Cape Peninsula
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A metrics model for evaluating Incident Command System adoption in a South African municipality.

by

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ABSTRACT

Over the years, South Africa has experienced a number of service-delivery-related protests due to unsatisfactory or inadequate services delivered to citizens. As such, municipalities strive to improve on safety and security services delivery. These municipalities have invested in IT solutions such as the incident command system (ICS) purposely to enhance task allocation, response time monitoring, information flow governance, and workflow incidents management, which are fundamental to service delivery. However, there is no empirical evidence of the significance and return on investment (ROI) of ICS. Furthermore, there is no mechanism for determining the strategic direction of the ICS towards improving service delivery.

This is a challenge because the attributes of ICS, such as the control and flow of incidents, management of functions, and response time have not been evaluated for efficiency and effectiveness. From a business process perspective, these challenges are prohibitive and derail municipalities' delivery of services, while from an IT perspective, the system's compatibility, and co-existence with other systems are some of the challenges that hinder ROI.

As such, the aim of the study was to develop a metrics model to evaluate the adoption of ICS. To achieve this aim, the case study design approach was followed. A South African municipality was selected as a case to be studied. Qualitative research methods were used to gain an in-depth understanding of ICS within the organisation. Data was collected from the case using the semi-structured interview technique. The data collected was analysed using the actor-network theory's (ANT) four moments of translation. The interpretivist approach was followed to understand the factors that influenced the operationalisation of ICS.

The factors that manifested from the critical analysis of data are as follows: *(1) Collaboration, (2) Heterogeneity, (3) Governance, (4) Interconnectivity, (5) Requirements, and (6) Top-down approach.* Based on these factors, a metrics model for evaluating the adoption of ICS was developed. This study is of significance to organisations in identifying the factors that influence the adoption of ICS. Furthermore, the model developed can be used as an implementation guide. Understanding the influencing factors and correctly implementing ICS is significant to IT specialists, business stakeholders, and municipalities in improving service delivery. Academically,

the study adds to the body of knowledge from the perspective of ANT, ICS, adoption, and IT evaluation.

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DEDICATION

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ACRONYMS

ANT	Actor-network theory
ICS	Incident Command System
IS	Information Systems
IT	Information Technology
ROI	Return on investment
CPUT	Cape Peninsula University of Technology

GLOSSARY

Term	Definition
ICS	The ICS is an information systems solution designed to address challenges such as resource utilization, communication among multiple agencies as well as coordination of efforts during an incident of any magnitude (Jensen & Thompson, 2015)
IT solutions	IT solutions are group of services, software, or hardware that are combined and offered to organisations to assist them in supporting business processes and address challenges
Evaluation	Evaluation is an applied inquiry process for collecting and compiling evidence that highlights the effectiveness, efficiency, and value of an artefact (Mthethwa & Jili, 2016).
Technology adoption	Adoption is the decision to make full use of an innovation. Innovation is an idea, practice, or object that is perceived as new by an individual or the unit adopting it (Thong & Yap, 1996).

CHAPTER 1 INTRODUCTION

1.1. Introduction

Many municipalities in South Africa experience emergencies due to a variety of incidents, which range from gangsterism' activities, wildfires affecting nature and informal settlements, and tourism related events. All these require the use of coordination, control, monitoring, and communication between the actors (stakeholders), which include community members, employees of these municipalities, and information technology specialists. Some of these municipalities adopt an Incident Command System (ICS), to enhance communication, improve response time, adequately monitor incidents, and improve efficiency of incident workflow management.

The ICS is an information systems solution designed to address challenges such as resource utilisation, communication among multiple agencies as well as coordination of efforts during an incident of any magnitude (Jensen & Thompson, 2015). Djalali et al. (2012:2) define ICS as: *"a standardized on-scene, all-hazards incident management approach designed specifically to allow responders to adopt an integrated organizational structure equal to the complexity and demands of any single incident or multiple incidents without being hindered by jurisdictional boundaries".*

In addition, the ICS is intended to enforce seamless coordination and collaboration of efforts from multiple agencies such as law enforcement, traffic services, fire fighters, and medical services in an environment (DHS, 2008). These are crucial aspects in dealing with emergencies because a coordinated interaction among multiple agencies working on one incident can eradicate confusion and increase response time (Farcas et al., 2021). It is on these basis municipalities adopt the ICS. Even though some municipalities across the world have adopted the technology and extensive research has been conducted on ICS, there seems to be no study that examines the business or technical value to an organisation (Chae & Bae, 2019; Chang, 2017). Nowell and Steelman (2019) suggest that one of the challenges of ICS is that it requires a hybrid governance structure, which many government administrations do not have. Also, this could be attributed to the fact that municipalities have not been able evaluate the technology and there is no metrics to do so.

Thus, two main fundamental concerns are associated with ICS adoption by municipalities. Firstly, there seems to be a limited reference point in South Africa, in addressing its technical challenges and providing support to users. According to Alber et al. (2019), a lack of case reference points for the implementations of technology often has negatively impact on manageability and actualisation of return on investment, from both technical and business perspectives. Secondly, the technology has not been evaluated to ascertain its potentials and value, in practice. Söllner et al. (2018) argue that lack of evaluation poses challenges to understanding the effects of synchronous and asynchronous technology performance.

1.2. Background to the research

The interest of this study was influenced by the researcher's experience. The researcher has been an employee of a municipality in South Africa that adopts the ICS. The researcher as a municipal employee is involved in the ICS post-project implementation. The researcher experienced and witnessed challenges such as database down time. This system failure usually occurs when business users execute reports for large selection criteria. This is because the SAP High-performance Analytic Appliance (HANA), a multi-model database that stores data in its memory instead of storing data on a disk, is the backbone of ICS. This database is utilised as an operational and reporting platform. There is a huge operational burden when this system fails because dispatching agents revert to responding to emergency calls manually.

This has had a huge financial burden on the department as it has had to exert large financial resources for the maintenance of this solution. When the ICS services are offline, the dispatching agents' workload is increased, creating a high-pressure environment with room for human error that may have fatal consequences. These repercussions affect citizens. The above-mentioned factors are what triggered the research of this study.

1.3. Research problem

The Incident Command System (ICS) is implemented in the municipality, purposely to enhance the allocation of tasks, monitor response time, govern information flow, and manage workflow of incidents, which are fundamental to service delivery. However, the significance and value-addition of the ICS, from both technology and business perspectives are not empirically known. In addition, there is no mechanism for determining the strategic direction of the ICS (Chang, 2017) towards improving service delivery. As a result, attributes of ICS, such as incidents control and flows, management

of functions, and response time have not been evaluated, to determine its efficiency and effectiveness. Thus, the problem is twofold. First, the challenges are prohibitive and derail municipalities' service delivery. The second problem is that the return on investment (ROI) of ICS adoption and use, from both technical and non-technical perspectives, is not known.

From a technical perspective, compatibility and co-existence with existing systems are some of the problems that hinder ROI. This is a major problem in that it is prohibitive and derails services primarily because: (1) the automated system (ICS) that controls and monitors incidents for the municipality are not known; (2) how ICS processes and manages information about incidents are black-boxed; and (3) these lagging knowledge poses a challenge for the integration of systems, which negatively affects service delivery because the systems depend on each other for information. This problem cuts across both the technology and business units of the organisation. The challenges stated above can only be addressed if the ICS is evaluated using a formal approach, such as a model.

1.4. Research aim

Based on the research problem presented above, the aim of this study is to develop a metrics model, which can be used to evaluate the adoption and use of the ICS in a municipality, from both technical and non-technical perspectives, in a municipality.

1.4.1. Research objectives

In achieving the aim of the research, the following objectives were articulated:

i. To understand how ICS is adopted and used, to enable and support service delivery, from both business and technology perspectives by a South African municipality.
ii. To examine the ICS from its attributes and ROI perspectives and associate them to service delivery.

1.4.2. Research questions

The research questions are formulated to answer the objectives as stated above. In doing so, the research questions are divided into two, main and subs questions, as follows:

Main Research Question:

How can a metrics model be developed to evaluate the ICS from both technical and non-technical perspectives, in a South African municipality?

Research Sub Questions:

i. How is ICS adopted and used to enable and support service delivery, from both business and technology perspectives by a South African municipality?
ii. What are ICS' attributes and ROI in its adoption and use for service delivery, in a South African municipality?

1.5. Literature review

This section presents a review of literature designed to give an in-depth understanding of the intended field of study. According to Brazer (2019), a literature review provides a framework for establishing the importance of the study and provides a benchmark for comparing the results with other findings. This section focuses on the core aspects of this study, which are the adoption of the technology, Incident Command System (ICS), and the evaluation of systems.

1.5.1. Implementation of information technology solutions

Information technology (IT) solutions offer organisations computing capability to deliver services through data, information, governance, and management of events (Ghobakhloo et al., 2011). Gabriel et al. (2014) suggest that the immense contribution of IT solution has increased the reliance on it by organisations. According to Iyamu (2022), IT solutions are increasingly employed for efficiency and effectiveness to improve service delivery.

The implementation of IT solution refers to the stage at which an organisation selects a particular technology for use (Lai, 2017). When organisations adopt such technologies, it is with the premise of an improvement in business processes and operations. The adopted technology can be used as a tool to either guide an activity or be the activity itself (Govender & Pretorius, 2015). Organisations adopt technologies for various reasons, for strategic or operational purposes. According to Naseer et al. (2013), technology adoption varies, depending on several factors, part of which are geographical locations. Technology adoption is often guided by requirements, which are gathered from units of the organisation (Ullah et al., 2021; Ali et al, 2020).

In the South African context, there is a small pool of empirical studies conducted by researchers such as Reid, 2005; Brazer, 2019; Ndabezitha, 2019; and Sabela-Rikhotso, 2022. All explore the implementation of an ICS in various institutions but not the evaluation thereof. According to Reid (2005), the devastating veld fires of 2000 in the Western Cape highlighted the need for a standardised disaster response-management approach in South Africa. Although the need for such a system was justified, the issue of command was a major impediment that consequently caused disjointed operations, a lack of co-ordination among the different agencies and decentralised reporting mechanisms.

Moreso, the management of an incident, emergency or disaster not only entails response, but also the management of resources such as people, vehicles, procedures, and technology (Brazer, 2019). There is a further emphasis on the importance of the management and co-ordination of responses. Municipalities such as Nkangala District Municipality (NDM), including its six local municipalities in Mpumalanga have partially implemented ICS components but the model with all its functions has not been implemented according to international standards (Ndabezitha, 2019). For instance, the primary responders in this district belong to different organisations. For example, fire services belong to local government while emergency medical services belong to provincial government. This creates jurisdiction boundary issues such as authority and co-ordination. Ndabezitha (2019) ascertains if NDM adopts ICS to manage all events and incidents, this would promote an efficient and effective municipality in dealing with incident management.

Although technology adoption varies from one organisation to another, it brings benefits. Oliveira and Martins (2011) highlight several benefits of technology adoption in an organisation. Technologies such as the ICS enable organisations to standardise their approach and execution when emergencies occur (Jensen & Thompson, 2015), such as dangerous multi-agency emergencies (Bigley & Roberts, 2001).

Despite the numerous benefits, challenges exist. Ejiaku (2014) identifies some of the challenges as policies, technology infrastructure, training, and environmental culture. Batubara et al. (2018) argue that the main challenges in adoption are from a technical perspective, including security and flexibility. Mustafa and Yaakub (2018) explain how challenges of adoption hinder the use of technology for innovation, which affect responsiveness, efficiency, and effectiveness. Even though there are many studies conducted about technology adoption, challenges persist (Chouki et al., 2022; Toufaily et al., 2021; Jewer et al., 2017). This can be attributed to a lack of understanding of how the challenges come to exist and how they manifest.

1.5.2. Evaluation of IT solutions in an organisation

Organisations implement IT solutions on the premise that it adds value through the enhancement of the business processes, operations, and strategic intentions (Kitsios & Kamariotou, 2019; Ilmudeen et al., 2019) hence, understanding the efficiency and deficiency of implemented IT solutions. Iyamu (2022) explains how IT solutions are getting sophisticated, at the same time, increasing in complication. Thus, evaluation is critical. Mthethwa and Jili (2016) define evaluation as an applied inquiry process for collecting and compiling evidence that highlights the effectiveness, efficiency, and value of an artefact. The concept of evaluation entails a systematic assessment of an adopted system's performance towards a specific criterion within an organisation (Patsioura, 2014). Goldkuhl and Lagsten (2012) place emphasis on the need for evaluation from the perspectives o assessment of goals and participatory association. Evaluation helps to identify factors of influence, towards the enhancement of a system (Krmac & Djordjević, 2019; Srisawasdi et al., 2018).

Systems evaluation is a complex and important endeavour from which an understanding of factors that influence an adoption of a solution in an organisation as well as the outcome of solutions are gained. The purpose of this is to (1) judge worth or merit, (2) improve the programmes or solutions and, (3) generate knowledge (Visser et al., 2013). It is critical for organisations to embark on the evaluation process because knowledge is gained from both the process and results (Goldkuhl & Lagsten, 2012). The results of such an inquiry equip organisations with enough data to motivate new initiatives and expenditures. Furthermore, these results can be used as a justification for continuing with initiatives, a means to seek additional funds as well as to assess initiative goals and understand standards and impacts.

It is critical for organisations to evaluate systems because without evaluation, organisations conclude based only on the theory that the adopted systems work.

According to Venable et al. (2017), the evaluation process is valuable to the organisation because it aids in determining how well an adopted system fulfils its intended purpose. The ICS adopted by the municipality has been in use since 2015 and deemed as a system that works. However, it has not been evaluated to attest to its efficiency and effectiveness in the organisation.

1.6. Underpinning theory

The purpose of this study is to develop a metrics model for evaluating a system adopted in an organisation. Actor-network theory (ANT) underpins the study.

1.6.1. Actor-network theory

Actor-network theory (ANT) is selected to underpin this study primarily because of its network distinctive approach (Birke & Knierim, 2020), shifting negotiation that entails in-depth interactions between actors (Iyamu, 2021), and translation at different stages or moments (Law & Callon, 1997). These factors are fundamental to the study in that they can assist in achieving the objectives of the study, from three main perspectives; gaining understanding of: (1) the ICS functions through problematisation, how things came to being; (2) different translation of events that are associated with the system; and (3) why the system is mobilised by both business and technology units. Other socio-technical theories that were explored such as Activity Theory (Dennehy & Conboy, 2017) and Diffusion of Innovation (Rogers, 2003); do not focus on the areas mentioned above.

ANT originates from the field of sociological studies (Callon, 1986). The theory refers to human and non-human as actors and focuses on shifting negotiation (Iyamu, 2021; Latour, 1992). In ANT, an entity is considered an actor if it has the capacity to make a difference (Callon, 1986), such as having an influence in the development of a system (Dwiartama & Rosin, 2014). Heeks and Stanforth (2015) view ANT as a pragmatic recursive sociological process that focuses on the way actors build and maintain networks. According to Islam et al. (2019), ANT is often used to explore how actor-networks are assembled, to achieve a common goal.

The moments of translation is perceived as the point where actors with similar interests are gathered and engaged to support claims of similar interests. There are four stages of the moment of translation: (1) Problematisation - is the first step where actors define their interests around a common problem and solution (Sage et al., 2020); (2) Interessement - refers to the moment when an actor succeeds in capturing the interest of other actors regarding the problematised issue (Rivera & Cox, 2016); (3) Enrolment

- during this stage, actors with a common interest gather to solve the problematised issue (Heeks & Stanforth, 2015); and (4) Mobilisation - is the last stage of the moment of translation. It refers to when a group of actors with a common goal have successfully gathered to form a network (Nehemia-Maletzky et al., 2018).

1.7. Research methodology

This section presents the methodology that would be applied in the study. This includes the philosophical assumption, research approach, research methods, research design, data collection and data analysis, as discussed below:

1.7.1. Philosophical assumption

There are two philosophical assumptions commonly applied in information systems (IS) studies, namely ontology and epistemology.

Ontology refers the existence and nature of many realities (Fletcher, 2017). In ontology there are many realities of what exist. In the context of this study, some of the realities are that ICS (technology) does exist; the technology is adopted and used in the municipality with the intention to improve services delivery; and business and technology units view the technology from different perspectives including its efficiency, effectiveness, and ROI. Based on the different views, the ontological stance most suitable and selected for this study is subjectivism.

Epistemological assumption refers to the theory of knowledge (Hussain et al., 2013). This means, epistemology is about gaining knowledge by studying the nature and origin of phenomena. Thus, epistemology describes how we come to know the truth or reality of something (Kivunja & Kuyini, 2017). It is from this angle Scotland (2012:9) states that epistemology assists to spin questions such as, "*what is the nature of the relationship between the would-be knower and what can be known?"*

Epistemologically, what can be known or learned about this study include why ICS was adopted; the factors that influence the adoption of the technology from both business and technology perspectives; and how the technology can be assessed in the context of a municipality. Thus, the epistemological stance is subjectivism. This is to understand why things happen in the way that they do (Iyamu, 2021) from different perspectives. Subjectivism allows associating meanings with actions and activities (Nehemia-Maletzky et al., 2018).

1.7.2. Research approach

Research approaches commonly used in IS studies are deductive and inductive. The inductive approach is followed in this study, primarily because it allows the researcher to induce his/her subjective understanding in building a model for evaluating ICS.

The inductive approach is a theory that is commonly associated with qualitative studies where the researcher uses data obtained to develop theories (Long, 2014). According to Alase (2017:12), *"the primary purpose of the inductive approach is to allow research findings to emerge from the frequent, dominant, or significant themes inherent in raw data, without the restraints imposed by structured methodologies".*

Since the aim of this study is to develop a metrics model, which can be used to evaluate the deployment of the ICS in a municipality, the inductive approach is the most appropriate. This allows the researcher to know the different realities and perspectives of participants.

1.7.3. Research methods

Research methods refer to the techniques that are used for conducting of research including data collection and analysis tools. These methods in the field of IS studies include quantitative and qualitative research methods. These are the two most popular methods in IS. In addition, the two methods can be combined and referred to as the mixed method.

Quantitative research is defined as a type of research in which phenomena are explained by collecting and analysing numerical data using statistically based methods (Bambale, 2014). In essence, quantitative studies seek to determine how many people undertake behaviours (Sutton & Austin, 2015).

On the other hand, qualitative research seeks a deeper meaning of the articulation of participants. It seeks to answer questions such as "how" and "why" as opposed to "how much" and "how many" (Husbands et al., 2017). As such, qualitative research focuses on assisting researchers to access the thoughts and feelings of research participants, leading to researchers acquiring a deeper understanding of a participant's experience (Sutton et al., 2015).

Based on the aim of this study, which is to develop a metrics model that can be used to evaluate the efficiency, effectiveness and ROI of ICS from both business and technology perspectives, the qualitative research method was applied as the most

suitable approach. This is primarily because the method enables inquiring using interrogatives such as what, who, when, how, why, and where, to understand why things or incidents happen in the way that they do (Iyamu, 2021).

1.7.4. Research design

Research design is defined as an overall plan for conducting a study (Asenahabi, 2019). According to Chowdhury et al. (2020), the robustness of any research depends on its design. Some research designs include survey, action research, grounded theory, and case study (Iyamu, 2021). The nature of the problem being studied required focus on a specific organisation (municipality), which made the case study design the most appropriate for this study.

The case study method is an in-depth inquiry of one or more subjects of study (cases) and associated contextual conditions (Sovacool et al., 2018). The case study method enables the researcher to understand the phenomenon by answering the questions “how” and “why” (Chowdhury et al., 2020). This method reveals the causal relationships between phenomena (Asenahabi, 2019).

A municipality was selected as a case for the purpose of this study. A set of criteria was used to select the municipality. The criteria included: (1) the municipality must have deployed the ICS for a period of at least twelve months. Many IT solutions are evaluated on annual basis (Kitsios & Kamariotou, 2019); and (2) the municipality should willingly grant access to be used as a case for the study.
For privacy and anonymity, the selected municipality was assigned a pseudo name. The researcher aimed to gain an in-depth understanding of the value of the ICS to the organisation and its stakeholders.

1.7.5. Data collection

Data collection refers to the stage at which researchers systematically gather data. The goal for all data collection is to capture quality evidence that then translates to rich data analysis and allows the building of a convincing and credible answer to questions that have been posed (Syed & Sudhakar, 2017).

There are different techniques that can be used by researchers for data collection. These techniques include document analysis, observation, and interviews (Kabir, 2016). For this qualitative study, data was collected using the semi-structured interview technique with participants from IT and business in the selected municipality. This is primarily because semi-structured interviews enable the researcher to establish a

conversational rapport with the interviewee, which leads to richness of data (Shaanika & Iyamu, 2018). Criteria were used to select the participants. The criteria included: (1) knowledge and experience of the phenomenon (ICS) being studied; (2) only employees who have up to two years' experience of the system (ICS) will be selected. Two years is considered extensive experience to have a good understanding of the system. The understanding is purposely to increase the richness of the data.

It is not common practice for a qualitative study to indicate the number of participants otherwise it would become difficult to justify that number. Furthermore, the researcher may be accused of bias. However, the interview process will have to stop at some point. Thus, the interview process will stop at the point of saturation; a point where the researcher finds no new information.

1.7.6 Data analysis

Actor-network theory (ANT) was used as a lens to guide the data analysis of the data. ANT is discussed in section 6.1, as a theory that underpins the study. The analysis will primarily focus on the core aspects that will lead towards achieving the aim of the study, which are:

i. How various actor-networks were formed, in the use, support and management of ICS in the organisation. This is to understand how roles and expertise align with the adoption and use of the technology.
ii. The relationship and interaction between actors, to determine the differences in views of business and technology units in the areas of efficiency, effectiveness and ROI, in the adoption and use of ICS, to improve service delivery.
iii. How the negotiations between the business and IT units shift in understanding the efficiency, effectiveness, and ROI, in the adoption and use of ICS, to improve service delivery. in the organisation.

1.8. Significance of the study

The significance of this study is in the development of a metrics model. This metrics model aims to provide guidance on how an ICS can be evaluated to determine its value to both IT and business operations and strategies to fortify service delivery. Thus, the outcome of the study will be significant to three main groups of stakeholders.

i. IT units of the municipality - can use the metrics model as a guideline when developing similar solutions.

ii. Business units of the municipality - municipalities with similar challenges and profile to the case study can use the results of this study to understand the factors that influence the adoption and evaluation of an ICS.
iii. The service recipients (community) - the evaluation and use of ICS can improve the efficiency and effectiveness of service delivery.

It will help these two entities gain a better understanding of the factors that influence the adoption of ICS in the organisation.

1.9. Contribution of the study

The contributions of this study will come from two main areas, theoretical and practical points of view.

Theoretically, the study provides the municipality and other municipalities terms of reference. From the academic front, the study will add to the existing literature, from the angles of evaluation, implementation and IS including the use of ANT for events in a local government administration (municipality). Furthermore, the metrics model developed can be used as a point of reference when other municipalities adopt the ICS.

Practically, the metrics model can be used to guide practices, which identifies return on investment (ROI), for value addition. Also, based on the model efficiency and effectiveness can be improved, to enhance services delivered by the municipalities. These factors can be used by other organisations as a guide to examine how the ICS is assessed.

1.10. Ethical considerations

This study was governed by the Cape Peninsula University of Technology's ethical code of conduct. This includes adhering to the following ethical guidelines:

i. The researcher obtained an ethical clearance letter from the Faculty of Informatics and Design.
ii. The researcher obtained a permission from the organisation before data collection.
iii. The researcher obtained consent from each of the participants, to interview and record the process.
    a. Based on criteria, participants were selected from groups of IT developers, network specialists, IT managers, business managers,

business analysts, and business users. These participants were selected because they understand the business processes needed to build this solution. In addition, call centre agents were selected because of they are the first point of contact when an emergency is logged. Furthermore, they capture the details of the incident.

iv. The researcher kept the collected data confidential and anonymous.
    a. The researcher assigned pseudo names to each participant, to ensure anonymity and privacy is guaranteed.
    b. Data obtained from participants was kept confidential and only available to the researcher and the supervisor for data analysis purposes.
v. The researcher explained to participants of their right to withdraw should they wish to do so, at any given time during the interview.

1.11. Delineation

This study only focused on evaluating the adoption of an ICS in a South African municipality.

1.12. Summary

The aim of this study is to develop a metrics model for evaluating an Incident Command System adoption in a South African Municipality. This chapter sought to highlight the significance of this study. The research problem was clearly articulated which formed the basis of formulating a research aim, objectives, and questions. Furthermore, this chapter provided a literature review, which covered areas such as ICS, adoption, and evaluation. This study specifically followed the qualitative method using semi-structured interviews to collect data to answer the research questions.

CHAPTER 2 LITERATURE REVIEW

2.1. Introduction

As stated in Chapter One, the aim of this research is to develop a metrics model for assessing the efficiency and effectiveness of the incident command system (ICS) in an organisation. The literature review was conducted based on this aim. Thus, the literature review focuses on the core aspects of the study, which are technology adoption, information technology (IT) solution evaluation, and ICS. In addition, a review is conducted about the theory, actor-network theory (ANT), that underpinned the study.

The chapter is organised into seven main sections. It begins with the introduction, followed by technology adoption. IT solution evaluation is discussed in the third section. The fourth section covers ICS. In the fifth and sixth sections, ANT and applying ANT in IT/IS studies are discussed, respectively. Finally, the chapter is concluded.

2.2. Technology adoption

Technology adoption is increasingly crucial in organisations across the world. It is defined as the process taken to reach a decision to accept or reject a new technology (Sepasgozar et al., 2016). Adoption is the decision to make full use of an innovation. Innovation is an idea, practice, or object that is perceived as new by an individual or the unit adopting it (Thong & Yap, 1996). As such, innovation is a term often used complementarily with new technology (Alexander et al., 2020). Wisdom, et al. (2014) argue that new technology adoption usually starts with the recognition that a need exists for technology before moving towards searching for solutions. Based on its features, the ICS has over the years proven that there is need for it in organisations, particularly, government administrations (Jensen & Waugh, 2014).

Adoption requires organisations to be prepared or ready to embark on the adoption journey (Uren & Edwards, 2023) while individuals are required to be willing to learn new things (Bukchin & Kerret, 2020; Rehman et al., 2016). Many organisations often adopt technology to provide effective and efficient service delivery and information to citizens, businesses, and other government agencies (Alzahraniet al., 2016). Dube et al. (2020) state that even though the adoption of technology creates opportunities, it can also generate problems by disrupting existing organisational routines and processes. Also, adopted technology can be unpredictable and have a negative impact on an organisation’s processes and newly implemented systems not being used.

Technology adoption is increasingly critical in organisations, including government administrations such as health, education, and law enforcement across the globe (Ismail & Abdullah, 2017; Ejiaku, 2014; Hendrix, et al., 2019). This is primarily due to three reasons. Firstly, technologies are rapidly evolving (Srinivas et al., 2022). Secondly, there are different ways of adopting technologies (Blichfeldt & Faullant, 2021). Thirdly, there are various factors that influence technology adoption, from one environment to another (Hooks et al., 2022). Fadeyi et al. (2022) identified seven factors influencing technology adoption.

The criticality of technology adoption spans different government sectors. In Greece, an e-health system was adopted for citizens' benefits (Katehakis et al., 2018). Also in the health sector, the Zambian government adopted a Smart Care e-health system that enables patients' medical information simpler to read and accessible from different parts of the globe (Kaumba, 2023; Malunga & Tembo, 2017). Fadeyi et al. (2022) explores technology adoption in the agriculture sector in Africa. Technologies are being adopted to revolutionise traditional teaching and learning methods in the education sector (Tarhini et al., 2019). According to Muhammad et al. (2021), technology adoption is critical to the transformation of education. Technology adoption is continuously used to aid, enable, and support law enforcement agencies in their roles of public safety, crime prevention, and order (Escamilla & Reichert, 2019).

Despite the benefits and the usefulness of technology adoption to organisations, there are still challenges. Some of the challenges are a lack of compatibility of infrastructure, a shortage of IT skills of the adopted technology, and the lack of a measurement system for performance (Glyptis et al., 2020). Also, the evolution of technology and organisational needs lead to compatibility and integration challenges. Ejiaku (2014) states that some developing countries are challenged with skilled IT resources in the areas of support, maintenance, and integration of IT solutions, especially with the rapid evolution of technology. What is even more challenging is the evaluation of technology adoption in the government sector because it a rigorous process. Esteves and Joseph (2008) ascertained that the lack of monitoring and evaluation of innovation and IT solutions affect the adoption process negatively.

2.3. Information technology evaluation

The evaluation of technology adoption in organisations, including government administrations, is an important process and can be rigorous. This is due to many factors, such as methods and principles that can be applied from both technology and business units' perspectives. Nor (2016) refers to evaluation as a set of principles,

methods, and techniques/tools used to effectively assess the potential value of a technology and its contribution to an organisation's competitiveness and profitability. Technology evaluation helps with exploring available technologies in the market and subsequently assess their suitability in supporting various functions of an organisation (Sabri et al., 2018). This cements the criticality of evaluation in the process of determining the effectiveness, efficiency, and return on investment (ROI) of an artefact (Song & Letch, 2012).

The implementation of IT solutions is challenging. It gets worse in some developing countries and contributes to failure rate, to a large extent (Elkadi, 2013). This is prohibitive in many respects such as cost and negative effect on service delivery. Hence, it is important to identify and understand the factors that influence the success and failure of IT implementation in an environment. Identifying these factors can be achieved through an evaluation process. Once an evaluation has been conducted, there is an irrefutable basis to justify and account for IT investments (Rammea & Grobbelaar, 2017). In addition, the process of evaluation creates an ability to identify strengths and weaknesses, shapes new guidelines and establishes best practices for the implementation of IT solutions in an environment (Balslev et al., 2022; Kunstelj & Vintar, 2004).

The significance of IT solutions evaluation has lured government of many countries to embark on evaluation process and project. The Hong Kong government conducted a survey to evaluate the eGovernment solution from users' perspective (Lee, 2022). In Australia, the Australian Bureau of Statistics evaluated society's adoption of ICT, focusing on measurement, for the government to better understand service demand (Esteves & Joseph, 2008). From the South African perspective, Madibane and Edoun (2022) conducted an evaluation study to understand the national government department's online presence since the inception of eGovernment in 2001. Various governments employ various approaches and methods in their processes of evaluation of IT solutions.

There are several studies that have introduced IS evaluation models, which include DeLone and McLean IS Success Model (DeLone & McLean,2003); Enterprise Systems Success (Gable et al., 2003), and IS Effectiveness Matrix (Seddon et al., 1998). Scott et al. (2016) proposed a Public Value theory, which encompasses three essential success attributes: efficiency, effectiveness, and value within the context of government. Iyamu (2022) proposes a model for assessing IT solutions from an architectural standpoint.

2.4. Incident Command System

The incident command system (ICS) was developed in the 1970s following the catastrophic fires that ambushed the state of California in the United States of America (USA). In response to the disaster, many firefighters came from various independent agencies and their involvement was uncoordinated. As a result, the agencies competed for turf, equipment, and supplies, which revealed challenges such as lack of leadership, collaboration, communication, and clear terminology (Christen et al., 2001). In response to these challenges, the Federal Emergency Management Agency (FEMA) developed the ICS as a component of the National Incident Management System (NIMS). ICS is designed to provide a leadership structure with clear communication, ease of collaboration, and allocation of roles (Burgiel, 2020).

The ICS is often defined as a hierarchical management system used by governmental departments such as fire, and police to respond to an emergency. For many organisations, the adoption of ICS signifies significant change in the environment and the services that they provide. However, the significance associated with the system is hardly demonstrated or visible in many organisations. Despite limited empirical evidence, Cole (2017) asserts that there have been few innovations that were as impactful as ICS when it comes to managing emergencies. However, since the development of ICS, there have been debates of the effectiveness of adopting this system (Chang, 2017).

The events of 9 September 2001, (popularly referred to as 9/11), and numerous wildfires and natural disasters such as earthquakes and hurricanes demonstrated how USA departments did not have sufficient emergency services and resources to handle large-scale emergencies (Hannestad, 2005). This prompted the USA government to mandate each state in the country to incorporate ICS in their emergency management strategy (Jensen & Thompson, 2016) and governments of many other countries followed suit. When organisations adopt ICS for emergency management, there are few differences in departmental operations when responding to an emergency or disaster. Thus, managing emergencies requires coordination and a single communication channel. In place of several logistical and communications processes, only one system of collective and integrated procedures should be used (Auf der Heide, 1989; Burgiel, 2020).

The ICS is a flexible and scalable system that is applicable for emergency purposes, in any complexity and longevity across various sectors and organisations. Hannestad (2005) examined how the US government integrated ICS with its emergency

management strategy by assessing the weaknesses. Zhang and She (2014) conducted a comparative study of two Chinese administrations to understand how they respond to incidents. Similarly, the Florida Department of Agriculture and Consumer Services has employed a response structure based on ICS to effectively respond to natural disasters and mosquito borne-disease threats (Clark & Rogers, 2020). More recently, during the COVID-19 outbreak, Farcas et al. (2020) conducted a study on the use of ICS for disaster preparedness. In the South African context, few studies have been conducted on the adoption of ICS (Reid, 2005; Ndabezitha, 2019; Brazer, 2019). None of these studies has explored or examined the efficiency and effectiveness of the ICS from both technical and business perspectives.

Despite the advantages ICS has brought, its adoption is not without challenges. In fact, Hannestad (2005) alluded that ICS may not be an ideal system for large scale emergency management. Waugh (2009:172) states that such systems, by their very nature, are inflexible, slow, and cumbersome and would be much less adaptable in task environments characterised by uncertainty and rapid change. Even though Hannestad (2005) and Waugh (2009) identified these challenges over a decade ago, the evolution of the system is yet to address them. According to Zang and Lee (2014), the pre-established hierarchies will never be adequate to the specific features of a given crisis and that enabling self-organisation during a crisis is the most effective approach.

In addition, there are concerns among practitioners in some sectors that ICS may not be as flexible and scalable for emergencies such as pandemics, as it is portrayed (Jensen & Waugh, 2014). Also, law enforcement agencies in some countries have expressed concern over the command structure of ICS, stating one of the challenges as its frequent conflicts with the powers normally granted to police officers on the streets (Jensen & Waugh, 2014). Furthermore, ICS has been criticized for ignoring the importance of inter departmental relationships, the spontaneous nature of response, the role of volunteers, and the potential for conflict between responding agencies (Brazer, 2019).

2.5. Actor-network theory

This study intends to evaluate the adoption of an incident command system in a municipality. It therefore requires an understanding of the roles of involving actors and agencies in the use of ICS, for service delivery, Thus, actor-network theory (ANT) is used to underpin the study. ANT is a socio-technical theory that focuses on actors' interaction and negotiation within networks (Callon, 1987). The core elements of ANT are the actor, network, and translation. ANT is primarily concerned with how actors (or

actants) are brought together in a heterogeneous network (Iyamu, 2022). Dankert (2011) defines actors as an entity that can accomplish or undergo an act. Actors come in human and non-human form and are perceived as equals with equal roles within an actor-network (Iyamu et al., 2013). The roles of human actors, agencies, including business, and IT units in the use of ICS are unknown empirically, which could be a contributing factor to the challenges of articulating the efficiency and effectiveness of the system in an environment.

An actor-network is defined as a group of actors with similar interests (Iyamu, 2013). There are agencies and groups or units with the various agencies that are interested in the adoption of ICS. In some instances, the group comes to be interested (Heeks & Stanforth, 2015) and how certain interest manifested (Law & Callon, 1997) within networks are not always known. This has significant influence and impact on the formulation and activities of networks. The formulation of an actor-network is the process of grouping multiple actors who have gone through the process of translating their common interests (Iyamu, 2021).

Translation is achieved through four moments. The translation process involves the engagement of actors with other actors to negotiate one another's interests with the aim of enrolling actors into a network. This is usually spearheaded by the focal actor. It is at this point that the focal actor manages to create connections with other actors that have the same interests as they do (Sepehr & Reihaneh, 2011). Since the translation process is one of ANT's main strengths (Johnson & Iyamu, 2019) and one of the focal areas of this study, the moments of translation is discussed in the remainder of this section.

2.5.1 Moments of translation

Translation is the central process through which a network grows or dissolves. For example, translation of events or activities dictates the effectiveness of the development and implementation of IT solutions and how the actor-network is formed and strengthened (Govender & Chitanana, 2016). There exist different activities and tasks in the adoption of ICS that require translation to enhance collaboration and improve service delivery. Translation is a process that comprises four moments that are intertwined and connected with one another (Iyamu, 2018). These four moments are known as: problematisation, interessement, enrolment, and mobilisation (Callon, 1986; Mahring et al., 2004) as depicted in figure 2.1 below.

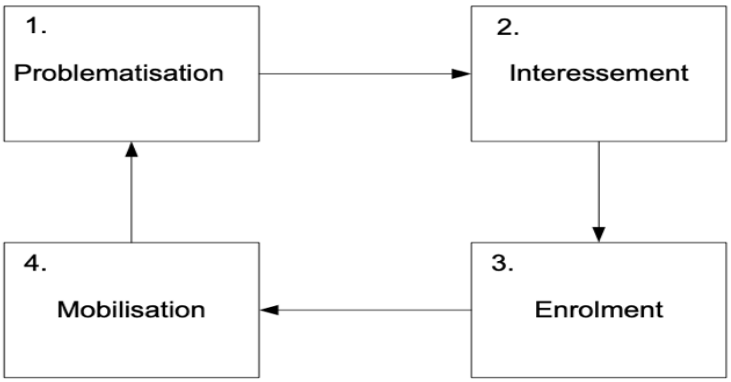

Figure 2.1: Moments of Translation

(Adapted from Callon, 1986)

- *Problematisation* is the first moment of translation. It is the point where the main actor identifies the problem to be solved (Iyamu, 2013) and the identification of actor roles within an actor-network (Nguyen & Nyella, 2010). It is worth noting that in its literal sense, the word “problem” has a negative connotation of something that is broken. However, in ANT, a problem is not necessarily that, but it can be an innovative improvement of a situation (Iyamu, 2018). It is during this stage that the main actor convinces all other actors to accept the proposed network (Afarikumah & Kwankam, 2013).
- *Interessement* is the second moment, wherein interested actors join a network of a problem that has been problematised (Nehemia-Maletzky et al., 2018). During interessment, there are a series of processes that the main actor follows in an attempt to lock other actors into positions that have been offered to them in the network (Afarikumah & Kwankam, 2013). In essence, the main actor convinces the other actors that the interests defined initially are in line with their own interests (Andrade & Urhuhart, 2010).
- *Enrolment* is the third moment. During this stage the main actor attempts to define and interrelate the various roles taken up by other actors (Shim & Shin, 2016). Here, alliance networks are formed, and stakeholders form groupings of common interests (Iyamu, 2018). Only the actors who have accepted roles assigned to them in the interessement moment get to participate in the activities of that network (Iyamu, 2022).
- *Mobilisation* is the final moment of the translation process. During this stage, the main actor, appointed or self-appointed representative is responsible for representing the actors within that network (Iyamu, 2022). The representative communicates the interests and roles of actors and the formed network (Shim & Shin, 2016). Iyamu (2022) highlights the importance of a strong network representative as this helps to strengthen

the network. Makovhololo and Iyamu (2020) state that the representative needs to continually convince the actors that their interests are still the same.

During the development and implementation of some IT projects, the concept of moments of translation are applied (Afarikumah & Kwankam, 2013). Iyamu (2013) ascertains that when ANT is applied as an underpinning theory, it is purposefully to gain a know-how of the development and implementation of IT enabled systems. However, to gain such an understanding, it is important to successfully traverse the moments of translation and create powerful enough actor-network that can carry a technology through to its successful implementation (Govender & Chitanana, 2016).

However, translation remains challenging in many environments. Dery et al. (2013) states that ANT proponents view a successful translation of an idea or project into a stable actor-network as a rarity and see network formation as a volatile and contested process. Despite the rarity of a successful translation, the moments of translation are helpful in providing reasons behind the success or failure of actor-networks (Zukas & Kilminster, 2014).

2.5.2 Actor-network theory and information systems

Over the years, more researchers have used ANT to guide the data analysis and interpretation process (Nehemia-Maletzky et al., 2018), particularly because of its detailed descriptive and narrative emphasis as well as its ontological association (Iyamu, 2018). The use of such theories to underpin IS and IT studies is primarily intended to investigate and understand why things are done the way they are done, who is involved during that process, as well as the repercussions of those interactions (Iyamu, 2013). It is for these reasons that ANT is suitable to study the process of technology adoption (Alexander & Silvis, 2014).

Andrade and Urquhart's (2010) applied ANT to examine the process of ICT for a development (ICT4D) initiative. In seeking to understand the factors that influence software testing in organisations deeper, Sekgweleo and Iyamu (2022) employed the moments of translation. Shim and Shin's (2016) analysis of China's Fintech industry was guided by ANT's moments of translation process. Johnson and Iyamu's (2019) framework for the adoption of e-commerce identified mobilisation as the successful deployment of e-commerce within the organisation which contributes to achieving the business requirements, goals, and objectives. Iyamu and Makovhololo (2020) also applied the moments of translation in the study to understand the impact of language in the delivery of healthcare.

When researchers apply ANT to IS study, it is with the intent of understanding the complexities of social constructs as well as the complexity of the organisation itself in relation to IS adoption (Cresswell, et al., 2010). This is evident in Cucciniello et al. (2015) study where the researchers aimed to reveal the how sociological and technological factors interacted towards a successful implementation of an Electronic Medical Records (EMR) system in a teaching hospital. Their reason for applying ANT is because ANT has the ability to unpack the factors that contribute to the successful implementation of a technology. This makes the application of ANT for data analysis particularly useful in achieving the study's aim.

2.6. Summary

This chapter presented a comprehensive literature reviewed of this study. It is subdivided into six sections that correlate to the key areas of literature review. These areas are introduction, technology adoption, technology evaluation, incident command system, and actor-network theory. The next chapter presents the research methodology.

CHAPTER 3 RESEARCH METHODOLOGY

3.1. Introduction

This study aimed to develop a metrics model which can be used in assessing the efficiency and effectiveness of the incident command system (ICS) in an organisation. In achieving this aim, a methodology was employed. This chapter discusses the methodology employed in the study. Kothari (2004) simply defines research methodology as a way to systematically solve the research problem. The "research methodology consists of methods, techniques, and approaches within systematic steps, such as strategy and design" (Iyamu, 2021:18) carefully applied to achieve the aim and objectives of this study.

This chapter is organised into eleven main sections. It begins with an introduction, followed by an overview. In the third and fourth sections, the philosophical assumption and philosophical stance are discussed. The fifth, sixth and seventh sections explain the research approach, research methods and research design. The eighth and ninth sections provide detailed information on data collection and data analysis. The tenth section explains the ethical considerations. Finally, the last section concludes the chapter.

3.2. Overview

The selection of the methodologies was guided by the aim of this study. This means that the selection of the research approach, methods, and design, including the data collection and data analysis were guided by the study's aim. The research onion (Figure 3.1) by Saunders et al. (2019) helps to illustrate and understand the levels of the philosophies, approaches, and strategies in the research process.

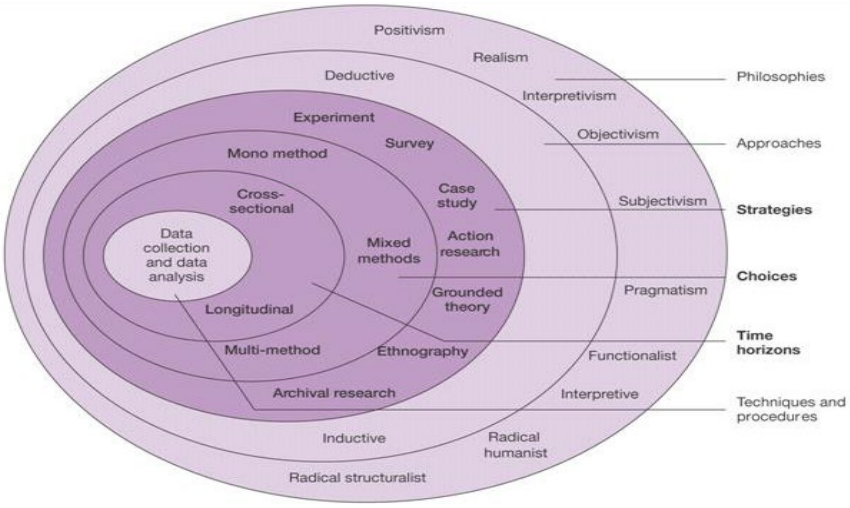

Figure 3.1: Research Onion

(Adapted from Saunders, et al. 2012)

There are interdependence and interrelationships between the research components of the methodology. For example, the philosophical stance dictates the approach employed, whether inductive or deductive (Sarker et al., 2018). The same goes for the methods selected, which are influenced by the approach. Riemenschneider and Armstrong (2021) describe how the inductive is tightly associated with qualitative methods. Thus, research follows specific steps, from philosophical to data analysis and findings, as suggested by Saunders et al. (2012).

3.3. Philosophical assumption

Research philosophy is defined as a system of beliefs and assumptions that guide the development of knowledge (Saunders et al., 2019). Håkansson (2013) asserts the importance of a philosophical assumption as it affects and steers the entire research. Philosophical assumptions fundamentally determine the researcher's methodological choices which can be identified as objective and subjective (AbuRaya & Gomaa, 2020). Furthermore, philosophical assumptions determine the methodology a researcher uses to answer research questions, determine the data collection procedures and techniques, as well as guide the data analysis process (Alturki, 2021). In information systems (IS) studies, ontology and epistemology are the two most common types of philosophical assumptions. Hathcoat et al. (2019) highlight that ontology concerns itself with what exists, whereas epistemology focuses on the nature, limitations, and justification of human knowledge.

Ontology

Ontology as a philosophical assumption is described as the study of being (Levers, 2013). Ontology concerns itself with the assumptions that society makes about the nature of reality (Saunders et al., 2019). Hence, it is viewed as the study of why things exist the way they do and what is there to know about their existence (Al-Saadi, 2014). Ontologically, the incident command system (ICS) does exist in some organisations (George-Ufot et al., 2022). Burgiel (2020) argues that the ICS is designed for various purposes to provide solutions in areas such as leadership structure with clear communication, ease of collaboration, and roles allocation.

Also, ontological assumptions shape the types of questions a researcher may ask about how the world works or how people act or interact (Hiller, 2016). As such, the key ontological question is often: what is the form and nature of reality and, consequently, what is there that can be known about it? (Marsh & Furlong, 2002). From an ontological perspective, a similar question triggers this study: what is the efficiency and effectiveness of the ICS in an organisation? This question has no answer, at least, from an empirical standpoint. What is known is that the ICS is very important to organisations (Khang et al., 2022).

Epistemology

Epistemology refers to the theory of knowledge. Epistemology concerns itself with looking at what exists and making sense of its existence (Al-Saadi, 2014). Epistemology examines the assumptions made about knowledge, how knowledge is formed, how we can ensure its adequacy and legitimacy, and how knowledge can be communicated to others (Saunders, et al., 2019). The ICS has many unknown challenges from interdepartmental relationships to response time and collaboration of agencies (Brazer, 2019).

Epistemology is concerned with the nature of knowledge, including which techniques or approaches to knowing what can be known about social reality (Iyamu, 2021). According to Levers (2013), an epistemological examination of an entity focuses on the relationship that exists between the knower and the knowledge, which prompts questions such as: “How do I know the world?”. As such, with that question answered, we can understand and explain how we know what we know (Ahmed, 2008). There are many challenges associated with the ICS (Igarashi & Blackburn, 2022; Matear, 2023), which need to be known before they can be resolved to improve the effectiveness and efficiency of the system.

In the context of this study, both ontological and epistemological philosophical assumptions apply because of the reality of the ICS and other technical and non-technical related factors that need to be known or learned about the system for organisational purposes. From both ontology and epistemology standpoints, the interpretive, subjective approach is selected as the philosophical stance. This is because the study seeks to understand why ICS was adopted, the nature of its efficiency and effectiveness from the technical (IT unit) and non-technical (business unit) perspectives, including its contributions to the stakeholders, as well as the return on investment (ROI).

3.4. Philosophical stance: Interpretivism

As depicted in Saunders et al.'s (2012) research onion, there are several taxonomies of research philosophy namely: positivism, interpretivism, realism and pragmatism. However, positivism and interpretivism are the two commonly used philosophies in IS studies (Clark, 2017). As stated above, the interpretive approach is employed as the philosophical stance in this study.

Interpretivism is described as an approach that emphasises understanding the beliefs, motivations, and reasoning of individuals in a social group (Nickerson, 2022). In their step-by-step guide of the case study method, Rashid et al. (2019) state that Interpretivism allows the researcher to have multiple views of a research problem because it allows the researcher to see the world through the eyes of the participants. Riemer and Johnston (2019) explain that interpretivism emerged when IS researchers realised the end-user is an important factor in explaining factors that influence IT adoption, or unexpected outcomes from IT applications in an organisation. The purpose of interpretivism is to study how individuals or social groups formulate and give meaning to different realities, as well as to demonstrate how these realities explain human actions and experiences (van der Walt, 2020). Hence, Uleanya and Yu (2023) highlight that interpretivism is crucial to decoding the meaning of collected data. However, for interpretivists to interpret the meanings of data, they must understand the context of the study for which that data was collected (Thanh & Thanh, 2015).

According to Zahle (2021), interpretivist researchers often prefer employing qualitative research methods in their studies. This is mainly because through qualitative methods, the interpretivist can capture robust data through the participant's experiences, understandings, and perceptions (Thanh & Thanh, 2015). The robustness of this data simplifies the role of the interpretivist which is to "understand, explain, and demystify social reality through the eyes of different participants" (Mack, 2010:8). Therefore, the

researcher's perception of a socially constructed reality is subjectively interpreted (van der Walt, 2020; Ikram & Kenayathula, 2022).

Thus, from our subjective stance, what can be learned about this study includes the factors that influence the adoption of ICS in a South African municipality from the perspectives of IT and non-IT departments. This is to understand why things happen in the way they do (Iyamu, 2021). Subjectivism allows an association of meaning with actions and activities (Nehemia-Maletzky et al., 2018).

3.5. Research approach

The next stage of the research process is the selection of the research approach as depicted in Figure 3.1. In research, there are two main modes of reasoning, namely: the deductive and inductive approaches. Soiferman (2010) defines deduction as an approach that begins with the general and ends with the specific, while induction is defined as moving from the specific to the general. Arguments based on laws, rules, or other widely accepted principles are best expressed deductively, while arguments based on experience or observation are best expressed inductively. Hence the inductive approach is selected as the most suitable reasoning approach to achieve the aim and objectives of this study.

Deductive

The deductive approach is defined by Adekoya et al. (2019) as a research strategy employed by researchers for the objective of testing a hypothesis or theory (Adekoya et al., 2019). This approach entails beginning with a theory from which hypotheses are derived, testing those hypotheses, and revising the theory (Woiceshyn & Daellenbach, 2018). Deductive reasoning occurs when a conclusion is derived logically from a set of theory-derived hypotheses, the conclusion being true when all the hypotheses are true (Saunders et al., 2019). Al-Ababneh, (2020) recommends that researchers apply this approach when collecting data and developing a theory as a finding of the data analysis. The researcher further asserts that the approach relates more to positivists.

Inductive

The inductive approach is referred to by Hayes and Heit (2018) as a reasoning approach that entails using existing knowledge to formulate predictions. Likewise, Crowther and Lauesen (2017) define the inductive research approach as one where the researcher develops a hypothesis and theories to explain empirical observations of the real world. As such, the inductive approach favours the interpretivist researcher and is better suited for the interpretation of qualitative data. Inductivists start with the

observation and collection of data and, thereafter, move to description and analysis to form a theory (Melnikovas, 2018). The primary purpose of the inductive approach is to allow research findings to emerge from the frequent, dominant, or significant themes inherent in raw data (Thomas, 2006). Through these findings, the researcher can gain new knowledge.

3.6. Research methods

Research methods provide procedures for accomplishing research tasks. These procedures guide how to initiate, carry out and complete research tasks (Håkansson, 2013). Quantitative and qualitative research methods are the two most popular methods adopted when conducting research. The third approach is an amalgamation of both methods and is referred to as the mixed method. This layer of the research onion, as seen in Figure 3.1, briefly defines the quantitative research method and discusses the qualitative methods to reveal the rationale behind selecting it for this study.

Quantitative research methods are concerned with collecting and analysing data that is structured and can be represented numerically (Goetzen, 2017). Quantitative research questions are direct, quantifiable, and often contain phrases such as what percentage? what proportion? to what extent? how many? how much?

On the other hand, qualitative research questions dig deeper, seeking to capture thoughts and the subject's viewpoint. Qualitative research is defined as the study of the nature of phenomena by examining the context in which they appear or the perspectives from which they can be perceived (Nielson & Ali, 2021). Bandal et al. (2018: 1189) simplify this by saying "By 'qualitative research', we mean scholarship that primarily relies on qualitative data and inductive theorizing". In essence, qualitative research generally includes data in the form of words rather than numbers (Busetto et al., 2020). Qualitative research is conducted when there is a problem or issue to be explored (Creswell & Poth, 2017). Researchers structure questions that enable them to gather participants' experiences, perceptions, and behaviour (Tenny et al., 2022). This allows the researcher to capture a richer dataset from the participant thus forming a basis for better understanding of the participant's views (Sutton & Austin, 2015). This is because, characteristically, qualitative research approaches are more descriptive of the phenomenon being studied (Saunders et al., 2019). It explores and provides deeper insights into real-world problems. Seeking, answers to "how", "what", "where", "when" and "why" open-ended questions (Martelli & Greener, 2018). Hence, this approach is favourable when a study proposes to answer research questions that

cannot typically be answered using (only) “yes or no” questions (Busetto et al., 2020). Furthermore, this approach grants the researchers the ability to explore more thoroughly the participants’ experiences, attitudes, and beliefs, as it does not regard facts as objective, but as a subjective reality related to differences in each individual (Almaiah et al., 2020).

As such, some researchers in the IS discipline have applied qualitative research methods studies. For instance, Pal and Vanijja (2020) conducted a study evaluating the perceived usability of an online learning platform. Almaiah et al. (2020) explored the critical challenges and factors influencing the E-learning system usage during the COVID-19 pandemic. On the other hand, Iyamu (2020), offered an exploratory analysis and insight into the factors that influence e-government’s enabling of e-health.

Considering the inductive nature of qualitative studies, the research process can be challenging to novice researchers (Cypress, 2019). It can be a time-consuming and relatively difficult process to undertake (Coast et al., 2012). For instance, in qualitative research, there is no definitive sample size. Instead, data saturation is the most commonly employed concept for estimating sample sizes (Guest et al., 2020). This study adopted the qualitative research method as it allowed the researcher to understand the factors that influence the adoption of ICS.

3.7. Research design

The research design is intended to provide an appropriate framework for a study (Sileyew, 2019). This framework includes how the study is organised, planned, designed, and finally conducted (Håkansson, 2013). Hence, Huntington-Klein (2021) cautions that a lack of a solid research design can be seen in the results of a study. There are different types of research designs commonly used in IS studies. These include action research, surveys, and case study (Kupfer, 2018).

Action research is an approach where a phenomenon is studied to identify a problem and based on the findings develop a solution (Bryman & Bell, 2011). It aims to both take action and create knowledge or theory about action (Erro-Garcés & Alfaro-Tanco, 2020; Shani & Coghlan, 2019). According to Elg et al. (2020), action research aims to produce knowledge that is both practical and scientifically relevant with the intention of improving or transforming the process or phenomenon under study. Its methods involve action, evaluation, and reflection. It is a process to gather evidence to implement change in practices (Clark et al., 2020). As such, action research is not suitable for this

study because neither the aim nor objectives require the observation or monitoring of any type of action.

In contrast, survey research is defined as the collection of information from a sample of individuals through their responses to questions (Ponto, 2015). The survey research design involves the use of questionnaires for collecting data from a sample taken from a given population of interest (Boman et al., 2018; Sarowar et al., 2018). This research design is usually associated with a deductive research approach, allowing data to be collected and analysed quantitatively (Saunders et al., 2019). According to Runeson and Höst (2009), survey design allows the researcher to be able to generalize the results of the study. However, obtaining a representative sample size remains critical to survey researchers because of its implication for the cost, time, and precision of the sample estimate (Adam, 2020). These qualities render the survey research approach unfitting for this study, whose focus is a municipality that has adopted the technology.

On the other hand, the case study approach was used in this study. This is because the researcher aims to gain an in-depth knowledge about a specific real-world issue. Feagin et al. (2016) describe a case study as a research approach designed to investigate a complex issue in its natural setting, often using qualitative research methods. It consists of a detailed investigation, often with empirical material collected over a period from a well-defined case to provide an analysis of the context and processes involved in the phenomenon (Rashid et al., 2019).

Noor (2008) sees case studies as being concerned with how and why things happen, allowing the investigation of contextual realities and the differences between what was planned and what happened. This approach can be used to explore, describe, or explain a phenomenon (Ellis & Levy, 2009). These attributes explain why the case study approach is perfect for capturing information on “how”, “what” and “why” questions about the phenomenon (Crowe et al., 2011). According to Heale and Twycross (2018), the nature of the phenomenon being investigated can be a person, a group of people or a unit. This approach has the potential to generate insights from intensive and in-depth research thus leading to rich empirical descriptions and the development of theory (Saunders et al., 2019).

Despite the advantages of case studies, there are limitations. Case studies may provide a deep understanding of a case; however, one case provides no basis for generalizing to a wider population beyond that case (Luo et al., 2017). Furthermore, the volumes of

data collected can be difficult to organise and the data analysis and interpretation need to be carefully thought through (Heale & Twycross, 2018).

Researchers may approach case studies in different ways depending on the epistemological standpoint of the researcher, that is, whether they take a critical, interpretivist or positivist approach (Crowe et al., 2011). They also have to consider whether it is wise to select a single case study, or if it is better to adopt multiple cases for the understanding of the phenomenon (Gustafsson, 2017). If a researcher wants to study a specific case without comparing it to another, then a single case study is warranted. However, if the researcher wants to study multiple cases through a comparison of similarities and differences of the individual cases, then a multiple-case study is warranted (Gustafsson, 2017; Heale & Twycross, 2018). Therefore, in consideration of the aim and scope of this study, the researcher subscribes to a single case in the form of a South African municipality that has adopted the incident command system (ICS). Moreover, the selection of participants is through a specific criterion that is described in Chapter One.

Obtaining permission from the identified case to conduct the study was a rigorous process that entailed an in-depth application process via the organisation's specialized research portal. The researcher was requested to submit an ethical certificate from the university along with the researcher's curriculum vitae (CV), proposal and the researcher's manager acknowledging awareness of the researcher's intentions. That process was a challenge because the workflow process was assigned to the incorrect individual for approval. To rectify this, a manual approval process had to be done. After numerous direct engagements with the relevant parties, the researcher was granted written permission to proceed with the study. This permission came in the form of an email.

The organisation showed immense interest in partaking in this study. The head of the department from the non-IT unit was encouraging and willing to participate in this process. As such, one of the employees arranged a few employees who were also forthcoming with information and made suggestions of their colleagues who might be interested. Although these employees fulfilled various roles within the unit, what is important is that they all have an interaction with the system being evaluated. This is beneficial because there is a plethora of views from which the researcher can learn.

Similarly, the head of the IT department unit was also interested in participating in the study. However, most of the employees in that unit were reluctant to participate in the

process either because of availability or willingness. Even though the researcher is an employee in that department, the relationships built did not fast-track the process of participation or entice the colleagues into participating. For the researcher, this was another dimension to the difficulty of conducting a study in your workplace.

3.8. Data collection

Data collection is the systematic process of collecting information from all the relevant sources to find answers to the research problem (Sarowar et al., 2018). The goal of data collection is to capture quality evidence that translates into rich data analysis and that allows for the building of convincing and credible answers to research questions (Syed & Sudhakar, 2017). As one of the important steps of research, plenty of quality time should be spent in data collection to gain appropriate results (Taherdoost, 2021). However, Olsen (2012) cautions that while a suitable data collection method helps to plan good research, it cannot guarantee the overall success of the research project. Many kinds of data collection methods can be used in research, and these include questionnaires, document analysis and interviews (Sarowar et al., 2018).

Questionnaires

A questionnaire is a written list of questions which are answered by a lot of people to provide information for a report or a survey (Sharma, 2022). These questions can either be open or close-ended. Касымбекова and Закенова (2022) define a questionnaire as a written survey in which communication between a researcher and a respondent is mediated by a questionnaire. Questionnaires are composed of the same set of questions posed to the respondents in a standardised manner (Roopa & Satya, 2015). Saunders et al (2019) caution that it is important to compose the correct set of questions so that it collects precise data that will help in answering research questions and meeting research objectives. When questionnaires are carefully planned, they can yield high-quality usable data, achieve good response rates and provide anonymity, the latter encouraging more honest and frank answers than, for example, interviews (Marshall, 2005).

Document Analysis

Document analysis is defined as a systematic procedure for reviewing or evaluating documents (Bowen, 2006). A researcher collates various written materials and elicits the needed information. The result can be used to provide context, generate questions, supplement other types of research data, track changes over time and validate other sources (Dalglish et al., 2021). Document analysis normally has a limited scope to help reduce the amount of irrelevant information that would be collected (Mwita, 2022).

Hence Wach and Ward (2023) recommend setting a criterion for document selection, collecting documents, articulating key areas of analysis, document coding, verification, and analysis. Morgan (2022) explains that document analysis can be useful, especially in instances where there are time and resource constraints about fieldwork, document analysis remains an underused approach to qualitative research (Morgan, 2022). Although the primary data collection method for the objectives of this study was semi-structured interviews, the researcher acquired strategic documentation from the organisation's website. These documents served as supporting documentation for the interviews conducted. These documents depicted the organisational structure and explained how the IT and non-IT departments fit in the organisation.

Interviews

Interviews are a research method that relies on asking questions to collect data (Mwita, 2022). Sewell (n.d) defines interviews as "attempts to understand the world from the subject's point of view, to unfold the meaning of peoples' experiences, to uncover their lived world before scientific explanations." Interviews can be conducted face-to-face or through the use of technological devices such as telephones and video conferencing. This is the most common format of data collection in qualitative research (Jamshed, 2014). Interviews can either be unstructured, structured, or semi-structured. The quality of the data collected during an interview will depend on both the interview design and the skill of the interviewer (Mathers, 2002).

Unstructured interviews are often referred to as in-depth interviews due to their ability to cover issues in great depth, consequently generating crucial information about the personal experiences and perspectives of respondents (Bihu, 2020). Unstructured interviews are conducted like regular conversations, with extremely minimal prior information about the research topic (Pyo, 2023). As such, unstructured interviews have no structure or predetermined interview plans.

In contrast, *structured interviews* are rigid and fully controlled by the researcher (Adhabi & Anozie, 2017). Structured interviews enable the researcher to ask each respondent the same questions in the same way (Mathers, 2002). During this interview process, the researcher is trained not to deviate from the set questions. Thus, following a tightly structured schedule of questions, similar to a questionnaire. This trait makes structured interviews a quantitative research method because the data produced is quantitative and can be better quantified (Canals, 2017).

On the other hand, *semi-structured* interviews are less rigid. Although the researcher is also guided by a predetermined set of questions, there is freedom to ask follow-up questions that are supplementary to the predetermined questions (DeJonckheere & Vaughn, 2019). This method typically consists of a conversational dialogue between researcher and participant where further questions emerge from the conversation. Adhabi and Anozie (2017) state that the implementation of such an interview is dependent on how the respondent responds to the researcher's probing. This method allows the researcher to gain a clearer understanding, especially for those answers that are unclear. As such, the semi-structured interview method is the preferred data collection method when the researcher's goal is to better understand the participant's unique perspective rather than a generalised understanding of a phenomenon (Adeoye-Olatunde & Olenik, 2021).

Based on the characteristics of semi-structured interviews and the objectives of this study, the semi-structured interview process is the most viable data collection method. Data will be collected from the participants of the studied case via a set of open-ended questions. Open-ended questions are used to explore topics in-depth, to understand processes, and to identify potential causes of observed correlations (Weller et al., 2018). As a guideline, for the data collection process, interviews should continue until a point of saturation is reached (Weller et al., 2018). Saturation is used in qualitative research as a criterion for discontinuing data collection and/or analysis because no additional data are being found (Saunders et al., 2018). The participants were identified and selected based on a set criterion. Iyamu (2018:10) highlights that “the criteria should include and highly consider factors such as experience (length of service), area of specialisation, and level in the organisational structure (or society)”.

Participants will be selected from both the IT and non-IT (business) units involved with the ICS in the organisation. The participants will be identified and selected based on the set criteria, which are as follows:

IT unit:

i. The participants must have been in the organisation (IT department) for at least two years.
ii. The participants must have been involved in the selection and implementation of IS/IT solutions.
iii. The participants must be willing to be part of the study.

Business unit:

i. The participants must have been in the organisation for at least two years.
ii. The participants use IT systems for their processes.
iii. The participants must be willing to be part of the study.

A total of fifteen interviews were conducted (Appendix A, 94-95). Ten of the interviews were conducted in the non-IT department where one of the participants preferred an in-person interview while the other thirteen preferred virtual interviews. The interviewer complied with both requests. The interview that was conducted in person was advantageous and intriguing in the sense that the participant was enthusiastic to demonstrate some of the features of the system. Another participant shared via email an overview of the phenomenon being studied. This was interesting as it strengthened the participant's subjective viewpoint. The other four interviews were conducted in the IT department. The number of people interviewed was based on their willingness and availability.

Although the interviewer had a list of questions that were imperative discussion points to serve as a guideline, questions were not asked in a predefined structure. A point of saturation was reached at ten participants in the non-IT department. This means there was no new information that was apparent. In contrast to that, in the IT department, the interviewer did not reach a point of saturation. However, there were no willing or available participants. Interviews were scheduled for one-hour slots with some interviews exceeding one hour while others lasted between twenty minutes to forty minutes. The interview process lasted a duration of three weeks.

With the permission of the interviewees, the interviews were audio recorded with the interviewer taking additional notes on pen and paper. The recording of the interviews was to capture everything shared eliminating the possibility of leaving information out. While the notes were for the purpose of follow-up questions and points of clarification.

Each interview was transcribed verbatim. Transcription is defined as the process of reproducing spoken words, such as recorded data from an interview, and converting it into written form so the data can be analysed (McGrath et al., 2019). Thereafter, the transcripts were cleaned of any language errors.

3.9. Data analysis

Data analysis is defined as the classification and interpretation of collected data in order to make subjectively meaningful statements (Mezmir, 2020). Lester et al (2020)

describes data analysis as a non-linear and iterative process. Data analysis is the most complex and time-consuming of all of the phases of research (Thorne, 2000). Qualitative data analysis involves the coding of data from transcripts. Coding is the process of identifying and labelling topics, similarities, and differences in the interview data (Adeoye-Olatunde & Olenik, 2021). It is during this process that the researcher can identify themes (Belotto, 2018).

As mentioned in earlier chapters, this study adopts the interpretivist approach as a means of data analysis. This is mainly because data will be collected through semi-structured interview process by interviewing participants to gain their subjective view of the technology being studied. As such, the moments of translation which is a tenet of the Actor-network theory will be applied to guide the data analysis process.

i. How various actor-networks were formed, in the use, support and management of ICS in the organisation. this is to understand how roles and expertise align with the adoption and use of the technology.
ii. The relationship and interaction between actors, to determine the differences in views of business and technology units, in the areas of efficiency, effectiveness and ROI, in the adoption and use of ICS, to improve service delivery.
iii. How the negotiations between the business and IT units shift in understanding the efficiency, effectiveness, and ROI, in the adoption and use of ICS, to improve service delivery. in the organisation.

3.10. Ethical considerations

This study will be governed by the Cape Peninsula University of Technology's ethical code of conduct (Appendix B, 96). This includes adhering to the following ethical guidelines:

i. The researcher will obtain an ethical clearance letter from the faculty of Informatics and Design.
ii. The researcher will obtain permission from the organisation before data collection will be embarked upon. The permission will be in the form of a letter from the organisation.
iii. The researcher will seek written consent from each of the participants, to interview and record the process.
    a. Based on the criteria, participants will be selected from groups of IT developers, network specialists, IT managers, business managers, business analysts, and business users. These because they understand

the business processes needed to build this solution. In addition, call centre agents will be selected because of their first point of contact role, when an emergency is logged. Furthermore, they capture the details of the incident.

iv. The researcher will keep the data collected, confidential and anonymous.
v. The researcher will assign pseudonyms to each participant, to ensure anonymity and privacy is guaranteed.
vi. Data obtained from participants will be kept confidential and only available to the researcher as well as the supervisor for data analysis purposes.
vii. The researcher will explain to participants of the right to withdraw should they wish to do so, at any given time during the interview process.

3.11. Summary

This chapter presented the philosophical assumption and methodology applied in the research and consisted of methods, approaches, and techniques. The methodology was based on the aim of the study, which is to develop a metrics model to evaluate the adoption and use of the ICS, from both technical and non-technical perspectives, in a municipality. In this chapter, the researcher also explained why certain research strategies were chosen. The chapter also highlighted the ethical considerations to cement the credibility of this study. The following chapter which is Chapter Four will present the general overview of the organisation that the researcher selected as a case on the basis of the objective of this study.

CHAPTER 4 CASE OVERVIEW

4.1. Introduction

This chapter presents the case overview of this study. The selected case is a metropolitan municipality in South Africa. This means this organisation met the criteria for it to be considered as a case. The criteria included an organisation (municipality) that has implemented the Incident Command System (ICS) and is willing to participate in this study. As such, data collected from this organisation provides knowledge and understanding of the factors that influence the adoption of ICS. In the interest of privacy and protection, the organisation is given a pseudonym. The name assigned to the organisation is Kwa-Maspala.

This chapter is organised into three main sections. It begins by explaining the fieldwork in the first section. This is followed by the case overview of the organisation. In the third section, the chapter is summarised.

4.1. Fieldwork

The researcher initiated the data collection process by seeking ethical clearance from the Cape Peninsula University of Technology's (CPUT) Informatics and Design faculty. This is to ensure that the data collected from the targeted organisation is handled in accordance with CPUT's code of ethics.

After obtaining this certificate of clearance, the researcher sought approval from the organisation selected as a case for this study. The process included registering on their research portal and providing the organisation with an overview of the study. This meant highlighting the aims and objectives of this study, who the targeted departments were and how long the researcher intended to conduct the data collection process. The organisation also sought to understand how the study would benefit it. Interestingly, the organisation required from the researcher a definite number of participants. However, because the study is qualitative, the researcher was unable to provide that number citing that a qualitative research continues until a point of saturation is reached.

The organisation also required a copy of the researcher's curriculum vitae (CV), research proposal, ethical clearance certificate, and an acknowledgement letter from the researcher's line manager since the researcher is an employee of the organisation. The organisation being a public entity, the process of obtaining approval was lengthy and rigorous. The researcher is an internal employee and therefore was able to reach

out to the various departments and participants involved in the study. The researcher obtained approval from the organisation's Organisational Research in the Policy and Strategy Department to interview employees with knowledge of ICS.

Based on the aim of the study, the qualitative methodology was used. The research design employed was a case study. A case study enabled the researcher to obtain an in-depth understanding of the case in its natural context.

Semi-structured interviews were conducted to collect data from the participants to understand their subjective views. A total of fifteen participants participated in the study. Ten of the participants were from the business department and five were from the information technology (IT) department. A point of saturation was reached at twelve participants. A point of saturation in qualitative studies is defined as the point or extremity where the researcher obtains the same information from the participants (Saunders et al, 2018).

The interviews were predominantly conducted using the Skype for Business application which was chosen as the preferred application because the participants at the organisation had free access to the application. However, with one of the participants, the interview was conducted in person. This was a different experience for the researcher as the participant showcased some of the features of the ICS.

The average duration of the interviews was 30 minutes with some reaching 60 minutes. This was considered a fair amount of time per interview to collect data during working hours and not inconvenience any employees in their daily operations. The interviewer received permission from the interviewees to use a voice recording device. This device was used to ensure that all that was said by the participants was captured and therefore available as evidence. These recordings were also used to facilitate transcribing purposes.

All data collected was stored in an encrypted cloud location that can only be accessed by the researcher and the supervisor for the study.

4.2. Case Overview

As discussed in Chapter Three, Kwa-Maspala (pseudonym) is one of the eight metropolitan municipalities in South Africa. It is the local government of the country's oldest city and the seat of the parliament of South Africa. It is a municipality that serves as the local government of a city that is hailed as one of Africa's smartest cities. Kwa-

Maspala is considered to be the best-run metropolitan municipality in South Africa. It is often described as a well-run, opportunity, safe, caring, and inclusive city. At the time of this study, Kwa-Maspala had a staff complement of approximately 26 225 employees.

Similar to other municipalities in South Africa, Kwa-Maspala is mandated with the delivery of effective and efficient services to its citizens. Kwa-Maspala strives to give priority to basic needs and to promote the social and economic development of the residents of the city. These services are provided by different divisions which make up the organisational structure. The organogram of Kwa-Maspala's IT and business divisions are depicted below:

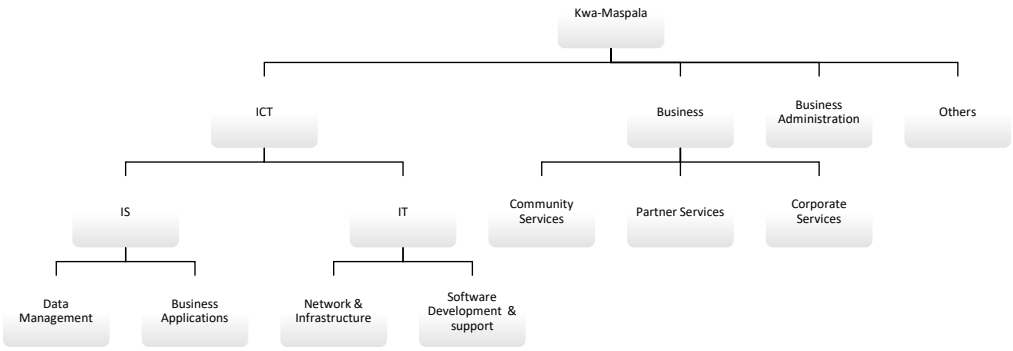

Figure 4.1: Organisational structure of Kwa-Maspala

The organisational structure depicts the IT hierarchy within Kwa-Maspala. It indicates the divisions and departments within the organisation. Some of these divisions include ICT, Business, Business Administration, and other divisions. With a staff complement of over 2500 permanent and contracted specialists, these divisions function as strategic enablers, initiators, and supporters of innovation. These specialists include software engineers, IT project managers, software developers, integration specialists, system analysts, business analysts, data analysts, database administrators, operations managers, network engineers, data architects and network administrators. The vision of these divisions is to provide strategic management and support services to the whole organisation with cutting-edge solutions that enable a customer-centric culture within Kwa-Maspala. Although these divisions have different functions, they play leading roles in driving customer centricity by ensuring that Kwa-Maspala's structures, systems and procedures are responsive to customer needs and serve residents in the most effective and efficient ways. They work in collaboration to provide support to the various

organisational units, thus significantly contributing to the efficiency and effectiveness of the municipality's service delivery.

The ICT division consists of the Information Systems (IS) department and the Information Technology (IT) department. The ICT division is perceived as a strategic technology partner to the organisation. It provides information technology and communication services to the organisation.

The IS department is responsible for the management, use, and application of information, knowledge, and records management to support the organisation's planning and service delivery. It is also an enabler of the integration of information and knowledge from the various departments within the organisation. This is to ensure that information, knowledge assets, and records are stored in the right place. They are properly managed and easily accessible to enable information-driven and evidence-based management, planning, decision-making, and service delivery in the town. The IS department is composed of various skill sets who are responsible for overseeing the administration of the organisation's data assets. This entails the collection and creation of data such as records of municipal ratepayers, land usage, building plans, geographical information, systems mapping, and geometrics. The team also supports the effective use of data throughout the organisation.

On the other hand, the IT department is perceived as a strategic technology partner to the organisation. This department provides information technology and communication services to the organisation. The organisation's IT projects are administered by this unit. It consists of software developers, project managers, business analysts, database administrators, and network specialists. Some of the responsibilities of the unit include overseeing the procurement of proposed technologies. They are tasked with understanding what the market offers in relation to what the organisation requires. This unit researches the cost of technologies, implementation, and the relevant software vendors. The unit is also responsible for the integration of any new technologies. It oversees how the new technologies are incorporated into the organisation and are introduced to employees for use.

When the organisation has identified an IT solution, the IT unit is responsible for the implementation and integration of all IT projects within Kwa-Maspala. This means that the team oversees the life cycle of an IT project from planning, conception, testing, launching, monitoring, and reporting. The unit is also responsible for solving problems that arise during projects. It is responsible for facilitating communication among the

various project teams, setting, and remaining within the project budget, communicating the deadlines, setting milestones, identifying the risks, and controlling the overall project cycle.

Within the IT department is the operations unit with database administrators and network specialists. The primary role of the operations unit is monitoring the organisation's servers and network management. They ensure that the networking in all buildings is configured correctly, and that the database is working at an optimal level. Following the hierarchy of authority bestowed on it by the organisation, the unit receives requests from top management such as the head of IT and the CIO.

The Business department is responsible for business processes performed to ensure that the organisation achieves its objectives of delivering services to citizens. The business unit is supported by the IT unit. Business is made up of community services, partner services, and corporate services. Community Services is composed of units such as Law Enforcement, Traffic Services, Disaster Risk Management and Fire Services. These units are responsible for ensuring that the citizens are law-abiding, and the town is safe from crime and disasters. The ICS system is used in this business unit. It has been operational for over 6 years. The different units within the business use ICS to support their day-to-day operations. The managers use ICS for processes like planning, workforce management, and strategising. By using ICS, the business unit is responsible for identifying future ICS enhancements and funding those enhancements.

4.3. Summary

The purpose of this chapter was to provide an overview of how the fieldwork was carried and an overview of the selected case. It also presented the organisational structure of Kwa-Maspala to create an understanding of how the IT unit and business unit are linked. The chapter outlined how the organisation uses information systems and information technology solutions to drive their business operations and enhance service delivery.

CHAPTER 5 DATA ANALYSIS

5.1 Introduction

This chapter presents the data analysis. It focuses on achieving the study's objectives presented in Chapter 1. Based on the objectives, the thematic technique from the interpretive approach perspective was employed for analysing the data. The analysis was guided using Actor-network theory (ANT). The theory was discussed in detail in Chapters 2 and 3.

The chapter is divided into four main sections. It begins with the introduction. The following section presents an overview of the data analysis. The third section presents the analysis in which the four moments of translation of ANT were applied. In the fourth section, the chapter is concluded with a summary.

5.2 Overview

As stated in Chapter 1 and repeated in Chapter 3, the study aimed to develop a metrics model for evaluating an Incident Command System (ICS). Based on the aim, the case study approach was employed, and data were collected from fifteen people at the point of saturation. The data were cleaned, and codenames were assigned to the participants to protect their identity. Details about the data collection are presented in Chapters 3 and 4.

The selected case is a metropolitan municipality in Western Cape South Africa. The presented case is assigned a pseudonym. The pseudonym ensures that the identities of the organisation and participants are protected. The organisation is assigned "Kwa-Maspala" as its pseudonym, which is abbreviated as "KM". A referencing format was formulated, in which 1 to 15 represents the number assigned to participants, and "P" represents the page number followed by the line number. For example, KM01, P1:1-2. The transcripts are sorted in no order.

In achieving the objectives of the study, the moments of translation of actor-network theory (ANT) were selected. As shown in Figure 5.1, the moments of translation consist of four stages, which are problematisation, interessement, enrolment, and mobilisation. The theory is introduced in Chapter 1 and a comprehensive discussion is presented in Chapter 2.

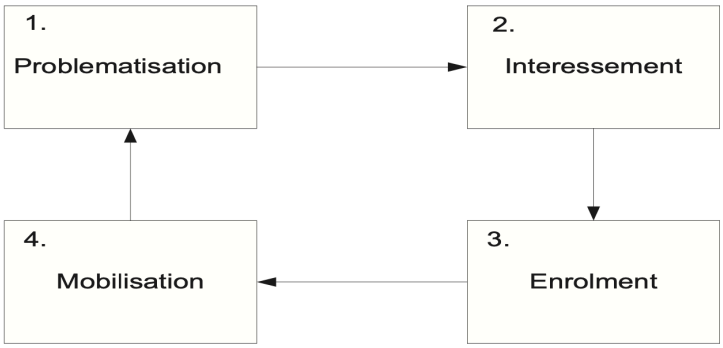

Figure 5.1: Moments of translation
(Adapted from Callon, 1986)

A detailed justification for selecting the ANT is provided in Chapter 3. This includes its strength to examine how networks are consciously or unconsciously formed. Another rationale is its focus on shifting negotiation. These are fundamental to achieving the objectives of the study. There seems to be no other theory that focuses on these attributes. Thus, the theory was selected and used as a lens in the data analysis. How the theory is used to guide the data analysis is diagrammatically presented in Figure 5.2.

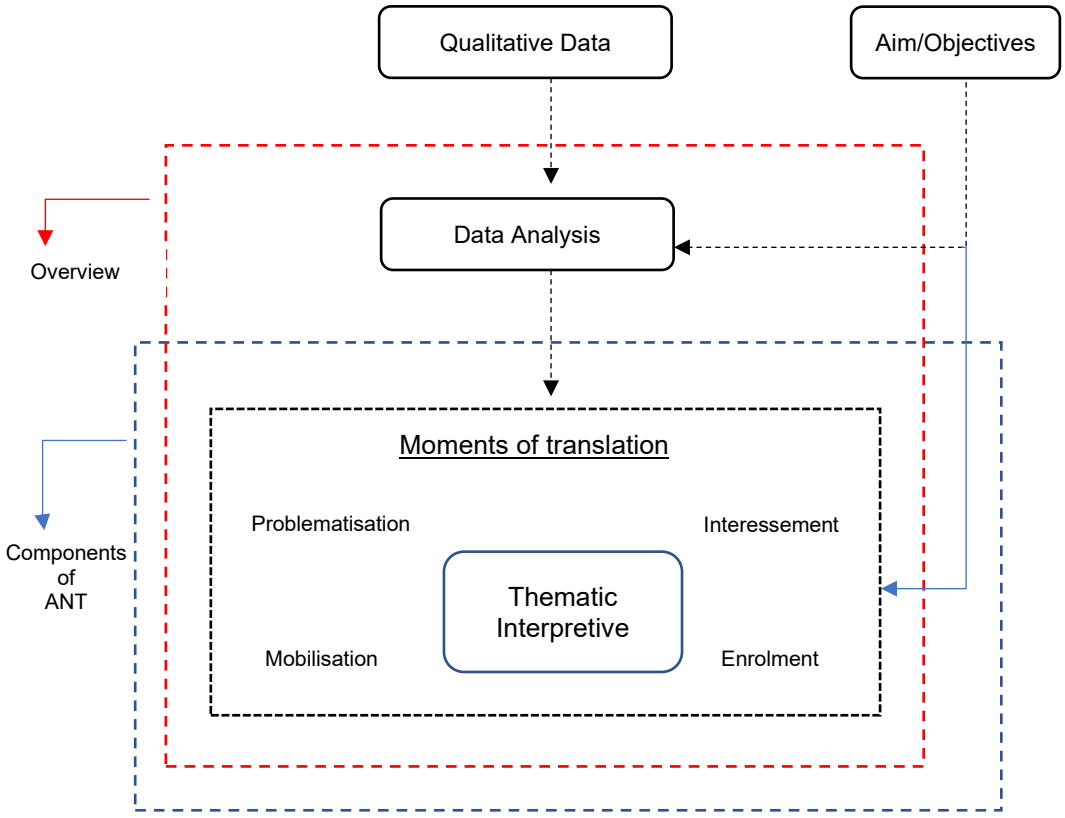

Figure 5.2: Data collection and analysis

The analysis begins by identifying the actors that are involved with the ICS, from both the business and IT units of the organisation used as a case study (Kwa-Maspala). Kwa-Maspala is a pseudonym for the organisation. The rationale for the use of a pseudonym is explained in Chapter 3. This is followed by an understanding of the networks that were created and the roles of the networks. Thereafter, the four moments of translation were applied, which led to the development of a metrics model for ICS, in Chapter 6.

5.3 Data Analysis: Moments of Translation

5.3.1 Actor

In ANT, actors are both human and non-human entities that have the power to make a difference in an environment or social system (Callon, 1986). Various actors are involved in the implementation and use of the ICS in Kwa-Maspala. The actors were assigned different roles and responsibilities in the implementation, support, and management stages of the ICS.

The human actors were employees in the business and IT units of the organisation. Among the personnel in the IT unit were project managers, business analysts, developers, product owners, data analysts, network support, and database administrators. During the implementation and maintenance process of ICS, the role of the project manager was to ensure that the system was implemented according to business requirements in the stipulated time, budget, and scope. The business analysts ensured that there was clear communication between business and ICS developers so that the system was designed and implemented according to business needs. The computer network specialists provided support for the system. Similarly, the database administrators also performed a crucial role in ensuring that the ICS is always available thus adhering to the 99% system uptime of an emergency system. One of the database administrators explains:

> “Post implementation of ICS, I was responsible for the contact centre. I was then technical lead for ICS but now I am the SAP HANA database administrator.” (KM06, P1: 5-6).

From the business unit, the personnel (actors) held various titles such as managers and users. Among the managers, there were system managers and department managers. Also, there were training facilitators, superusers, and law enforcement officers. The system manager was responsible for introducing new functionalities of ICS in the organisation. The department manager was responsible for the overall management of the ICS and reported to the executive management. The training

facilitators also played a crucial role. They ensured that users such as law enforcement officers knew how to use the ICS, appropriately. Also, the training facilitators managed the change process and were responsible for creating awareness of the capabilities of ICS and how it could be used to improve productivity, to benefit the organisation. According to one of the participants:

> "In the change management process, ICS needs to have a change champion to tell officers why the system is there. I think that's going to make officers feel more at ease." (KM12, P1: 88-89).

The superusers were business users who were highly experienced in using the ICS. They are the first point of contact for those who know the system or are learning about it. Similarly, law enforcement users are the patrolling officers who are using an integrated functionality of the ICS through a mobile device. One of the participants briefly explained as follows:

> "Mobility gives officers the ability to also understand where they are going. It also gives them a history of the location they are going to" (KM11, P4:127-128).

Non-human actors within Kwa-Maspala include IT solutions and other artefacts. The IT solutions included technology such as mobile devices, personal computers (PCs), software, databases, body-worn and dashboard cameras, and drones. Other artefacts consisted of documentation, the South African National Standards (SANS) code, and processes such as policies. One of the participants says:

> "We were able to introduce body-worn cameras. It's the first implementation in the country of body-worn cameras in the security clusters within local government or national government" (KM15, P1:436-438).

Consciously or unconsciously, the actors collaborate to influence the activities of ICS in the organisation. According to Nehemia-Maletzky et al. (2018), actors collaborate to create something new or different. The collaboration of the actors affects the outcome of the use and management of the ICS in the organisation. This has a direct or indirect influence on the return on the investment on ICS.

5.3.2 Network

In ANT, a network consists of human and non-human actors that have a common interest or goal. This means that a network cannot exist without actors. Another important aspect is that the network can be formed consciously or unconsciously

(Johnson & Iyamu, 2018). In Kwa-Maspala, there were many networks concerning ICS. The networks were hierarchical across the organisation. This means that there were networks within networks. ANT refers to this as heterogeneity. For example, first, the IT and business units were separate networks. Within these units (networks), there were other subunits or departments. This was the setting of the environment at the time of this study. The hierarchical formation of the networks was defined by the organisational structure, which is a conscious action by the organisation.

However, some networks were formed unconsciously. This includes groups of people who work together in enabling, supporting, or managing the ICS but are in different units or departments in the organisation. They form a collaborative team outside of the organisational structure to execute tasks. Owing to their membership of different networks, the team that was formed based on collaboration is heterogeneous.

Within the IT units, some of the networks that existed were the IT steering committee (ITSC), Enterprise Architecture (EA) team, and Supply Chain Management (SCM) team. Each of these networks has distinctive roles and responsibilities. The ITSC was responsible for the strategy and governance of IT solutions. The committee decides on the types of projects that must be undertaken including the implementation processes. The role of EA was to define the structure and operations of the organisation. Also, EA plays an important role in unifying and coordinating departmental processes across the organisation. Based on regulatory and best practices, the team sets standards and governance for managing the ICS. The SCM team was responsible for the procurement of services and artefacts needed for the implementation of ICS in the organisation. This includes the management and support of the system. An employee explains the importance of governance as follows:

> "We have had incidents in the past where the chief architect had resigned. This left the position vacant for a while. That affected our task of governance, which had detrimental implications in the way we managed projects within the environment" (KM15, P10:361-364).

However, there were some areas where roles or responsibilities overlapped. For example, one of the roles of both the EA team and ITSC entails governance of IT solutions, which include ICS. An overlap of tasks between units or committees enacts heterogeneity. From Latour's (1996) explanation, each element in a network is simply defined by the heterogeneous list of its associates. According to Iyamu (2013), heterogeneous networks avoid arbitrary dichotomies and structures by overcoming

defined identities. This increases the need for effective and efficient use of IT resources such as ICS, in achieving business goals and objectives.

Similar to the IT unit, there were many subunits within the business unit. Some of the networks that existed included training compliance and policy officers, end-users, and management teams. The network of end-users was unconsciously formed. This is because the group was recognised or within the hierarchical structure of the organisation. They were part of the business unit and were active users of the system. They used the system to fulfil their roles and responsibilities. They had in-depth knowledge of the system. The end-users understood the business processes and recognised some of the shortcomings of the system. One of the participants explained it as follows:

> "in some instances, we are tasked to look at what is needed within our environment and then find the solution . . . . … . that we envision would provide value downstream. The process would be to build your case and then motivate for your budget" (KM15, P1:507-508, P1:528-529).

Within the business unit, there was a network of managers. This group was responsible for the management of business units. The group reports to the executive management of the organisation. The executive management was a network on its own. The network of people constitutes the mayor of the town. The executive management was responsible for the overall strategy of the organisation. One of the participants said:

> "We have priority meetings with our management structures and steering committees within business and IT that are tasked with decision-making in that space (KM15, P11: 400-401).

5.3.3 Problematisation

In ANT, problematisation is a stage in moments of translation where the focal actor identifies a problem that needs to be addressed and considers ways to address the problem (Johnson & Iyamu, 2018; Twum-darko & Harker, 2017). In Kwa-Maspala, the ICS was problematised. The problematisation of the system was triggered by a need for innovation, scalable IT solutions, and an interconnectivity of departments. This was attributed to the increasing reliance on technology as a key service delivery enabler in the organisation. According to one of the participants:

> "The need was for all the different departments to be on a common platform to improve efficiencies, get to data sharing, and ultimately deliver better service" (KM10, P1:13-14).

When an organisation plans to implement a solution that is considered complex, involving multiple departments and different methods of handling processes, events, and incidents including data, it needs to be divided into smaller units and teams to improve holistic coverage and management. This allows the stakeholders including the executive management team to gain a better understanding of the big picture before diving into details. Thus, gaining a clear understanding of the end goal before starting the project. Often, the executive management embarks on roadshows visiting countries that have implemented the identified emergency management solution. In addition to that, executive management conducts workshops where the business requirements are presented. Thus, soliciting design inputs from panellists to access factors such as scalability, interconnectivity, and collaborative strengths or levels.

> "Management went to different countries to see what systems they used and what was best practice. We obviously also had to use SAP, which was being used in the organisation which was a little challenging. Ultimately, we found that we must do an in-house solution" (KM14, P1:14-17).

How the ICS was problematised was critical because buy-in from the stakeholders was essential to grant legitimacy to the acquisition of the system. It began with the executive management in the organisation where a need for an innovative system for law enforcement was identified. Subsequently, problematisation of the systems happened at various levels, in both IT and business units. In the IT unit, the CIO problematised the system to the employees. In the process, the CIO received system requirements from business management to be translated into system requirements. The result of this process led to the determination of ICS being a suitable IT solution on the basis that it fulfilled the business requirements. Similarly, within the business unit, the problematisation started with the executive committee. The problematised item was presented to business management who conducted workshops to draw up specifications and design of the solution.

In problematising the ICS, requirements were gathered from both IT and business units. Only the senior managers were involved in the gathering and articulation of the requirements. Thereafter, it was problematised to other employees. This means that a top-down approach was followed, which excluded the end-users from the process of gathering requirements. This means that the executive management team employed the power bestowed on it by the organisational structure to exclude other employees at that stage of the process. The top-down approach had both negative and positive implications in the process of problematising ICS in the organisation.

From a negative perspective, the challenges inherent in the top-down approach are that system ideas are limited to the predetermined solutions. This means that communication occurs at a management level which excludes end-users from engaging in the problematised task and collaborating. Also, the lack of inclusivity among the employees manifests resistance, which affects operationalising the use and performance of the system in the organisation. Another challenge was that this approach could lead to ill-informed decisions if management does not seek input from people who operationalise the system. Iyamu and Batyashe (2020) explain the criticality of operationalisation in achieving the goals and objectives of an organisation. One of the participants said:

> "Despite best interest and best attempts, I don't think this was rolled out correctly within the department. It was very much done at a high level with information at a top structure. It was great that there were change management sessions held, but I don't think enough information and practical information was brought across to staff." (KM14, P4:115-118).

One of the benefits of the top-down approach is that the decisions to select and implement the solution are at a faster rate. This is because there are fewer negotiations and compromises in the processes. Therefore, it takes a shorter time to arrive at decisions which reduces delays in the selection and implementation processes. Another advantage is that with the approach there is centralised control and decision-making. This is because the roles and responsibilities are decided upon by management and instructions are given to employees. Fundamentally, the relationship between the executive management team and other employees was defined by power.

The problematisation of the ICS in Kwa-Maspala was not straightforward. Somehow, it was complicated owing to the largeness of the environment, from IT to business units. Additionally, this could be attributed to the various interests that were visible and some unclear in the process.

5.3.4 Interessement

Interessement is the second stage of the moments of translation. Iyamu (2018) explains interessement as the stage where the stakeholders' interests are determined based on their understanding of the problematised issue. The selection and operationalisation (implementation, use, and management) of ICS attracted interest from multiple groups of people within and outside of Kwa-Maspala. From the organisation's perspective, the groups of people were employees of the IT and business units. The external parties were consultants contracted to perform certain tasks on the system. The interest was

influenced by different reasons and factors. Also, the interest was informed by roles and responsibilities within the organisational structure.

The interest of IT as a unit was primarily how the system would be supported and maintained. Within the IT unit, there were teams such as software developers, analysts, database administrators, managers, and executive managers. The interests of these teams varied. The software developers and analysts were interested in adding more functions to the system. The database administrators had a keen interest in the integration of ICS with other systems and databases. While the managers were concerned with the use and management of the system and its value to the organisation. Thus, the management team ensured that the system requirements were specified according to business requirements. Owing to the different roles and responsibilities towards a common interest, negotiations happened. The negotiations emanate from interaction between the employees at various stages of the process. Based on the requirements, the actors (employees) negotiated among themselves towards the operationalisation of ICS in Kwa-Maspala. The project managers were responsible for overseeing the progress of the ICS project. One of the employees explained as follows:

> "Within the IT environment, we would have the IT managers that manage the IT resources that are allocated to ICS. And then within business, we have resources that look after specific components of the ICS solution. Between those we would have bi-weekly SME meetings where we can raise some of the system issues that arise" (KM15, P11:394-398).

The business unit had end-users, managers and executive managers interested in the problematised solution. These networks had different interests in the implementation of ICS in the organisation. Some of the interests were influenced by either organisational or personal goals, even though the system was implemented to assist actors and networks within the business unit in carrying out their daily tasks. One of the factors that attracted interest is its use to improve service delivery. For example, when citizens call the organisation (Kwa-Maspala) to report an incident, emergency or crime, call-centre agents can geolocate the caller to pick up the caller's exact location and pinpoint which law enforcement officers are near the reported incident. Additionally, they can determine which of those officers can attend to the incident, in real-time. This makes their roles easier because the call-centre agent can provide the law enforcement officers with the right information about the incident. One of the participants explains:

> “ICS is not only an incident registration system, but it also has strong functional aspects to it. For example, it has geospatial functionality that enables us to understand the exact location of a caller or an officer. That's one of the most important things about instant response. It's about knowing where we need to go” (KM11, P1:30-33).

In the organisation, the business end-users and managers’ interest in ICS was influenced by their use of ICS to carry out their duties, to fulfil business objectives. They used the system in a variety of ways and for different business processes. These include operational planning, disaster management, and workforce management. Operational planning includes using the data available in ICS to plan how best to tackle problem areas in the city (town). Disaster management involves the system’s command and control capabilities to manage how the business unit responds to disasters to minimise their impact. Workforce management includes the ability to use, manage and monitor the number of law enforcement officers in a given period. These reasons triggered their interest in the use, implementation, and management of ICS. This is because they needed IT solutions that support them in improving service delivery. One of the employees explained:

> “I think the departments have come on board. They see the value of the system now. It has taken a long time to get them to see it. And the value is that the system is actually for them and it's not for management; it's for everyone in the system” (KM10, P3: 80-82).

From a perspective of personal interests, many of the actors and groups’ interests were influenced by knowledge, career advancements or the power to make a difference. For instance, some employees’ interests were triggered by knowing that certain tasks could not be completed without their input. This could have been because of the number of years an employee has been in that unit. In some cases, it could have been an in-depth knowledge and understanding of that unit’s business processes. One of the employees explains:

> “Currently, my role is to manage the system. Previously, I was working in the fire and rescue department with the responsibility of scoping the system requirements for that department. This is because I had experience and knowledge of the system’s functionality and how it is being utilised.” (KM15, P2: 46-48).

In Kwa-Maspala, many people were interested in ICS. However, not every one of them could participate in the operationalisation of the system. This is attributed to various factors, from individual, group, or organisational perspectives.

5.3.5 Enrolment

In the third moment of translation, enrolment occurs. Iyamu and Moloi (2013) describe enrolment as the stage where actors take action in their interest by participating in the activities of the problematised initiative. During the enrolment stage, the focal actor defines roles for other actors in the network (Govender & Chitanana, 2016). Directly or indirectly, the focal actor negotiates with the actors in allocating the tasks. The negotiation is influenced by various factors, which are of personal or organisational interest. Personal interest includes growth and job security. Organisational interest can be deliverables that can improve efficiency and effectiveness in providing services. Thus, a contractual agreement between an employee and the organisation is used as a focal point. ANT refers to this as an obligatory passage point (OPP). The OPP is a set of conditions that actors need to fulfil to satisfy interests defined for them by the focal actor (Devi & Kumar, 2018).

The actors who participated in the operationalisation of ICS in the organisation were employees in different units, from IT to business. Also, the employees were at different levels as defined by the organisational structure. The levels include team, unit, and management. Subsequently, two factors were the determinants in the allocation of tasks: (1) tasks were allocated based on skillset and seniority, as defined by the organisational structure; and (2) negotiations were influenced by stock of knowledge, skillset, and seniority in the hierarchy. Iyamu (2017) argues that the stock of knowledge is used as a source of dominance, which means that it influences interactions, legitimately.

The process of selecting and implementing the ICS was a rigid exercise that took about two years to conclude. It became a rigorous process that involved multiple stakeholders such as management, subject matter experts (SME), and enterprise software providers. Managers in the organisation exercised the powers bestowed on them by their roles to negotiate with actors and participate in the activities of operationalising ICS in fulfilling the organisational goals. This approach also influenced the vendors whom the Kwa-Maspala negotiated with in implementing ICS. This means management identified the software vendor and negotiated with them to accept the roles and responsibilities defined for them. One of the participants explains:

> “SAP conducted system demonstrations to business management that were obviously sales pitches. SAP did these demonstrations in terms of how they can basically provide this emergency system to the

> organisation. When business saw it, they were impressed with the sales pitch." (KM01, P2:41-44).

In the IT and business unit, tasks were allocated to teams based on a team's roles and responsibilities towards the implementation of ICS. Each team represented a diversity of skills and knowledge necessary to implement the required solution. As such, team members were allocated tasks based on their roles and responsibilities.

Since the implementation of ICS in the organisation was the responsibility of a software vendor who was skilled at implementing IT solutions, the team of IT specialists were allocated roles based on their specialities. The software vendor brought their team to implement ICS without relying on the organisation's staff. Hence some of the employees were not involved in the implementation of ICS. This became a challenge because the organisation's employees (IT specialists) were later assigned the responsibilities of system support. This was a challenge because they found it difficult to perform their roles without knowledge of the implementation.

In Kwa-Maspala, some of the actors did not know the organisation's reasons for implementing ICS. This could have been because of the top-down approach that was identified in the problematisation stage. Seemingly, the organisation's management made decisions with little or no input from many of the end-users. Subsequently, many of the stakeholders who are the primary end-users were excluded from discussions about the solution. This created a perception that even though these stakeholders were excluded from the implementation of ICS, they were expected to use, support, and maintain it. One of the users says:

> "there were people, including permanent staff, involved in selecting the system but that reason was never disclosed. I think it remains a secret to this day as to what the rationale was" (KM01, P1:30-31).

In the business unit of the organisation, the participation of team members (end-users) was mandatory. This was because the end-users carry out the daily tasks enabled and supported using the ICS. This makes the use of the system fundamental to service delivery. Also, it makes users' participation in the operationalisation of ICS critical. For example, the involvement of end-users allows the requirements-gathering process to capture system needs and wants that would not be apparent to management. Furthermore, by involving end-users, the organisation reduces the potential resistance to changes that come with the new solution. Their involvement in the process can also aid in improving their experience with the ICS. Ultimately, the involvement of end-users means the organisation increases the chances of realising the full value of the IT

solution. This is because the end-users will adopt and use the solution. One of the employees highlighted:

> "ICS is a great system in terms of functionality and what it's capable of doing. However, that does not translate to how people are using it. A system is as good as how the people utilise it and utilise all its functionality." (KM08, P1: 8-10).

Some employees in the IT unit were frustrated because of the obligatory passageway that was set for them. This was evident in the reluctance to accept and execute their tasks in supporting and maintaining ICS in the organisation. This reluctance stemmed from a lack of involvement in the implementation process which resulted in them finding it challenging to support the system. One of the participants expressed his opinion from a frustrated standpoint as follows:

> "I am a developer, and my role is to support and maintain the system. I was dumped into that position, without any form of handover" (KM02, P1: 4-5).

In Kwa-Maspala, the operationalisation of the ICS was not as smooth as was envisaged. There were challenges, which were more of human factors than the technology solution. Consequently, the challenges distort an understanding of the actual value, functions, and return on investment of the ICS, in the organisation. Hence, mobilisation becomes critical.

5.3.6 Mobilisation

Mobilisation is the final moment of translation. The mobilisation stage involves the persuasion of actors that their interests are aligned with those of the focal actor (Shim & Shin, 2016). During this stage, all actors have successfully bought into the network. When actors enrol in a network, the consequences of success or failure spread through the network, so that there is mutual interest that makes everyone successful (Nehemia-Maletzky et al., 2018).

During the implementation of ICS in Kwa-Maspala, mobilisation occurred at strategic and operational levels of the IT and business units, led by spokespersons. Spokespersons can be appointed by the organisation (network) or self-appointed. In Kwa-Maspala, spokespersons were appointed to encourage and get buy-in from employees, for the implementation, use and management of ICS. The focal actors (spokespersons) at both strategic and operational levels played crucial roles in the

process of negotiating with other actors in their networks to buy-in and contribute to the operationalisation of the ICS in the organisation.

At a strategic level, the CIO was the focal actor for the implementation of ICS. This was because of her position as the CIO. Thus, she mobilises the executive management team to buy-in and support business requirements and the IT unit's implementation of ICS. There were reasons why the CIO negotiated the buy-in of the executive management. One of the reasons was that, as the head (CIO) of the IT unit, she was responsible for IT solutions in the organisation. Thus, she had a mandate, to fulfil the organisation's objectives such as providing strategic IT solutions that can support current business needs and improve its efficiency and effectiveness. Another reason was job security. The CIO endeavours to meet her performance management (IPM) plan by providing IT solutions such as the ICS that strategically support and enable Kwa-Maspala to improve service delivery.

At an operational level, managers were spokespersons for both IT and business units. They were contractually obliged to mobilise employees in their units to buy-in into the process. Many of the managers used staff meetings as a platform for the mobilisation drive. In the meetings, the implementation, use or management of ICS were regularly discussed. It was an opportunity for some of the managers to enact their roles as bestowed on them by the organisation. The IT managers' roles and responsibilities included negotiating with software vendors, IT specialists, project managers, business analysts, database administrators, and other stakeholders. Based on their responsibilities, the managers were able to persuade the stakeholders to enrol into a network that collectively acted towards implementing the ICS as per business requirements.

Some of the managers ensured that the networks connected with IT solutions were in agreement with their plan on how the ICS should be operationalised in Kwa-Maspala. The business managers as spokespersons also played a fundamental role in mobilising actors such as end-users and training facilitators towards the use of ICS. The collective effort of these networks resulted in the implementation, use and management of ICS in Kwa-Maspala. One of the participants briefly explained:

> "Safety and Security is allocated a huge budget to assist us with the implementation of new solutions and the management of ICS. We are fortunate to have a mayor that has adopted technology and is pushing for the use of technology in our environment." (KM15, P12:434-436).

In the business unit, many of the end-users appointed themselves as spokespersons or volunteered to persuade their colleagues on the need to use the ICS in executing their tasks. They took it upon themselves to successfully mobilise and use the system to conduct their day-today activities thus fulfilling their roles and responsibilities. This group of volunteers seemed to have a common understanding about the system, that it was implemented for efficiency and effectiveness. Thus, it will improve the service delivery that Kwa-Maspala provides to the citizens. By so doing, the organisation can realise its return on the investment. Also, the use of the system has a direct impact on the increased policing visibility in the city of Kwa-Maspala. The visibility of the law enforcement officers increases response time, which improves the efficiency and effectiveness of service delivery. One of the users explained briefly, as follows.

> "We cannot measure ROI in monetary value. There is no monetary value. However, I think in terms of the services that the organisation provides by using the system, that's definitely improving how the policing cluster, the fire departments, and the disaster risks are managed. "(KM01, P6: 241-251).

Although mobilisation was taking place, the process had its challenges. There were technical and non-technical challenges. From a technical perspective, the challenges manifested in the form of knowledge and experience of how the system will be used, implemented, or managed. As such, some stakeholders found it challenging to maintain while some found it challenging to use or manage the ICS. From a non-technical perspective, there were challenges with perceptions of what the system is intended to do. This perception manifested from the stakeholders' motivation to keep the status quo or the unwillingness to change from legacy systems.

5.4 Findings from the analysis

From the analysis, as presented above in section 5.3, factors that influence the implementation of ICS from both IT and business units' perspectives in Kwa-Maspala were revealed. The factors are six, presented as follows:

Collaboration

Collaboration is the process where a group of people come together and contribute their expertise to achieve a goal. Castañer and Oliveira (2020:966) define collaboration as a "cooperative, interorganisational relationship that is negotiated in an ongoing communicative process". Collaboration in Kwa-Maspala increased the way different teams worked together to solve problems. Thus, increasing the organisation's efficiency, effectiveness, and usefulness.

Heterogeneity

Heterogeneous networks refer to the networks comprising multiple types of entities as well as their interaction relationships (Pham et al., 2016). It is something that replicates itself in different environments. In Kwa-Maspala, there are people such as project managers who belong to different groups and play fundamental roles in the implementation of ICS.

Governance

IT Governance refers to an organisation's policies and standard principles aimed at ensuring IT investments support business objectives. It is a set of rules and regulations that are an integral part of enterprise architecture. To an organisation, IT governance means effective development, management, and use of IT solutions as per business requirements (Gavilanes-Molina & Merchán-Rodríguez, 2022). In Kwa-Maspala, the IT governance unit was responsible for ensuring that implementation of ICS followed organisational standards and policies.

Interconnectivity

The interconnectivity refers to the way silos within an organisation are broken. Interconnectivity allows organisations to optimise the access and sharing of data and resources among departments. The implementation of ICS in Kwa-Maspala allowed the organisation to operationalise several departments onto a single platform. Thus, improving how the business unit operated and enhanced service delivery.

Requirements

Requirements are things that are wanted or needed to achieve a certain objective. Aslaksen and Merz (2003) defines requirements as the process of writing things towards the creation of an end goal. Requirements can either be business, user or system-related. In Kwa-Maspala, business and system requirements were the two types of requirements that influenced the adoption of ICS.

Top-Down approach

The top-down approach is one of the decision-making strategies that are often employed to reach objectives. The top-down approach to management is when company-wide decisions are made solely by top management. When organisations follow the top-down approach to implement IT solutions, the emphasis is on hierarchical control within the organisation (Koontz & Newig, 2014). In Kwa-Maspala, this approach was followed within the business and IT units towards the implementation of ICS.

The findings are interpreted. This is presented and discussed in Chapter 6. The interpretation is to gain a better understanding of how the findings (factors) manifest themselves, to influence the use and management of ICS in the Kwa-Maspala. An understanding of the manifestation enables the development of the metrics model, which is the aim of the study.

5.5 Summary

This chapter presented the analysis of the data collected from the case (Kwa-Maspala) studied. ANT was applied as a lens to guide the analysis. Based on the analysis, the factors that influence the implementation of the ICS in Kwa-Maspala were revealed. The factors manifest themselves to determine the success or failure of the system in the organisation. In the context of the study, success refers to improved efficiency and effectiveness, including return on investment. The next chapter presents the interpretations of the findings.

CHAPTER 6
INTERPRETATION OF FINDINGS AND METRICS MODEL

6.1 Introduction

Based on the aim of the study, which is to develop a metrics model for the deployment of an incident command system (ICS), as discussed in Chapter 1 and revisited in Chapter 3, data was collected. Chapter 5 presented the data analysis, in which actor-network theory (ANT) was employed as a lens. From the analysis, there were findings. This chapter presents the interpretation of the findings.

This Chapter is divided into five main sections. The first section introduces the chapter. This is followed by an overview of the chapter, which highlights the findings from the analysis. In the third section, the findings are interpreted through discussion by following the subjective reasoning approach. The proposed metrics model is presented in the fourth section. Finally, a summary of the chapter is presented.

6.2 Overview

As stated in Chapter 1 and repeated in Chapter 3, the study aimed to develop a metrics model for evaluating an Incident Command System (ICS). Based on the aim, the study approach was followed. The case studied is discussed in Chapter 4. ANT was used to guide the data analysis. The theory is introduced in Chapter 1 and comprehensively discussed in Chapter 2. Based on the analysis, six factors were found to influence the deployment and use of ICS in an organisation. The factors are (1) Collaboration, (2) Heterogeneity, (3) Governance, (4) Interconnectivity, (5) Requirements, and (6) Top-down approach.

The findings were interpreted to understand the factors better. This is to have a deeper understanding of the attributes that constitute each of the factors within the context of the study. The interpretation process was conducted by following the subjective approach. The interpretation of the findings (factors) is presented in the section that follows.

6.3 Interpretation of the findings

This section presents the interpretation of the factors that were found to influence the implementation, use, and management of ICS in Kwa-Maspala. In the interpretation, Figures 6.1 to 6.6 are used to diagrammatically demonstrate the links and relationships

of the factors and their attributes. This is intended to enhance the understanding of the interpretation of the findings.

6.3.1 Collaboration

Collaboration is the act of working together. Stout and Keast (2021) ascertained that collaboration is a description of a process in which people from different departments or teams work together to form networks, alliances, or joint ventures to solve a problem. According to Waugh (2009), collaborative processes are effective when responding to emergencies of any scale. This means that collaboration supersedes silos (or individual) effort and helps to generate an opportunity to solve complex and challenging problems in an environment. In the emergency environment in Kwa-Maspala, responding to an emergency is usually an unplanned event that often requires the collective effort of multiple departments or teams. However, collaborative effort is always as smooth as it is sometimes portrayed. Hence, the attributes of collaboration in the context of ICS were examined in this study.

Thus, collaboration was a critical factor in the implementation, use, and management of ICS in Kwa-Maspala. In the operation of ICS in Kwa-Maspala, collaboration was influenced by two main attributes, coordination, and communication. As depicted in Figure 6.1, the attributes are also linked.

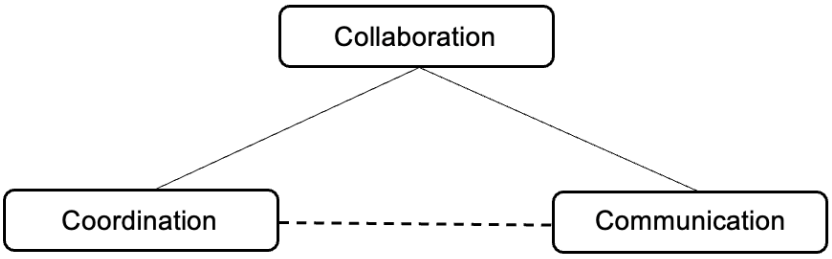

Figure 6.1 Collaboration

Coordination is a process through which separate, or a variety of things can be made to work together. Markowitz et al. (2003) suggest that coordination is a stage-oriented process where participants synchronise interactions and activities. Subsequently, coordination is often employed to effectively align resources to meet objectives in many organisations. In Kwa-Maspala, coordination manifested from collaboration, to join multiple law enforcement departments in a common platform of the organisation. The coordination facilitates more effective and efficient responses to incidents. Also, the coordination effort helps to align and synchronise business processes and standards of practice towards improving response time for emergency purposes.

The other aspect of collaboration is communication. The human actors rely on communication to remain at the same wavelength. Communication is the process of either receiving or sharing information. It is often considered a critical pillar of a collaboration effort (Martin et al., 2016). It thus guides how actors respond to emergency incidents. In the case of ICS for emergency incidents, communication is critical, primarily because it enables the effort of the law enforcement agents to coordinate their responses. The criticality arises because failure or lack of information can result in detrimental circumstances. For example, agents employ various resources to respond to an emergency based on the information that they have access to. Thus, communication is an attribute embedded in the collaboration factor that influenced the operationalisation of ICS in Kwa-Maspala.

6.3.2 Heterogeneity

Heterogeneity refers to the replication of an entity in another environment. According to Latour (1996), each element in the network is simply defined by the heterogeneous list of its associates. Iyamu (2021:75) suggests that “heterogeneity is reflected in different organisational principles that are in simultaneous action and interaction”. In Kwa-Maspala, the implementation, use, and management of ICS entail heterogeneity of people (employees) and synchronisation of processes, as illustrated in Figure 6.2. Also, there is an interwoven relationship between people and synchronisation. The relationship is drawn from the fact that synchronisation happens with the aid of humans, which in turn, enables human effort in interaction and executing activities.

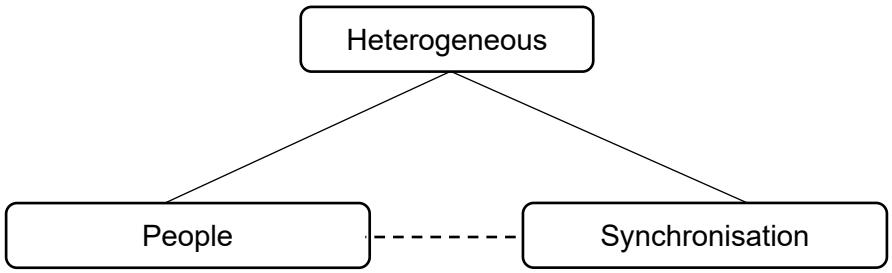

Figure 6.2: Heterogeneity

People (employees) make up various networks that operationalise ICS in Kwa-Maspala. Some of the groups (networks) constituted managers who were employed by the business and IT units. These groups also formed members of the steering committees and governance networks. The heterogeneity of the people and the networks contribute to defining how ICS is implemented, used, and managed including the output, in Kwa-Maspala. In other instances, the traffic officers, firefighters, and the

tool (ICS) that they use form part of existing networks, in responding to incidents or providing services.

The functionalities of ICS are not unique to a specific team or department. The functions are replicated in ways that allow different groups of people to use them for their processes and activities. For example, when citizens report an emergency, ICS allows for the dissemination of requests to responsible departments and processes and actions are synchronised in responding to the incident. To be more specific, the traffic officers and firefighters synchronise processes and activities in their quest to respond to incidents and deliver services. Synchronisation helps to avoid conflicts and eradicate or reduce duplications using the same functionality. It therefore means that the organisation can have a holistic view of the different subnetworks that have synchronised their activities.

6.3.3 Governance

Governance comprises a set of standards, principles, and policies, as shown in Figure 6.3. Governance is an integral part of an organisation's processes, activities, and events. As revealed in the analysis, the processes and functions of ICS rely on governance, from standards, principles, or policies perspectives. Also, as shown in Figure 6.3, the attributes of governance are interrelated. The attributes, standards, principles, and policies influence each other.

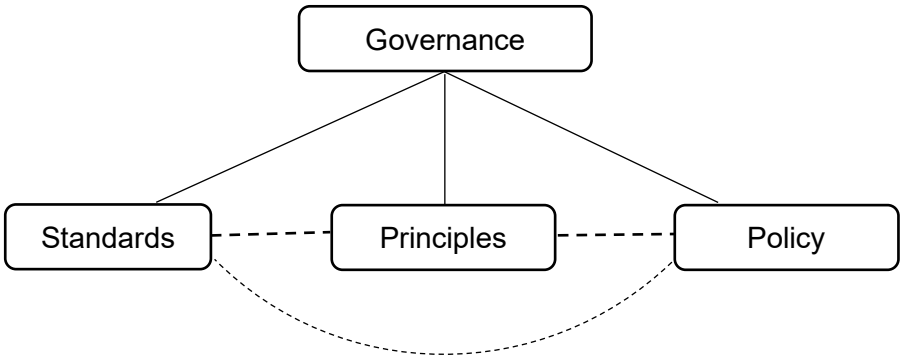

Figure 6.3: Governance

Standards are a set of established norms or best practices, which are often used to guide the selection and management of IT solutions such as the ICS, in an organisation. Additionally, implementations adhere to standards towards achieving the set objectives. They are critical to the compatibility and interoperability of ICS, in ensuring the execution of its processes and functions for an improved service delivery to the citizens. Bai (2021) suggests that standards are powerful tools that can help to drive innovation and increase an organisation’s productivity. ICS is a system that is

integrated with other systems and functionality, which makes standard critical during integration.

Principles are formulated to guide the operations of an organisation. The principles are intended to steer resourcing and technology decisions, which include implementation and the use of IT solutions. According to Juiz et al. (2014), principles encourage better decision-making and the efficient use of resources. It also enforces accountability for the managers of those resources. In Kwa-Maspala, ICS was implemented as a mission-critical emergency management system that was required to have maximum uptime. As such, one of the principles was that critical systems had to be accessible, user-friendly, and well-integrated to enable the activities of the different business units. Based on principles, standards are defined and policy statements are formulated.

Another important pillar of governance is policies. The policies outline the specific guidelines and procedures that govern an organisation's IT activities and resources. In the context of ICS, policy provides guidelines on how to implement, use, and manage the solution to ensure that service delivery is improved. ICS is a complex IT solution primarily because it is used by many people and teams with varying requirements and needs, across an organisation. The guidelines help to simplify and streamline the use and management of ICS in an organisation. For example, ICS is used by law enforcement agents or units for various policing reasons. This includes storing sensitive, private, and confidential-related data. The IT security and privacy policy in Kwa-Maspala is one of the most critical policies. This is because the policy serves as a guide towards secure inter-departmental use, storage and sharing of data guided by standards and principles.

6.3.4 Interconnectivity

Interconnectivity refers to how different aspects of an organisation are connected, towards achieving goals and objectives. In the context of ICS, cross-unit and cross-function are the two main attributes of interconnectivity. The attributes are interlinked as shown in Figure 6.4. The interconnectedness of units and functions allows people (employees) and teams to have easier and more flexible access to data and resources across an organisation.

The interconnectivity enables and supports the implementation of ICS in Kwa-Maspala, which allows managers to manage incidents in unified and consistent ways between units and functions. Also, the interconnectivity of units is important to allow personnel

in different units, with differing roles and responsibilities, to integrate their efforts in using ICS to provide services.

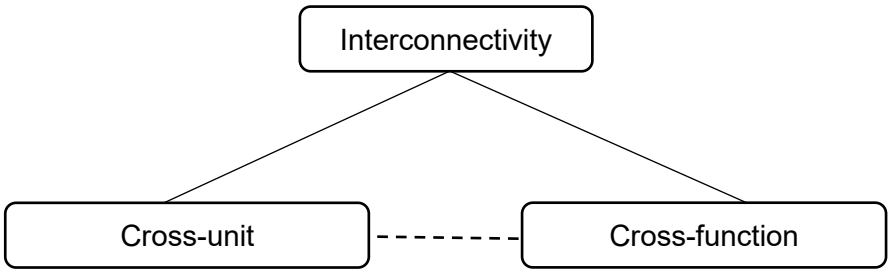

Figure 6.4: Interconnectivity

When an incident occurs, the department relies on ICS to connect the various responding units. ICS is used to ensure coordinated and accurate communication among the units. For instance, when an incident is reported, the call-centre agents trigger the interconnectivity across units and functions by sending to the respective personnel authority for actions. If the incident requires the functions of firefighters and disaster risk management (DRM), the units are connected through functions that will be performed in response to the emergency. In such a scenario, the responding units connect to effectively respond to the reported incident.

6.3.5 Requirements

A requirement is a set of conditions that need to be fulfilled to achieve a defined objective. Aslaksen and Merz (2003) define requirements as the process of writing things towards the creation of an end goal. In the context of this study, requirements provide a detailed description of what ICS should do, how it should behave, and the constraints and other factors that it must satisfy. Thus, organisational requirements consist of requirements from both business and IT units, as shown in Figure 6.5. In Kwa-Maspala, the two sets of requirements influenced the operationalisation of ICS.

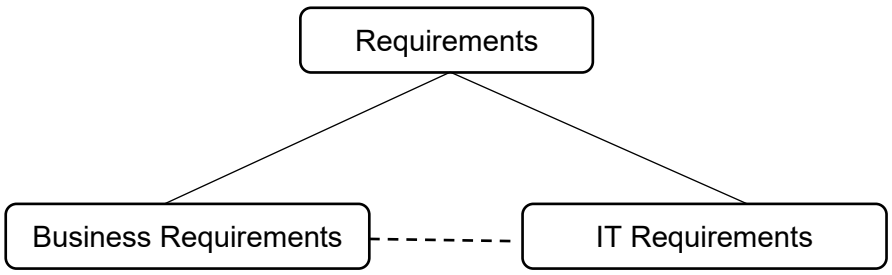

Figure 6.5: Requirements

The business requirements are solicited from the business units. The requirements represent business needs at the time. Business requirements are about the activities

and processes which the ICS should enable and support. However, the business requirements should not be disconnected from the IT requirements. This is primarily because IT requirements are the building blocks of business requirements. This means that IT requirements describe how the proposed solution will deliver business requirements.

In the implementation of ICS, it is vital to comprehensively define IT requirements and align them with business. This ensures a more comprehensive and holistic coverage of the organisational needs. Also, it enables the assessment of the system, from both business and IT perspectives, in the organisation. Based on the assessment, a better understanding of the return on investment (ROI) can be achieved. The ROI helps to determine the level of use and benefits to the organisation. From the analysis, the business units have a high reliance on ICS in maintaining and improving service delivery. This makes IT requirements for ICS a mission-critical task, which must be completed in enabling the organisation's law enforcement unit.

6.3.6 Top-Down approach

The top-down approach is one of the decision-making strategies of many organisations. Following the approach, decisions in an organisation are made at the top (executive or senior management) level and are drilled down to the lower levels (rest of the employees). This approach was employed across business and IT units of the organisation during the implementation of ICS. In Kwa-Maspala, two attributes, buy-in and performance informed the top-down approach in operationalising ICS. The two attributes can be linked as shown in Figure 6.6.

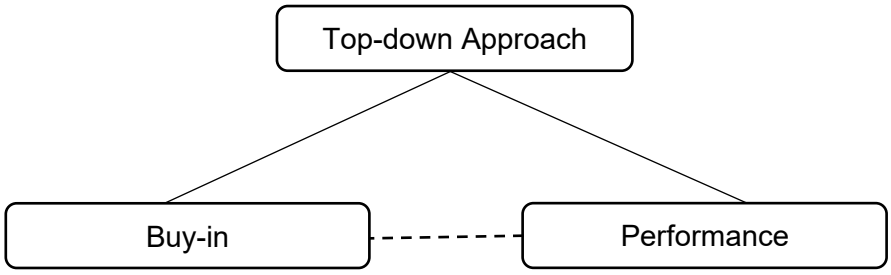

Figure 6.6: Top-down approach

Executive buy-in is a form of agreement or approval by the top or senior management of an organisation. This means that executive management has complete visibility of the proposed solution and is completely on-board with its implementation. The top-down approach manifested itself through buy-in from the executive stakeholders. Based on the essentiality of the ICS, its approval must be decided by top management.

Such approval instils motivation for the use and management of ICS, which potentially improves organisational performance.

However, the approach influences how employees perceive the system. In Kwa-Maspala, the top-down approach was not well received by some of the employees. The view of this group of employees was that the decision-making process was not inclusive of them, and ICS was imposed on them. For example, some employees felt that the exclusion from the implementation of the system meant that they did not know the technical details of ICS even though they were obligated to support it. Some of the users felt that the system was a means of monitoring and tracking them. When interpreting these views, it means that the system is perceived as a challenge and a tool of micromanagement. As such, some end-users resisted using the system while some support staff felt obligated to support the system. Some of the reasons stakeholders hesitated with ICS in the organisation ranged from; (1) insufficient training and system introduction, (2) loyalty to legacy ways of working, and (3) the perceived complexity of ICS.

6.4 A metrics model for the Incident Command System

This study aimed to develop a metrics model that could be used to guide organisations implementing ICS. Metrics are a powerful tool used in organisations, usually, to set goals and determine the usefulness of products and levels of service (Dmitriev & Wu, 2016). The authors ascertain a metrics need to be correctly defined because of their fundamental influence on outcomes.

Based on the findings from the analysis and interpretation of the findings, as presented in Chapter 5 and above, respectively, a metrics model is developed. As revealed from the data analysis, six factors influence the implementation, use, and management of ICS to improve service delivery. The factors were interpreted, based on which thirteen attributes were found to influence and determine the operationalisation of ICS in an organisation The attributes are (1) Coordination, (2) Communication, (3) People, (4) Synchronisation, (5) Policy (6) Principles, (7) Standards, (8) Cross-unit, (9) Cross-function, (10) IT Requirements, (11) Business Requirements, (12) Buy-in, and (13) Performance.

However, this study does not suggest that these are the only factors or attributes that influence the implementation, use and management of ICS. The factors and attributes are based on empirical evidence from this study. The attributes were therefore used to develop a metrics model (MM) for ICS. The MM is a two-phase approach, which is defined in Tables 6.1 and 6.2. Phase #2 depends on Phase #1.

Phase #1 – at this Phase, Table 6.1 is employed. The table consists of the Y (row) and X (column) axes. The attributes are listed on the Y axis while the X axis consists of numerical-based strengths. The values are from 0 to 8, lowest to highest, respectively. The numeric value is limited to 8, to avoid an average score of more than 100 per cent. Using the MM, each attribute is allocated a numeric value based on individual or group assessment. The score value is calculated on average.

Table 6.1: ICS determining attributes

#	Influencing Factor	8	7	6	5	4	3	2	1	0
1	**Coordination**									
2	Communication									
3	People									
4	Synchronisation									
5	Policy									
6	Principles									
7	Standards									
8	Cross-unit									
9	Cross-function									
10	IT Requirements									
11	Business Requirements									
12	Buy-in									
13	Performance									
Total:										

Once all the influencing factors have been calculated and summed up to determine the average, the weight is used to determine the final evaluation of the adoption of ICS in the organisation. The sum (scoring) of the influencing factors is referred to as the ICS organisational value, as illustrated in Table 6.2. The scoring range and status are as follows: > 65 means the system is strategic, 52 – 64 means the system needs to be maintained, 40 – 51 means the system needs to be improved and maintained, and 0 – 39 means the system needs to be phased out.

Table 6.2: ICS organisational value

Value	Description	Score	Status
Comprehensive	ICS is implemented in the organisation with an improvement in the efficiency and effectiveness of business processes and an attainable ROI. The system is scalable and robust enough to enable additional features and improvements.	> 65	Strategic

Standard	ICS is implemented in the organisation with an improvement in the efficiency and effectiveness of business processes and an attainable ROI.	52 - 65	Maintain
Satisfactory	ICS is implemented and offers standard features that work as per business requirements. The processes may be efficient but not effective. As such, there is little evidence of ROI.	40 - 51	Improve and maintain
Poor	ICS is implemented but does not meet the business requirements. There is no improvement in the efficiency and effectiveness of business processes. As such, there is no ROI for the organisation.	0 - 39	Phase out

When an organisation's score is > 65, it means the system is strategic. Strategic systems are IT solutions that contribute to the organisation's business strategies. They are IT solutions that focus on long-term planning and important decision-making that guides the overall direction of the business. The operationalisation of strategic systems enhances the efficiency and effectiveness of business operations. Similarly, a score of 52 – 64 means the system needs to be maintained. These types of IT solutions are operational systems. They are concerned with daily operations and what needs to be done to meet short-term goals and immediate requests.

On the other hand, a score between 40 – 51 means the system needs to be improved and maintained. Organisations improve and maintain IT solutions to make them more efficient, secure, and user-friendly. Thus, improving on aspects such as system performance, scalability, and integration capabilities, while a score between 0 – 39 means the system needs to be phased out. Organisations phase out IT solutions when technology becomes less useful. This could be because newer, better technology becomes available. Furthermore, software vendors stop supporting older versions of the system thus decreasing the system's initial value and future functionality.

6.5 Summary

This chapter presented the interpretation of the factors that were found to be influential in the adoption of ICS in Kwa-Maspala. The moments of translation were used to guide the interpretation of findings. Based on the interpretation, a metrics model was developed, thus fulfilling the aim of this study. The next chapter presents the conclusion.

CHAPTER 7
CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

This is the last chapter of the mini-thesis. It focuses on two main areas, the conclusion, and recommendations of the study. In the conclusion, it summarises chapters 1 to 6 of the thesis and presents a self-evaluation of the study. Additionally, it summarises the study outcome. It recommends how the outcome can be applied or operationalised in an environment and proposes areas for further studies.

The study aimed to develop a metrics model (MM), which can be used to evaluate the implementation and use of the ICS in South African municipalities. The aim is presented in Chapter 1 and repeated in Chapters 3 and 5. Based on the aim, the case study approach was followed, and data was collected using the semi-structured interview technique, as discussed in Chapter 3. The data analysis process was guided by actor-network theory (ANT)'s moments of translation. The interpretation of findings and the development of ICS metrics model are presented in Chapter 6.

This chapter is structured into six sections. The first section presents the overview of the chapters. The evaluation of the study is presented next. This is followed by the limitations of the study in section four. The fifth section identifies the opportunity for further studies as well as recommendations. Then the contribution of this study is discussed in section six. The seventh section concludes the chapter.

7.2 Overview of chapters

Chapter 1:

The first chapter laid the foundation of this study. It provided an introduction and background to the research problem and stated the research problem. Based on the background, the researcher highlighted the aims and objectives of the study before conducting a brief literature review. The chapter also presented a brief research design and methodology, ethics, delineation of the study, significance, and contribution. These topics were further explored and discussed in detail in Chapter 3 of this thesis.

Chapter 2:

Chapter 2 presented an intensive literature review related to the topics covered in this study. The areas of focus are *technology adoption*, *information technology evaluation,*

and incident command system. As an underpinning theory, the actor-network theory was also discussed including its application to information systems research.

Chapter 3:

In Chapter 3, the research methodology identified the approach and technique that the study followed to achieve the aims and objectives as stipulated in Chapter 1. In the chapter, the philosophical assumptions, research methods, research design, data collection, and data analysis approaches and techniques were comprehensively discussed, as they applied to the study. The qualitative research method was employed as the most appropriate to solicit the factors that influenced the adoption of ICS. The research design employed was the case study approach where an organisation in the Western Cape was identified based on its fit to the criteria set. Data was collected following the semi-structured interview technique.

Chapter 4:

This chapter provided an overview of the case used in the study. This includes the background of the case and how the business and IT units of the organisation were structured. The process of conducting fieldwork, which forms part of the data collection, is explained in the Chapter.

Chapter 5:

The analysis and findings of this study are presented in this chapter. The analysis was carried out using moments of translation from the perspective of ANT. As presented in the chapter, this means that each moment of translation was employed to guide the data analysis. The theory is extensively discussed in chapter 2.

Chapter 6:

Chapter 6 presents the findings and interpretations of the study. Based on the findings and interpretation, a metrics model was developed. The processes involved in the development of the MM for ICS, from extracting the findings to the interpretation stages, were explained in the chapter. The model can be used to guide the adoption of ICS by other municipalities or organisations in South Africa.

7.3 Evaluation of the study

This section presents an evaluation of the study. It began by revisiting the research questions. The questions were based on the research problem as presented in Chapter 1. The main question of this study sought to understand how a metrics model can be

developed to evaluate the ICS from both technical and non-technical perspectives, in a South African municipality. As such, the two research sub-questions were asked:

i. How is ICS adopted and used, to enable and support service delivery, from both business and technology perspectives by a South African municipality?
ii. What are ICS' attributes and ROI, in its adoption and use for service delivery, in a South African municipality?

These questions were revisited in the quest of evaluating this study. This process followed Dane (2010)'s research evaluation questionnaire where he proposes six components (who? what? where? when? how? and why?) for assessing and evaluating qualitative research. The practice of evaluation is a systematic means of assessing the credibility and quality of a study (Mårtensson et al., 2016).

Table 7.1: Evaluation questionnaire

Component	Evaluation
Who	Participants were selected from both the IT and business units involved with the ICS in the organisation. The participants were identified and selected based on the criteria set, which are as follows: *IT unit:* i. The participants must have been in the organisation (IT department) for at least two years. ii. The participants must have been involved in the selection and implementation of IS/IT solutions. iii. The participants must be willing to be part of the study. *Business unit:* i. The participants must have been in the organisation for at least two years. ii. The participants use IT systems for their processes. iii. The participants must be willing to be part of the study. A total of fifteen (15) participants were interviewed. Each of the participants was assigned a pseudonym in the interest of anonymity and privacy. For example, KM01 to KM15 was assigned to each participant, from numbers 1 to 15.
What	The operationalisation of ICS was investigated to develop a mechanism for assessing the system. Thus, it was critical to gain a better understanding of the factors that influenced the implementation and use of the system. To

	achieve this objective, data was collected from both the business and IT units. This methodology is detailed in Chapter 3. The collected data was analysed in Chapter 5 and interpreted in Chapter 6. The factors that manifested from that process are as follows: *(1) Collaboration, (2) Heterogeneity, (3) Governance, (4) Interconnectivity, (5) Requirements, and (6) Top-down approach.*
Where	The organisation of interest was a municipality in the Western Cape of South Africa.
When	The data collection process occurred in November 2023. Participants were interviewed either in person or virtually. This choice was made based on their locations, influenced by comfort and availability. Cleaning of transcripts was done shortly after each interview while the interview was still fresh in the researcher's mind. This process happened in December. In January, data was analysed and interpreted. This was beneficial because there was no elongated time lapse between collecting and analysis.
How	Chapter 3 details the research methodology section. This is where the research approach, method and design are discussed to substantiate the researcher's choices about the objectives and aim of the study. The study followed the interpretive paradigm, using the inductive approach. For this study, the qualitative method was used, and the case study design was applied. Data was collected through the semi-structured interview technique. The actor-network theory was employed as a lens to guide the data analysis process. Based on the analysis and interpretation, a metrics model was designed to fulfil the aim of this study.
Why	Based on the literature reviewed, there was a small pool of researchers exploring the topic of ICS particularly in a South African context. Furthermore, for those organisations that have implemented ICS, there is no metrics model to evaluate its implementation to gage efficiency, effectiveness, and ROI from both a business and IT perspective. The study also affords readers an understanding of the factors that influenced the adoption of ICS.

7.4 Summary of the outcomes

This section presents an evaluation of the study. This includes how the study achieved its aim and objectives. The aim and objectives were presented in both Chapter 1 and 3 of the study. The study aimed to develop a metrics model, which can be used to evaluate the adoption and use of the ICS, from both an IT and business unit perspective in a municipality.

Through answering the research questions, the researcher sought to highlight how the objectives were reached:

First Research Question:

How is ICS adopted and used to enable and support service delivery, from both business and technology perspectives by a South African municipality?

In the organisation, ICS is used by managers, end-users and technical consultants in the business and IT units. The business end-users and managers use ICS to carry out their duties to fulfil business objectives. They made use of the system in a variety of ways and for different business processes. These include operational planning, disaster management, and workforce management. Operational planning includes using the data available in ICS to plan how best to tackle problem areas in the city (town). Disaster management involves the system's command and control capabilities to manage how the business unit responds to disasters to minimise their impact. Workforce management includes the ability to use, manage and monitor the number of law enforcement officers in each period.

From an IT perspective the IT unit, had specialists such as software developers, analysts, database administrators, managers, and executive managers. The interests of these teams varied. The software developers and analysts maintained and enhanced the system by adding to it more functions to it. The database administrators integrated ICS with other systems and databases, while the managers were concerned with the use and management of the system and its value to the organisation.
All of these collaborative efforts had an impact on the services delivered by the Safety and Security department of the organisation.

Second Research Question:

What are ICS' attributes and ROI, in its adoption and use for service delivery, in a South African municipality?

IT solutions such as ICS are implemented for their characteristics of effectiveness and efficiency. These characteristics enable the enhancement of business processes and activities. The intention of this is to improve services delivered and achieve organisational goals. The effectiveness and efficiency of IT solutions are measured by how well the system enables the organisation to improve its processes and meet objectives. When a system is used well enough to improve on such aspects, this usually means there is a return on investment (ROI). It is for this reason that the attributes of such ICS are examined to determine the organisation's return on investment.

Based on the data analysis process to answer research questions and objectives, six factors that influenced the adoption of ICS in Kwa-Maspala were identified. These factors are as follows: *(1) collaboration, (2) Heterogeneity, (3) Governance, (4) Interconnectivity, (5) Requirements, and (6) Top-down approach.* The subjective interpretation of these factors allowed the researcher to gain a deeper understanding of the organisation's adoption of ICS. The interpretation was guided by the notion of following the actor as conceptualised by ANT's moments of translation.

Based on the factors mentioned above, a metrics model (Table 6.1) was developed. The model can be used to guide organisations during the adoption of ICS.

7.5 Significance of the study

This metrics model (MM) aims to guide how an ICS can be evaluated to determine its value to both IT and Business operations and strategies to fortify service delivery. Thus, the study is significant to three main groups (networks) and in various ways.

The first groups are the business and IT units. The second group is the technology (ICS) product owners. To the first groups, the study, through the MM, provides a mechanism for assessing the ICS in their environments. The MM enables assessment of ICS from both technical and non-technical perspectives. Such assessment can boost confidence in the use of the system to improve service delivery.

Based on the MM, which is built on empirical evidence, the product owners understand better how to enhance and improve the features of the technology solution. This can increase the competitive use of the technology. Thus, the outcome of the study is significant as follows:

i. IT units of the municipality - can use the metrics model as a guideline when developing similar solutions.
ii. Business units of the municipality - municipalities with similar challenges and profiles to the case study can use the results of this study to understand the factors that influence the implementation and use of an ICS.
iii. The service recipients (community) - the evaluation of ICS can improve its use, towards a more efficient and effective service delivery.

7.6 Contribution of the study

The contributions of this study come from theoretical, methodological, and practical points of view.

Theoretical Contribution:

This study contributes theoretically by revealing the factors that influence the adoption of ICS. These factors have not yet been discussed in existing literature. As such, this study contributes to the body of knowledge from a local and international perspective. Locally, it contributes to the dense literature on ICS, and internationally, it contributes to the analysis of ICS data through ANT as a lens. Furthermore, the study aimed to produce a metrics model. Since this aim has been achieved, the study contributes that metrics albeit theoretically. The study also produced a conceptual data collection and analysis framework. The purpose of this framework was to systematically collect and analyse data within the bounds of ANT. At the time of this study, the model and framework did not exist hence both outputs are major theoretical contributions.

Methodological Contribution:

This study methodologically applied the subjective interpretivist approach while studying a case. This means the researcher had the unique opportunity to study the implementation, use and management of ICS in a South African municipality. As such, the researcher was able to understand why things happened the way they did through the guidance of ANT. Thus, it demonstrates how the aim and objectives of the study were achieved through this method as depicted in Figure 5.1.

Practical Contribution:

This study makes a practical contribution in three ways. Firstly, it identified and discussed the factors that influenced the adoption of ICS as depicted in Figures 6.1 to 6.6. Secondly, it expanded the factors to its attributes to compose the metrics model (table 6.1) that can be used by organisations as a practical guide on what needs to be considered to adopt an ICS. The model is used in conjunction with Table 6.2 where the system is classified according to Table 6.1's score. The metrics model as a practical contribution is important because it serves as a reference point for the South African local government. Therefore, municipal IT and business managers and strategists can use this model as a basis for adopting ICS, and developing policies and regulations on how to manage, regulate and support ICS.

7.7 Limitations of the study

This study applies to local government institutions in South Africa. As such, the results of the study are transferrable only to South African municipalities and municipalities of other developing countries. At the time of this study, there was limited literature on the adoption of ICS in South Africa, particularly local government institutions.

7.8 Further studies

In this study, the researcher applied the actor-network theory as an underpinning theory and as a lens for data analysis. As such a metrics model was developed to achieve the aim and objective of the study. However, the metrics model has not been tested hence it remains a theoretical contribution. The researcher therefore suggests a study where the metrics model is practically tested in an organisation seeking to adopt an incident command system to assess its fit for purpose. Future studies can also explore how the application of other theories to underpin the study and guide data analysis can achieve different results.

7.9 Recommendations

The aim of the study which was to develop a metrics model to evaluate the adoption of an incident command system in a municipality in South Africa was achieved. However, the researcher identified change management and system capabilities as crucial gaps that need to be addressed.

Change Management:

Although the adoption of ICS in the organisation was an anticipated initiative that brought an improvement in the effectiveness and efficiency of business processes, a good change management process is needed for it to be well adopted among the various stakeholders. This is to ensure there is a seamless transition from legacy systems to the new system. The change management plan should aim to assist the various stakeholders with an understanding of the purpose of the system.

System Capabilities:

The researcher also recommend that decision-makers understand the different safety and security systems in the market. They should aim to contrast the different systems to one another to understand system capabilities versus business requirements. This enables them to identify the effort of customisations that will need to be done to fulfil those requirements.

7.10 Summary

This chapter presented the conclusion of the study. The research was evaluated against the objectives set in Chapter 1 and concluded that all the objectives were achieved. The theoretical and practical contribution of the study was discussed. The chapter also discussed the significance of the study, including the factors that contributed to the development of the metrics model. In this chapter, recommendations

for further research are brought forward. The study achieved its aim of developing a metrics model for the evaluation of ICS in a South African municipality.

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APPENDICES

APPENDIX A: INTERVIEW GUIDELINES (QUESTIONS)

Business unit

1. How long have you been using the EPIC system?
2. Based on your experience, how would you describe the system?
3. What do you think the department thinks of the system? *** *Is this your view or do your colleagues think the same thing?*
4. What do you think the organisation thinks of the system? *** *Is this your view or do your colleagues think the same thing?*
5. What are some of the activities that you use the EPIC system for?
6. In your view, why do you think the EPIC system is most suitable for these activities?

a. Please give me an example.

7. In your view, what are some of the benefits of the system?

a. Why do you think XXXX is a benefit?

8. In your view, what are some of the challenges that you have encountered with the system?

a. How is XXX a challenge?

9. From your view, why do you think these challenges exist?
10. How were these challenges addressed?
11. In your view, what do you think are some of the implications of these challenges on the department/organisation?
12. If you can, please share some of the implications with me.
13. Is there something you would like to add?

Information Technology unit:

1. How long has the EPIC system been implemented in the organisation?
2. How was the system selected?
    a. What I mean is there a technical template used for selecting the system?
3. Why do you think the system was selected?
4. Does the system coexist/integrate with other systems?
5. From your technical perspective, what are some of the benefits of this system in the department?
6. Please tell me why you think XXX is a benefit to the department?
7. From your technical perspective, what are some of the benefits of this system in the organisation?
    a. Please tell me why you think XXX is a benefit to the organisation?
8. From your technical perspective, what are some of the challenges of this system in the department?
    a. Please tell me why you think XXX is a challenge to the department?
9. From a technical perspective, what are some of the challenges of this system in the organisation?
    a. Please tell me why you think XXX is a challenge to the organisation?
10. Why do you think these challenges exist?
11. How are these challenges resolved?
12. In your view, what do you think are some of the implications of these challenges on the organisation?
13. In your view, what do you think are some of the implications of these challenges on the department?
14. If you can, please share some of the implications with me.
15. Is there something you would like to add?

APPENDIX B: ETHICS APPROVAL

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creating futures

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19 October 2023

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Reference no: 208019626/2023/24

Project title: A metrics model for evaluating Incident Command System adoption in a South African municipality

Approval period: 19 October 2023 – 31 December 2024

This is to certify that the Faculty of Informatics and Design Research Ethics Committee of the Cape Peninsula University of Technology approved the methodology and ethics of Ms Asithandile Johnnie (208019626) for Master of Information Communication and Technology.

Any amendments, extension or other modifications to the protocol must be submitted to the Research Ethics Committee for approval.

The Committee must be informed of any serious adverse event and/or termination of the study.

Prof L.J. Theo
Chair: Research Ethics Committee
Faculty of Informatics and Design
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