechanisms, namely, creation—the creation and distribution to users of the access codes to the new system; interpretation—training the client and external users; and enactment—periodic review meetings, distribution of user manuals and video tutorials for the system, and error reporting mechanisms. The outcome of these processes is the communication of the shared understanding using means and media that are more institutionalised, formalised, frequent, and that have a wider reach and richness. The outputs of enactment, such as user manuals, periodic review meetings, and video tutorials, are examples of means of institutionalisation and formalisation. Per these activities, the influencing factors tend to be positive emotions from empowered or trained users; the language of engagement, which is supportive and inclusive; politics, which can influence continuity; and the availability of project resources from the project sponsor (e.g., project funding).

The proposed model, illustrated in Figure 7.1, is abstracted from the case study examined in this thesis. It can be adapted as guide for how MU is created and sustained in other interoperable projects in the public sector, though they may differ in scale and in the nature of the stakeholder interaction. This is a starting point that illustrates knowledge that no study to date has attempted to examine, namely the evolution of MU throughout the development phases of an interoperable system or an information system.

7.4 Research Contributions and Implications

The purpose of this study is to develop a framework that explains the creation and sustenance of mutual understanding between stakeholders in the development of an IOFMS in a developing economy. The framework, illustrated in Figure 7.1, was developed through the use of the sensemaking theory to explore the structures and mechanisms that underpin the creation and sustenance of mutual understanding in an IOFMS, particularly payroll add-on systems in the public sector of Ghana. The ensuing framework and 14 findings of the study have generated several contributions to and implications for research, practice, and policy, which are outlined below.

7.4.1 Contributions to and Implications for Research

Based on sensemaking theory (Sandberg & Tsoukas, 2014), this study postulated that mutual understanding stems from triggers and is achieved through processes, leading to outcomes, while also being influenced by a number of factors. Prior to this, no study had attempted to explore how sensemaking and sensegiving activities, as defined by Sandberg and Tsoukas (2014), occur throughout the development of information systems. Nevertheless, IS researchers like Jenkin *et al.* (2019) have advocated for more studies on mutual understanding in information systems development projects. This aspect of this study directly addresses this call for research. It furthermore addresses the need for more theorisation in interoperability research and the call for more non-deterministic or social theories in IFMIS research (Naya & Beldona, 2010; Jenkin *et al.*, 2019; Nuhu *et al.*, 2018). By the addressing this call for research, the study has revealed a new understanding of the triggers, processes, outcomes, and influencing factors of sensemaking from the perspective of interoperable systems development. Concerning triggers, while Sandberg and Tsoukas (2014) categorise triggers by their severity—major or minor—they do not discuss the interaction between different types of triggers. This study has

established that even when the triggers of sensemaking and sensegiving activities are already major at the inception of a project, they nevertheless tend to increase in severity as the project progresses to meet the demands of the later stages or phases of the interoperable systems development process. Further, the triggers may not even be apparent until there an interface or an engagement has occurred between the organisation and an external stimulus, activity, or actor. These findings helped to elucidate the evolution of sensemaking triggers, in terms of their visibility and how they are influenced by time. The study also noted that project phases and mutually agreed deliverables can serve as triggers because of their use as project control mechanisms for subsequent activities and their use to ensure that specific goals concerning the project are met. Previous studies have not treated project planning and control mechanisms as triggers; rather, they have discussed triggers such as ambiguity, insecurity, and contradictions (Weick, 1995) or the perception or anticipation of a sensemaking gap, discursive ability, and process facilitators (Maitlis & Lawrence, 2007).

Concerning processes, previous studies outlined three sensemaking processes: creation, interpretation, and enactment. Although the three sensemaking processes can be found in the sensemaking studies reviewed by Sandberg and Tsoukas (2014), the authors note that only a handful of the studies reviewed (1 percent) take all of them into account. Extant studies are largely silent on the distinction between the processes of "creation" and "interpretation", treating them as the same process. By focusing on interoperable systems development projects, this study has provided new insights into the contribution of all three mechanisms to the creation of mutual understanding in information systems projects. This study established the creation mechanisms as *sense integration, data integration,* and *developing and distributing new data/information for use;* the interpretation mechanisms as *prototyping, joint reviewing, consultation, testing, and training;* and the enactment mechanisms as *formalisation and*

institutionalisation, the establishment of consent, illustration/demonstration, and documentation. Beyond outlining these mechanisms, this study went on to explain how they affect MU in interoperable systems development. For example, enactment mechanisms can serve as protective mechanisms that reduce or remove the potential for actors to revoke, undermine, subvert, or weaken the sense and mutual understanding that have been established. These mechanisms also enable actors to engage in a "collective reflection-in action" cycle through which an information systems (IS) design can emerge as the result of actors producing, sharing, and reflecting on explicit objects. These perspectives are not found in the existing literature but are rather explored for the first time in this study, thereby providing an opportunity for researchers to explore how enactment mechanisms can be used to protect the sense or MU held by a collective.

Concerning outcomes, this study posited four levels of mutual understanding that hierarchically span the project lifecycle of interoperable development projects. It was established that mutual understanding starts as a shared understanding at the senior management level and then progresses to broader consensus beyond the senior management level. As wider consensus is gained, there is a need to demonstrate the viability of the 'sense' made; hence, the focus moves to the technical expression of the shared understanding (e.g. a prototype), which can serve as an enactment mechanism to protect the shared understanding. Beyond the technical expression, measures can be taken to ensure that the focal cognitive outcome or shared understanding is communicated, using means or media that are more institutionalised, formalised, frequent, and have a wider reach and richness. This presupposes that at the start of a project, mutual understanding may manifest as shared understanding between the developer and the senior management on the client side but that as the project progresses, it expands to include other organisational members, thereby institutionalising the new understanding. As a result,

sensemaking activities tend to increase in their level of complexity, formalisation, frequency, reach, and richness as a project progresses through the systems development lifecycle. These characteristics of sensemaking outcomes—the increases in actor interaction and the level of complexity, formalisation, frequency, reach, and richness—are also absent in the current literature, again offering an opportunity for new research directions. The exploration of the relationship between sensemaking activities and the systems development lifecycle across different information systems projects provides yet another endeavour for knowledge creation.

Concerning influencing factors, the study identified the context-based experiences of the beneficiary actors, the cognitive frames and emotions of the actors, technology [in the form of prototypes], and the lack of core project resources, such as financial resources. We identified these five influencing factors as factors that can stall a project [inhibitors]—financial resources, context-based experiences, and negative emotions—and factors that reinforce the need for sensemaking or demonstrate its value [enablers]—technology [prototypes] and cognitive frames. This categorisation of influencing factors has not been identified in previous sensemaking literature, though it is important. Sensemaking processes have the potential to create or affect the cognitive framing of the actors in interoperable systems development projects. When the processes or tangible outcomes [prototypes] adequately address the context-based experiences of the beneficiary actors, mutual understanding is a more plausible outcome. Hence, this study posits that in addition to identifying influencing factors, understanding the relationships between the factors also matters. Further, in reference to Chapter two, the influencing factors unearthed in this study tend to echo four dimensions of institutional powers that exist in such IFMIS projects: 1) power over resources, 2) processes, 3) meanings, and 4) systems (Alsharari *et al.*, 2015). This doctoral research confirms the effects of these powers. As seen in this research, these powers are also influenced by external political and economic

systems at the macro-level (government policies, interests and agenda) and sometimes at the meta-level (donor agencies and international development partners).

In sum, this application of sensemaking theory to interoperable systems research has demonstrated that the techno-organisational perspective of interoperability should be the focus of information systems researchers. The findings of this study indicate that both *actors* [their cognitive frames, emotions, and context-based experiences] and *technology* [prototypes as tangible outcomes of sensemaking activities] shape MU and project outcomes. It also emphasises that sensemaking is not only necessary for independent information systems to work together but also for the development of these systems, especially in the public sector. Mutual understanding among the actors of each of independent information system is thus a prerequisite of the attempt to become interoperable. Through this study, we learned that independent information systems need to seek to achieve internal MU and functionality before attempting to establish MU for the purpose of cooperation or to achieve interoperability. Because this study focused on financial management systems, future research on interoperability might examine how the level of MU in independent non-financial and non-governmental information systems affects the achievement of interoperability.

7.4.2 Contributions to and Implications for Practice and Policy

Several contributions to practice and policy have been offered by this study. First, as discussed earlier, the study offers a distinct understanding and perspective of interoperability. Practitioners, system developers, and government agencies responsible for the development of an IOFMS should have a multi-dimensional understanding of interoperability—an understanding that embraces both the technological and organisational perspectives of interoperability. A unified understanding can shape the expectations of interoperability and

keep them oriented towards mutual outcomes. Policy makers and public sector officials might consider formally defining their perspective of interoperability before the commencement of an interoperability project. This can help eliminate or reduce ambiguities in the expectations for the project.

The second contribution is the finding that sensemaking outcomes tend to differ in each phase of the development of an IOFMS. For example, while shared consent is ultimately needed for interoperability, it should be noted that the creation and sustenance of consent occurs progressively from a lower level consensus, often among a few people such as senior management, to eventually reach an institutionalised and formalised consensus. The progressive development of MU should thus be expected, and the level of consensus should be assessed at each project phase. Policy makers and public sector officials might consider institutionalising such an assessment as part of the project.

A third contribution is that where the useful functions of heterogenous systems depend on interoperability, mutual understanding is relatively easy to create or establish because there is a somewhat unified goal. If the importance of the unified goal far surpasses that of individual interests and goals, the parties tend to align and make sense more easily. Practitioners and policy makers alike might therefore consider making the unified goal of an interoperability project more visible and tangible. Project activities should include interpretation mechanisms such as prototyping, joint reviewing, consultation, testing, and training to aid in aligning individual interests and goals with the unified goal. Fourth, though the technical expression of MU and protection and communication mechanisms are all important for interoperability, protection and communication mechanisms tend to matter more for the sustenance and continuous acceptance of the interoperable system. Practitioners and policy makers who avoid

compromise on the formalisation and institutionalisation, establishment of consent, illustration and demonstration of 'sense', and documentation are more likely to sustain MU throughout the development of an interoperable system. Finally, the findings of this study can be used as guidelines for how to achieve MU in the development of an IOFMS in the public sector. Hitherto, such guidelines did not exist.

7.5 Limitations and Future Research Directions

In information systems research, arguably only a handful of researchers have critically engaged with MU, sensemaking, and ISD (Jenkin *et al.*, 2019), and almost none have sought to further develop these concepts by mapping sensemaking triggers, processes, outcomes, and influencing factors within IS projects (Sandberg & Tsoukas, 2014). This study is therefore the first of its kind to undertake this endeavour and to do so from the perspective of interoperable systems, which present diverse complexities in making heterogeneous systems and processes work together. That said, this study focused only on the government payroll add-on systems in the Ghanaian public sector. The findings, though valuable, can benefit from further research examining non-financial systems and systems spanning functions of government beyond payroll. Possibilities are health insurance systems, educational systems, procurement systems, and inter-governmental systems for trade. Further, this study was not able to examine how certain managerial practices, such as the leadership styles of senior management or their motivational mechanisms, affect sensemaking processes and outcomes. Focused study of such practices may provide valuable insights to both researchers and practitioners. Further, concerning interoperability, this study focused more on issues related to organisational interoperability. Depending on the extent of access to the data, future research can explore other dimensions, such as the syntactic (communication protocols and APIs) and semantic operability in more detail.

REFERENCES

Abolafia, M. Y. (2010). Narrative construction as sensemaking: How a central bank thinks. *Organisation studies*, *31*(3), 349-367.

Ackroyd, S. (2010). Critical realism, Organisation theory, methodology, and the emerging science of reconfiguration. In *Elements of a philosophy of management and Organisation* (pp. 47–77). Springer, Berlin, Heidelberg.

Alfaro, J. J., Rodríguez-Rodríguez, R., Verdecho, M. J., & Ortiz, A. (2009). Business process interoperability and collaborative performance measurement. *International Journal of Computer Integrated Manufacturing*, *22*(9), 877–889.

Alsharari, N. M., & Youssef, M. A. (2017). Management accounting change and the implementation of GFMIS: A Jordanian case study. *Asian Review of Accounting*, 25(2), 242–261.

Alsharari, N. M., Dixon, R., & Youssef, M. A. E. A. (2015). Management accounting change: Critical review and a new contextual framework. *Journal of Accounting & Organisational Change*, *11*(4), 476–502.

Andrews, M., McNaught, T., & Samji, S. (2018). *Opening adaptation windows onto Public Financial Management reform gaps in Mozambique* (Working Paper No. 341). Harvard University, Center for International Development Faculty.

Angell, I. O., & Smithson, S. (1991). *Information systems management: Opportunities and risks*. Macmillan, Basingstoke.

Archmann, S., & Kudlacek, I. (2008). Interoperability and the exchange of good practice cases. *European Journal of ePractice*, *2*(1), 3–12.

Aveson, D., & Fitzgerald, G. (2006, August). Methodologies for developing information systems: A historical perspective. In *IFIP world computer congress, TC 8* (pp. 27–38). Springer, Boston, MA.

Avgerou, C., & Cornford, T. (1998). *Developing information systems: Concepts, issues and practice*. Macmillan International Higher Education.

Avison, D., & Fitzgerald, G. (2003). *Information systems development: methodologies, techniques and tools*. McGraw-Hill.

Bassil, Y. (2012). A simulation model for the waterfall software development life cycle. *International Journal of Engineering & Technology*, *2*(5), 1–7.

Baskar, S., Shakeel, P. M., Kumar, R., Burhanuddin, M. A., & Sampath, R. (2020). A dynamic and interoperable communication framework for controlling the operations of wearable sensors in smart healthcare applications. *Computer Communications*, *149*, 17-26.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*(4), 544–559.

Beath, C. M. (1987, December). Managing the user relationship in information systems development projects: A transaction governance approach. In *ICIS 1987 Proceedings. 20.* Retrieved on November 20, 2020 from https://aisel.aisnet.org/icis1987/20

Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS Quarterly*, *11*(3), 369–386.

Betley, M., Bird, A., & Ghartey, A. (2012). *Evaluation of public financial management reform in Ghana, 2001–2010 final country case study report.* Joint Evaluation 2012: 8, SIDA, DANIDA and AfDB. Swedish International Development Cooperation Agency.

Bhaskar, R. (1978). *A realist theory of science.* Harvester, Hemel Hempstead.

Bhaskar, R. (1979). *The possibility of naturalism.* Harvester Press, Sussex, UK.

Bhaskar, R. (1989). *Reclaiming reality*. Verso, London.

Bhaskar, R., & Hartwig, M. (2010). *The formation of critical realism: A personal perspective*. Routledge, London and New York.

Birrell, D., Dunsire, G., & Menzies, K. (2010). Match point: Duplication and the scholarly record: The online catalogue and repository interoperability study (OCRIS), and its findings on duplication and authority control in OPACs and IRs. *Cataloging & Classification Quarterly*, *48*(5), 377–402.

Boateng, R. & Hinson, R. (2008). Information systems development: Where does knowledge lie and how does learning occur? *Development and Learning in Organisations*, *22*(3), 18–20.

Boateng, R. (2016). *Research made easy, limited edition.* Create Space Independent Publishing (an Amazon Company), Charleston, USA.

Boateng, R. (2016). Resources, electronic-commerce capabilities and electronic-commerce benefits: Conceptualizing the links. *Information Technology for Development*, *22*(6), 1–23.

Boateng, R. (2020). *Research made easy - second edition*. Kindle Independent Publishing (an Amazon Company), Seattle, USA.

Boateng, R., & Hinson, R. (2008). Information systems development: Where does knowledge lie and how does learning occur? *Development and Learning in Organisations: An International Journal*, *22*(3), 18–20.

Boateng, R., Acheampong, B., & Bedi, I. (2019). Preliminary insights into dominant issues, theories and methodologies in platform interoperability research. *Twenty-fifth Americas Conference on Information Systems, Cancun*, 2019.

Bocij, P., Chaffey, D., Greasley, A., & Hickie, S. (1999). *Business information systems: Technology, development and management.* Financial Times Management, London

Bogner, W. C., & Barr, P. S. (2000). Making sense in hypercompetitive environments: A cognitive explanation for the persistence of high velocity competition. *Organisation Science*, *11*(2), 212–226.

Boudes, T., & Laroche, H. (2009). Taking off the heat: Narrative sensemaking in post-crisis inquiry reports. *Organisation Studies*, *30*(4), 377-396.

Brooke, C. (2002). Critical perspectives on information systems: an impression of the research landscape. *Journal of Information Technology*, *17*(4), 271–283.

Buhalis, D., & Leung, R. (2018). Smart hospitality—Interconnectivity and interoperability towards an ecosystem. *International Journal of Hospitality Management*, *71*, 41–50.

Burrell, G. & Morgan, G. (1979). *Sociological paradigms and Organisational analysis.* London Heinemann Educational Books.

Carlsson, S. A. (2006, February). Towards an information systems design research framework: A critical realist perspective. In *Proceedings of the First International Conference on Design Science Research in Information Systems and Technology, Claremont, CA* (pp. 192-212).

Chalu, H. (2019). The effect of IFMIS adoption on financial reporting quality in Tanzanian local governments. *Business Management Review*, *22*(2), 1–31.

Chen, D., (2006). Enterprise interoperability framework. *In Proceedings of Enterprise Modelling and Ontologies for Interoperability*, EMOI-Interop.

Chiu, J. L., & Linn, M. C. (2011). Knowledge integration and wise engineering. *Journal of Pre-College Engineering Education Research (J-PEER)*, *1*(1), 1–14.

Chua, W. F. (1986). Radical developments in accounting thought. *Accounting Review*, *61*(4), 601–632.

Cornelissen, J. P. (2012). Sensemaking under pressure: The influence of professional roles and social accountability on the creation of sense. *Organisation Science*, *23*(1), 118-137.

Creswell, J. (2013). *Qualitative enquiry and research design: Choosing among five approaches* (3rd ed.). Sage, Los Angeles.

Creswell, J. W. (1994). A Framework for the Study. In J. W. Creswell (Ed.), *Research Design: Qualitative & Quantitative Approaches* (pp. 1–19). Sage, Thousand Oaks, CA.

Creswell, J. W. (2017). *CUSTOM: CEC Edition Qualitative Inquiry and Research Design* 3e. Sage Publications, Thousand Oaks, CA.

Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and Conducting Mixed Methods Research*. Sage Publications, Thousand Oaks.

Danermark, B., Ekstrom, M., Jakobsen, L., & Karlsson, J. C. (2002). *Explaining society: Critical realism in the social sciences*. Routledge, London, UK.

De Vaujany, F. X. (2008). Capturing reflexivity modes in IS: A critical realist approach. *Information and Organisation*, *18*(1), 51-72.

Delaram, J., & Valilai, O. F. (2017). A novel solution for manufacturing interoperability fulfillment using interoperability service providers. *Procedia CIRP*, *63*, 774–779.

Dener, C., Watkins, J., & Dorotinsky, W. L. (2011). *Financial management information systems: 25 years of World Bank experience on what works and what doesn't*. The World Bank.

Dennis, A., Wixom, B. H., & Roth, R. M. (2018). *Systems analysis and design*. John Wiley & sons.

Dewey, J. (1910). *How we think*. Heath & Co., Boston, D.C.

Dill, C. R., & Romiszowski, A. J. (1997). The instructional development paradigm: an instruction. In C. R. Dill, & A. J. Romiszowski. (Eds.), *Instructional development paradigms* (pp. 5-30). Educational Technology Publications, Englewood Cliffs, NJ.

DiSessa, A. A. (1993). Toward an epistemology of physics. *Cognition and Instruction*, *10*(2), 105–225.

Dobson, P. J. (2001). The philosophy of critical realism—an opportunity for information systems research. *Information Systems Frontiers*, *3*(2), 199–210.

Dobson, P. J. (2002). Critical realism and information systems research: why bother with philosophy. *Information Research, 7*(2), 1–13.

Doolin, B. (2004). Power and resistance in the implementation of a medical management information system. *Information Systems Journal*, *14*(4), 343-362.

Dorotinsky, W., & Watkins, J. (2013). Government financial management information systems. In R. Allen, R. Hemming, & B. H.Potter (Eds.), *The International Handbook of Public Financial Management* (pp. 797–816). Palgrave Macmillan.

Dos Santos, E. M. D., & Reinhard, N. (2012). Electronic government interoperability: Identifying the barriers for frameworks adoption. *Social Science Computer Review*, *30*(1), 71–82.

Dougherty, D. S., & Drumheller, K. (2006). Sensemaking and emotions in Organisations: Accounting for emotions in a rational(ised) context. *Communication Studies*, *57*(2), 215–238.

Dunbar, R. L., & Garud, R. (2009). Distributed knowledge and indeterminate meaning: The case of the Columbia shuttle flight. *Organisation Studies*, *30*(4), 397–421.

Easton, G. (2010). Critical realism in case study research. *Industrial Marketing Management*, *39*(1), 118–128.

Effah, J. (2016). Institutional effects on e-payment entrepreneurship in a developing country: enablers and constraints. *Information Technology for Development*, *22*(2), 205–219.

Effah, J., & Nuhu, H. (2017). Institutional barriers to digitalisation of government budgeting in developing countries: A case study of Ghana. *The Electronic Journal of Information Systems in Developing Countries*, *82*(1), 1–17.

Elster, J. (1998). A plea for mechanisms, in Hedstrøm, P. and Swedberg, R. (Eds), *Social mechanisms: An analytical approach to social theory* (pp. 45–73). Cambridge University Press, Cambridge.

Emmel, N. (2013). *Sampling and choosing cases in qualitative research: A realist approach*. Sage, London.

Estermann, B., Riedl, R., & Neuroni, A. C. (2009). Integrated and transcendent e-Government: Keys for analysing Organisational structure and governance. In *Proceedings of the 10th Annual International Conference on Digital Government Research: Social Networks: Making Connections between Citizens, Data and Government* (pp. 162–171). Digital Government Society of North America.

Fletcher, A. J. (2017). Applying critical realism in qualitative research: methodology meets method. *International Journal of Social Research Methodology*, *20*(2), 181–194.

Ford, M. J. (2012). A dialogic account of sense-making in scientific argumentation and reasoning. *Cognition and Instruction, 30*(3), 207–245.

Galliers, R. (1992). *Information systems research: Issues, methods and practical guidelines*. Blackwell Scientific.

Gcora, N., & Chigona, W. (2019). Post-implementation evaluation and challenges of Integrated Financial Management Information Systems for municipalities in South Africa. *South African Journal of Information Management*, *21*(1), 1–12.

Ghenassia, A., Beuscart, J. B., Ficheur, G., Occelli, F., Babykina, E., Chazard, E., & Genin, M. (2017). A generic method for improving the spatial interoperability of medical and ecological databases. *International Journal of Health Geographics*, *16*(1), 36.

Ghezzi, A., Cortimiglia, M. N., & Balocco, R. (2012). Mobile content and service delivery platforms: A technology classification model. *Info*, *14*(2),72–88,

Gioia, D. A., & Chittipeddi, K. (1991). Sensemaking and sensegiving in strategic change initiation. *Strategic Management Journal*, *12*(6), 433–448.

Gogan, J. L., Williams, C. B., & Fedorowicz, J. (2007). RFID and interorganisational collaboration: Political and administrative challenges. *Electronic Government, an International Journal*, *4*(4), 423–435.

Golzarpoor, B., Haas, C. T., Rayside, D., Kang, S., & Weston, M. (2018). Improving construction industry process interoperability with Industry Foundation Processes (IFP). *Advanced Engineering Informatics*, *38*, 555–568.

Gottschalk, P., & Solli-Sæther, H. (2009). Stages of e-government interoperability. In P. Gottschalk, & H. Solli-Sæther (Eds.), *E-Government Interoperability and Information Resource integration: Frameworks for Aligned Development* (pp. 108–123). IGI Global.

Gregory, R. W., Beck, R., & Keil, M. (2013). Control balancing in information systems development offshoring projects. *Mis Quarterly*, *37*(4), 1211–1232.

Grover, V., Lyytinen, K., Srinivasan, A., & Tan, B. (2008). Contributing to rigorous and forward thinking explanatory theory. *Journal of the Association for Information Systems*, *9*(2), 40–47.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. *Handbook of Qualitative Research*, *2*(163-194), 105.

Guijarro, L. (2007). Interoperability frameworks and enterprise architectures in e-government initiatives in Europe and the United States. *Government Information Quarterly*, *24*(1), 89–101.

Guijarro, L. (2009). Semantic interoperability in eGovernment initiatives. *Computer Standards & Interfaces*, *31*(1), 174–180.

Halevy, A. Y. (2001). Answering queries using views: A survey. *The VLDB Journal*, *10*(4), 270–294.

Hammer, D., & van Zee, E. (2006). Chapter 2: The beginnings of scientific reasoning. In *Seeing the science in children's thinking: Case studies of student inquiry in physical science* (pp. 13–35). Heinemann, Portsmouth, NH.

Hammer, D., Elby, A., Scherr, R. E., & Redish, E. F. (2005). Resources, framing, and transfer. In J. P. Mestre (Ed.), *Transfer of learning from a modern multidisciplinary perspective* (pp. 89–120). IAP, Greenwich, CT.

Hendriks, C. J. (2012). Integrated Financial Management Information Systems: Guidelines for effective implementation by the public sector of South Africa: Original research. *South African Journal of Information Management, 14*(1), 1–9.

Henning, F. (2018). A theoretical framework on the determinants of organisational adoption of interoperability standards in Government Information Networks. *Government Information Quarterly, 35*(4), S61–S67.

Hove, M., & Wynne, A. (2010). The experience of medium-term expenditure framework & integrated financial management information system reforms in sub-Saharan Africa: What is the balance sheet. Retrieved on April 7, 2019 from http://www.acbf-pact.org/knowledge/documents/Occasional Paper 9.pdf

IEEE (2000). *The Authoritative Dictionary of IEEE Standards Terms* (7th ed.). IEEE Std 100–2000.

ISO (2009). *Industrial Automation Systems and Integration -- Manufacturing Software Capability Profiling for Interoperability – Second Edition.* ISO 16100-1:2009. ISO/TC 184/SC 5. Geneva, Switzerland.

Janssen, M., & Feenstra, R. (2010). Service portfolios for supply chain composition: Creating business network interoperability and agility. *International Journal of Computer Integrated Manufacturing*, *23*(8–9), 747–757.

Jenkin, T. A., Chan, Y. E., & Sabherwal, R. (2019). Mutual understanding in information systems development: Changes within and across projects. *MIS Quarterly*, *43*(2), 649–671.

Jirava, P. (2004). System development life cycle. In *Scientific papers of the University of Pardubice series D* (pp. 118–125). Univerzita Pardubice.

Joshi, K. D., Sarker, S., & Sarker, S. (2007). Knowledge transfer within information systems development teams: Examining the role of knowledge source attributes. *Decision Support Systems*, *43*(2), 322–335.

Kaplan, B., & Duchon, D. (1988). Combining qualitative and quantitative methods in information systems research: a case study. *MIS Quarterly*, *12*(4), 571–586.

Kendall, K. E., & Kendall, J. E. (2010). *Systems analysis and design*. Prentice Hall Press.

Kirsch, L. J. (2004). Deploying common systems globally: The dynamics of control. *Information Systems Research*, (*15*)4, 374–395.

Klein, H. K., & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly*, *23*(1), 67–93.

Klischewski, R., & Scholl, H. J. (2006). Information quality as a common ground for key players in e-government integration and interoperability. In *Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS'06)* (Vol. 4, pp. 72–72). IEEE.

Korica, M., & Molloy, E. (2010). Making sense of professional identities: Stories of medical professionals and new technologies. *Human Relations*, *63*(12), 1879–1901.

Krauss, S. E. (2005). Research paradigms and meaning making: a primer. *The Qualitative Report*, *10*(4), 758–770.

Kubicek, H., & Cimander, R. (2009). Three dimensions of Organisational interoperability. *European Journal of ePractice*, *6*, 1–12.

Kuhn, T. S. (1970). Book & film reviews: Revolutionary view of the history of science: The structure of scientific revolutions. *The Physics Teacher*, *8*(2), 96–98.

Lapointe, L., & Rivard, S. (2005). A multilevel model of resistance to information technology implementation. *MIS quarterly*, *29*(3), 461-491.

Levina, N. (2005). Collaborating on multiparty information systems development projects: A collective reflection-in-action view. *Information systems research*, *16*(2), 109-130.

Levine Daniel, J., & Eckerd, A. (2019). Organisational sensegiving: Indicators and nonprofit signaling. *Nonprofit Management and Leadership*, *30*(2), 213-231.

Levy, Y., & Ellis, T. J. (2006). A systems approach to conduct an effective literature review in support of information systems research. *Informing Science: The International Journal of an Emerging Transdiscipline, 9,* 181–212.

Lincoln, Y. S., Lynham, S. A., & Guba, E. G. (2011). Paradigmatic controversies, contradictions, and emerging confluences, revisited. *The Sage Handbook of Qualitative Research*, *4*, 97–128.

Lind, M. R., & Zmud, R. W. (1991). The influence of a convergence in understanding between technology providers and users on information technology innovativeness. *Organisation Science*, *2*(2), 195–217.

Llanes-Padrón, D., & Pastor-Sánchez, J-A (2017). Records in contexts: the road of archives to semantic interoperability. *Program*, *51*(4), 387–405.

Lyytinen, K. (1987). Different perspectives on Information Systems: Problems and solutions. *ACM Computing Surveys, 19*(1), 5–46.

Maheshwari, D., & Janssen, M. (2014). Reconceptualizing measuring, benchmarking for improving interoperability in smart ecosystems: The effect of ubiquitous data and crowdsourcing. *Government Information Quarterly, 31*, S84–S92.

Maitlis, S., & Lawrence, T. B. (2007). Triggers and enablers of sensegiving in Organisations. *Academy of management Journal*, *50*(1), 57-84.

Maitlis, S., & Sonenshein, S. (2010). Sensemaking in crisis and change: Inspiration and insights from Weick (1988). *Journal of Management Studies*, *47*(3), 551–580.

Majchrzak, A., More, P. H., & Faraj, S. (2012). Transcending knowledge differences in cross-functional teams. *Organisation Science*, *23*(4), 951-970.

Manicas, P. (1998) A realist social science. In M. Archer, R. Bhaskar, A. Collier, T. Lawson, & A. Norrie (Eds.), *Critical realism: Essential reading*. Routledge, London.

Mason, J. (2002). *Researching your own practice: The discipline of noticing.* Routledge-Falmer, New York.

Micheni, E. M. (2017). Analysis of the critical success factors of Integrated Financial Management Information Systems in selected Kenyan counties. *Journal of Finance and Accounting*, *5*(5), 185–192.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* 2nd Sage, Thousand Oaks, CA.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). Sage Publications, Thousand Oaks.

Mingers, J. (2004). Real-izing information systems: critical realism as an underpinning philosophy for information systems. *Information and Organisation*, *14*(2), 87–103.

Mingers, J., Mutch, A., & Willcocks, L. (2013). Critical realism in information systems research. *MIS Quarterly*, *37*(3), 795–802.

Morris, E., Levine, L., Meyers, C., Place, P., & Plakosh, D. (2004). *System of Systems Interoperability (SOSI): Final report*. Software Engineering Institute, Carnegie Mellon University, Pittsburgh, PA.

Munk, S. (2002). An analysis of basic interoperability related terms, system of interoperability types. *Academic and Applied Research in Military Science, 1,* 117–132.

Mutch, A. (2002). Actors and networks or agents and structures: Towards a realist view of information systems. *Organisation*, *9*(3), 477–496.

Myers, M. D., & Avison, D. (Eds.). (2002). *Qualitative research in information systems: a reader*. Sage.

Nayar, A., & Beldona, S. (2010). Interoperability and open travel alliance standards: Strategic perspectives. *International Journal of Contemporary Hospitality Management*, *22*(7), 1010–1032.

Nelson, K. M., & Cooprider, J. G. (1996). The contribution of shared knowledge to IS group performance. *MIS Quarterly*, *20*(4), 409–432.

Nor, A. I. (2019). Increasing government revenue through Integrated Financial Management System case of Federal Government of Somalia. *European Journal of Economic and Financial Research, 3*(5), 9–20.

Novakouski, M., & Lewis, G. A. (2012). *Interoperability in the e-Government Context* (No. CMU/SEI-2011-TN-014).

Nuhu, H., Effah, J., & Van Belle, J. P. (2018). Implementing e-government Financial Systems in a developing country: An institutional perspective. *Development Informatics Association (IDIA 2018)*, 45.

Odden, T. O., & Russ, R. (2017). Charges are everywhere: A case of student sensemaking about electric current. In *Physics education research conference proceedings* (pp. 280-283).

Ofori-Atta, K. (2017, October 18). GIFMIS to replace stand-alone legacy financial management systems *Ghana News Agency*. Retrieved on April 5, 2019 from https://www.businessghana.com/site/news/business/153774/GIFMIS-to-replace-stand-alone-legacy-financial-management-systems

Orlikowski, W. J. (2000). Using technology and constituting structures: A practice lens for studying technology in Organisations. *Organisation Science*, *11*(4), 404–428.

Orlikowski, W. J., & Baroudi, J. J. (1991). Studying information technology in Organisations: Research approaches and assumptions. *Information Systems Research*, *2*(1), 1–28.

Osborne, J. F., & Patterson, A. (2011). Scientific argument and explanation: A necessary distinction?. *Science Education*, *95*(4), 627–638.

Pardo T. A., & Tayi, G. K. (2007). InterOrganisational information integration: A key enabler for digital government. *Government Information Quarterly*, *24*(1), 691–715.

Paré, G. (2004). Investigating information systems with positivist case study research. *Communications of the Association for Information Systems*, *13*(1), 233–264.

Perucci, F. (2020, February 21). Data Interoperability: Lessons from UN Statisticians. Statistics Division, UN Department of Economic and Social Affairs. Retrieved October 10, 2020, from https://unite.un.org/news/data-interoperability-lessons-un-statisticians

Petter, S., & McLean, E. R. (2009). A meta-analytic assessment of the DeLone and McLean IS success model: An examination of IS success at the individual level. *Information & Management*, *46*(3), 159–166.

Pinto, J. K., & Slevin, D. P. (1987). Critical factors in successful project implementation. *IEEE Transactions on Engineering Management*, (1), 22–27.

Prodanović, R. I., & Vulić, I. B. (2017). Model for PKI interoperability in Serbia. *Vojnotehnički glasnik*, *65*(2), 530–549.

Puustjarvi, J., & Puustjarvi, L. (2011). Personal Health Ontology: Towards the interoperation of e-health tools. *International Journal of Electronic Healthcare*, *6*(1), 62–75.

Ragunath, P. K., Velmourougan, S., Davachelvan, P., Kayalvizhi, S., & Ravimohan, R. (2010). Evolving a new model (SDLC Model-2010) for software development life cycle (SDLC). *International Journal of Computer Science and Network Security*, *10*(1), 112–119.

Ray, D., Gulla, U., & Dash, S. S. (2011). The Indian approach to e-government interoperability. *JOAAG*, *6*(1), 27–42.

Rezaei, R., Chiew, T. K., & Lee, S. P. (2014). A review on e-business interoperability frameworks. *Journal of Systems and Software*, *93*, 199–216.

Robey, D., Smith, L. A., & Vijayasarathy, L. R. (1993). Perceptions of conflict and success in information systems development projects. *Journal of Management Information Systems*, *10*(1), 123–140.

Rodin-Brown, E. (2008). *Integrated Financial Management Information Systems: A practical guide.* Retrieved on April 6, 2019, from http://pdf.usaid.gov/pdf_docs/PNADK595.pdf

Rosenberg, S., Hammer, D., & Phelan, J. (2006). Multiple epistemological coherences in an eighth-grade discussion of the rock cycle. *Journal of the Learning Sciences*, *15*(2), 261–292.

Sabherwal, R., & Grover, V. (2010). A taxonomy of political processes in systems development. *Information Systems Journal*, *20*(5), 419-447.

Sambamurthy, V., & Kirsch, L. J. (2000). An integrative framework of the information systems development process. *Decision Sciences*, *31*(2), 391–411.

Sandberg, J., & Tsoukas, H. (2015). Making sense of the sensemaking perspective: Its constituents, limitations, and opportunities for further development. *Journal of Organisational Behaviour*, *36*(S1), S6–S32.

Sarantakos, S. (1998). Varieties of social research. In *Social research* (pp. 31-71). Palgrave, London.

Saunders, M. & Lewis, P. & Thornhill, A. & Bristow, A. (2019). *Research Methods for Business Students - Chapter 4: Understanding research philosophy and approaches to theory development.* Pearson Education Limited, London.

Sayer, A. (2000). *Realism and social science*. Sage Publications, London.

Schnelker, D. L. (2006). The student-as-bricoleur: Making sense of research paradigms. *Teaching and Teacher Education*, *22*(1), 42–57.

Scholl, H. J., & Klischewski, R. (2007). E-government integration and interoperability: Framing the research agenda. *International Journal of Public Administration*, *30*(8–9), 889–920.

Scholl, H. J., Kubicek, H., Cimander, R., & Klischewski, R. (2012). Process integration, information sharing, and system interoperation in government: A comparative case analysis. *Government Information Quarterly*, *29*(3), 313–323.

Seidl, D., & Werle, F. (2018). Inter-Organisational sensemaking in the face of strategic meta-problems: Requisite variety and dynamics of participation. *Strategic Management Journal*, *39*(3), 830-858.

Senyo, P. K., Addae, E., & Boateng, R. (2018). Cloud computing research: A review of research themes, frameworks, methods and future research directions. *International Journal of Information Management*, *38*(1), 128–139.

Sharma, R., & Panigrahi, P. K. (2015). Developing a roadmap for planning and implementation of interoperability capability in e-government. *Transforming Government: People, Process and Policy*, *9*(4), 426–447.

Shelly, G.B., & Rosenblatt, H.J. (2012). *Systems Analysis and Design. 9th Edition*.: Course Technology, Cengage Learning, Boston.

Shen, J., & Linn, M. C. (2011). A technology-enhanced unit of modelling static electricity: Integrating scientific explanations and everyday observations. *International Journal of Science Education*, *33*(12), 1597–1623.

Sherin, B. L., Krakowski, M., & Lee, V. R. (2012). Some assembly required: How scientific explanations are constructed during clinical interviews. *Journal of Research in Science Teaching*, *49*(2), 166–198.

Sommerville, I. (2010). *Software engineering: International version.* Pearson, Boston, MA.

Stake, R. E. (2008). Qualitative case studies. In N. K. Denzin & Y. N. Lincoln (Eds.), *Strategies of qualitative inquiry* (pp. 119-149). Sage Publications, Thousand Oaks, CA.

State Services Commission. (2007). New Zealand e-government interoperability framework. Retrieved on September 7, 2019 from http://www.e.govt.nz

Stigliani, I., & Elsbach, K. D. (2018). Identity co-formation in an emerging industry: Forging Organisational distinctiveness and industry coherence through sensemaking and sensegiving. *Journal of Management Studies*, *55*(8), 1323-1355.

Stigliani, I., & Ravasi, D. (2012). Organizing thoughts and connecting brains: Material practices and the transition from individual to group-level prospective sensemaking. *Academy of Management journal*, *55*(5), 1232–1259.

Tanko, S. (2013, May 8). GIFMIS to manage public funds. *Ghana News Agency*. Retrieved on April 5, 2019 from https://www.ghanaweb.com/GhanaHomePage/business/GIFMIS-to-manage-public-funds-273365#

Tannen, D. (Ed.). (1993). *Framing in discourse*. Oxford University Press on Demand.

Telegdy, Á. (2018). Public wage spillovers: The role of individual characteristics and employer wage policies. *Labour Economics*, *55*, 116–129.

Thayer, R. H., & Christensen, M. J. (2005). *Software engineering, the development process-Volume 1*. Wiley-IEEE Computer Society Pr.

Tih, S., Wong, K. K., Lynn, G. S., & Reilly, R. R. (2016). Prototyping, customer involvement, and speed of information dissemination in new product success, *Journal of Business & Industrial Marketing*, *31*(4), 437-448

Thorogood, J. (2019). New materialism and old materials: Chemical geopolitics, interoperability and opium determination in the 1950s. *Political Geography*, *75*, 102064.

Tripathi, R., Gupta, M. & Bhattacharya, J. (2012). Interoperability adoption among government and corporate portals in India: a study. *Journal of Enterprise Information Management*, *25*(2), 98–122.

Tripathi, R., Gupta, M. P., & Bhattacharya, J. (2013). Effect of Organisational factors on interoperability adoption for Indian portals. *Transforming Government: People, Process and Policy*, *7*(3), 285–308.

Trochim, W. M. K. (2020). Research methods knowledge base: Construct validity. Retrieved on November 20, 2020 from https://conjointly.com/kb/construct-validity/

Tzeng, C. H. (2018). How foreign knowledge spillovers by returnee managers occur at domestic firms: An institutional theory perspective. *International Business Review*, *27*(3), 625–641.

Van der Veer, H., & Wiles, A. (2008). *Achieving technical interoperability*. Sophia Antipolis Cedex, France: European Telecommunications Standards Institute.

Vernadat, F. B. (2010). Technical, semantic and Organisational issues of enterprise interoperability and networking. *Annual Reviews in Control*, *34*(1), 139–144.

Vlaar, P. W., van Fenema, P. C., & Tiwari, V. (2008). Cocreating understanding and value in distributed work: How members of onsite and offshore vendor teams give, make, demand, and break sense. *MIS Quarterly*, *32*(2), 227–255.

Wadia, J. (2000). Welcome to digital democracy. Times Computing, 22 November. Retrieved on January 30, 2019 from www.timescomputing.com/20001122/nws1.html

Wallace, L., Keil, M., and Rai, A. (2003). How software project risk affects project performance: An investigation of the dimensions of risk and an exploratory model. *Decision Sciences*, *35*(2), 289–321.

Walsham, G. (2006). Doing interpretive research. *European Journal of Information Systems*, *15*(3), 320–330.

Wang, G.G. (2002), Definition and Review of Virtual Prototyping, *Journal of Computing and Information Science in Engineering*, *2*(3), 232-237.

Weichhart, G. (2014). Learning for sustainable organisational interoperability. *IFAC Proceedings Volumes*, *47*(3), 4280–4285.

Weichhart, G. (2015). Supporting the evolution and interoperability of organisational models with e-learning technologies. *Annual Reviews in Control*, *39*, 118–127.

Weichhart, G., Stary, C., & Vernadat, F. (2018). Enterprise modelling for interoperable and knowledge-based enterprises. *International Journal of Production Research*, *56*(8), 2818–2840.

Weick, K. (1979). *The social psychology of organizing* (2nd ed.). Addison-Wesley, Reading, MA.

Weick, K. (1995). Sensemaking in Organisations. Sage Publications, Thousand Oaks, CA.

Weick, K. E. (2001). *Making sense of the Organisation.* Blackwell Publishing, Malden, MA.

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (2005). Organizing and the process of sensemaking. *Organisation Science*, *16*(4), 409-421.

Widergren, S. E., Hardin, D., Ambrosio, R., Drummond, R., Gunther, E., Gilchrist, G., & Cohen, D. (2007). *Interoperability Context-Setting Framework* (No. PNNL-SA-53687). Pacific Northwest National Lab. (PNNL), Richland, WA (United States).

Wikgren, M. (2005). Critical realism as a philosophy and social theory in information science? *Journal of Documentation*, *61*(1), 11–22.

World Bank (2015). Managing Change in PFM System Reforms: A Guide for Practitioners. Financial Management Information Systems Community of Practice. World Bank Group. Retrieved on 12 June 2019 from http://bit.ly/2MtTrHy

Wynn Jr, D., & Williams, C. K. (2012). Principles for conducting critical realist case study research in information systems. *MIS Quarterly*, *36*(3), 787–810.

Yazan, B. (2015). Three approaches to case study methods in education: Yin, Merriam, and Stake. *The Qualitative Report*, *20*(2), 134–152.

Yeboah, S.K. (2015). *Public Sector Financial Management Reforms in Ghana: The case of Ghana Integrated Financial Management Information System* (GIFMIS). Master of Philosophy Thesis. University of Ghana Business School (Published at: University of Ghana Digital Collections http://ugspace.ug.edu.gh).

Yin, R. K. (1994). Discovering the future of the case study. Method in evaluation research. *Evaluation Practice*, *15*(3), 283–290.

Yin, R. K. (2009). *Case study research: Design and methods*. Sage Publications, Thousand oaks.

Yin, R. K. (2013). Validity and generalization in future case study evaluations. *Evaluation,19*(3), 321–332.

Zengenene, D. (2013). Global interoperability and linked data in libraries. *New Library World. 114* (1/2),84-87

APPENDICES

Appendix A: Methodology for Review of the Literature on Interoperable Systems

The search for articles was conducted with the phrase "platform interoperability" and keyword "interoperability" on the abstracts, keywords and titles 'search spaces' across the databases. Collecting literature from electronic sources is mostly performed by researchers to gather literature that provides justification for arguments or assertions they make in their study on a particular subject (Petter & McLean, 2009). Searches were conducted in five journal databases: Online Wiley, Emerald, EBSCOhost, ScienceDirect, and Taylor & Francis. A contributory reason for the use of these five databases was the lack of identifiable papers that discuss the concept of platform interoperability. However, in the view of Levy and Ellis (2006), these journal databases are ranked as part of the sources of the top fifty information systems journals. As such, a fair representation has been made in this regard. The study sought for journal papers published from 2008 to 2020.

Inclusion and Exclusion Criteria

Three criteria were used to gather appropriate and reliable literature that will enable the purpose of the research to be fulfilled. First, for a paper to be considered for use in this study, it must be a recognisable peer review article or journal. Thus, conference papers, doctorate dissertations and master's theses, textbooks and magazine publications were eliminated. Second, the paper should provide a substantial discussion on interoperability of systems or platforms.

As such papers that did not have substantial details and a clear discussion on the concept of interoperability of systems or platforms were excluded (e.g. Zengenene, 2013; Thorogood,

2019). Third, its subject should be related to this review's conceptualisation of the term. Papers that sought to conceptualise the topic of interoperability or platform interoperability were also considered and included in the study as long as they met the first three conditions. As this study sought to review studies published over the past decade, the search was filtered to return only scholarly journal articles published from 2008 to 2020.

Data Extraction and Synthesis

A total of 174 papers were initially identified and downloaded from the search of the electronic databases. However, after downloading the papers from the electronic databases, a total of 157 papers were deemed to meet the selection criteria and were used for the analysis. To clearly indicate the purpose of this study, these papers were summarised according to three themes: dominant issues about platform interoperability, dominant conceptual or theoretical approaches to studying platform interoperability and dominant methodological approaches to studying platform interoperability.

Appendix B: Interview Guide

MUTUAL UNDERSTANDING AND INTEROPERABLE SYSTEMS DEVELOPMENT IN THE PUBLIC SECTOR OF GHANA: A SENSEMAKING THEORY PERSPECTIVE

Participants: Project Implementation Stakeholders

Investigator: Mr. Bryan Acheampong

Interview – the interview will be guided by the study's research framework which is based on sensemaking theory. However, there is room for unstructured conversation that contributes to a better understanding of how mutual understanding is generated for successful implementation of interoperable financial management systems. The following questions will be primary.

Purpose:

My study is about how project stakeholders give and make sense to achieve mutual understanding in the design, development and implementation of interoperable government financial management systems. **The purpose is to develop a theoretical framework that explains the creation and sustenance of mutual understanding between stakeholders in the development of interoperable financial management systems in a developing economy**.

Assurance:

You have the assurance of the University of Ghana that all information gathered will be protected and used solely for academic purposes. Findings from the study will be presented to you before any final publication. The interview should last from 45 minutes to 1 hour. I will be taking handwritten notes during the session as well as record electronically. The recordings will be transcribed and submitted to you for any addition or subtraction before I proceed with any analysis.

If you have any questions about your rights as a research participant in this study you may contact the Administrator of the Ethics Committee for Humanities, ISSER, University of Ghana at ech@isser.edu.gh / ech@ug.edu.gh or 00233- 303-933-866.
Are there any questions you may have about the interview?

General Question

General information about interviewee and setting: *Full name, profession, position, department, number of years with organisation, phone, email.*

Background Information

1. What is your background?
2. What is your role in the analysis, design, development and implementation of the add-on systems for GIFMIS?
3. Kindly describe what you actually did.

Research Objective 1: Triggers and Processes for Mutual Understanding

4. What triggered you to give out information to make other stakeholders understand your expectations or requirements from the project?
5. What triggered you to receive or accept other project stakeholders' information about their project expectations or requirements?
6. How did you receive information from other project stakeholders?
7. In what formats was project information shared or received?

Research Objective 2: Effect of Project Mechanisms on Sensemaking Processes and Outcomes

8. How did you make sense of the project during the project analysis phase?
9. What was the outcome of the analysis phase for you and the other stakeholders?
10. How did you make sense of the project during the project design phase?
11. What was the outcome of the design phase for you and the other stakeholders?
12. How did you make sense of the project during the project development phase?
13. What was the outcome of the development phase for you and the other stakeholders?
14. How did you make sense of the project during the project implementation phase?
15. What was the outcome of the implementation phase for you and the other stakeholders?
16. How did you make sense of the project during the post-implementation phase?
17. What was the outcome of the post-implementation phase for you and the other stakeholders?

Research Objective 3: Influencing factors of Mutual Understanding

18. What conditions enabled you to achieve mutual understanding with other project stakeholders?
19. What conditions constrained you from achieving mutual understanding with other project stakeholders?

Closing remarks

Thank you for sharing this valuable information.

Is there anything else you would like to add before we end?

Thank you for your time. I may get in touch again for clarification when needed.

Appendix C: Ethical Clearance Notification Letter

UNIVERSITY OF GHANA
ETHICS COMMITTEE FOR THE HUMANITIES (ECH)
P. O. Box LG 74, Legon, Accra, Ghana

My Ref. No…ECH 177 /19-20 …

August 5th, 2020

Bryan Acheampong
University of Ghana Business School
UG, Legon-Accra

ETHICAL CLEARANCE
(ECH 177/19-20)

The protocol tittle below has been reviewed and approved by the ECH Committee.

TITLE OF PROTOCOL: **MUTUAL UNDERSTANDING IN THE DEVELOPMENT INTEROPERABLE SYSTEMS IN THE PUBLIC SECTOR.**

PRINCIPAL INVESTIGATOR: **BRYAN ACHEAMPONG**

Please note that the final review report must be submitted to the Committee at the completion of the study. Your research records may be audited at any time during or after the implementation. Any modification of this research project must be submitted to ECH for review and approval prior to implementation.

Please report all serious adverse events related to this study to ECH within seven (7) days verbally and in writing within fourteen (14) days.

This certificate is valid till June 4th, 2021. You are to submit annual reports for continuing review.

Please accept my congratulations.

Yours Sincerely,

Professor C. Charles Mate-Kole
ECH Chair

Cc: Professor John Effah, University of Ghana, UG.
Dr. Owusu Acheampong, University of Ghana Business School, UG.

Tel: +233-303933866 Email: ech@ug.edu.gh

Appendix D: Publications from the Thesis

Book Chapter

Acheampong, B., & Bedi, I. (2020). Mutual Understanding in Interoperable/Integrated Financial Management Systems Implementation in the Public Sector: A Viewpoint for Future Research. In R. Boateng (ed). *Handbook of Research on Managing Information Systems in Developing Economies*. (pp. 522-531). PA, USA: IGI Global.

Conference Paper

Boateng, R., **Acheampong**, B., & Bedi, I. (2019). Preliminary Insights into Dominant Issues, Theories and Methodologies in Platform Interoperability Research. In *Twenty-Fifth American Conference on Information Systems* (pp.1-10). Cancun, Mexico: Association for Information Systems Electronic Library. AMCIS 2019 -ISBN: 978-0-9966831-8-0

Other Publications of the Student

Journal Article

Ofosu-Ampong, K., & **Acheampong**, B. (2022). Adoption of contactless technologies for remote work in Ghana post-Covid-19: Insights from the technology-organisation-environment framework. *Digital Business, 2*(2), 100023.

Book Chapters

Boateng, R., & **Acheampong**, B. (2022). Embracing the New Normal: Guidelines for Small Businesses in Emerging Economies. In R. Boateng, S.L. Boateng, & T. Anning Dorson (2022) (eds). *Delivering Distinctive Value in Emerging Economies - Efficient and Sustainably Responsible Perspectives from Management Researchers and Practitioners*. (pp. 3-9). New York, USA: Productivity Press, Routledge.

Annan-Noonoo, P., **Acheampong**, B., Budu, J., & Entee, E. (2022). A review of dominant issues, multi-dimensions, and future research directions for smart cities. R. Boateng, S.L. Boateng, & T. Anning Dorson (2022) (eds). *Digital Innovations, Business and Society in Africa – New Frontiers and A Shared Vision.* (pp. 281-310). Cham, Switzerland: Springer International Publishing.