MANAGING OPERATIONAL INFORMATION AND INTELLIGENCE USING KNOWLEDGE MANAGEMENT PRINCIPLES: A WORK-BASED STUDY AT QUEENSLAND POLICE SERVICE AUSTRALIA

A Thesis submitted by

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ABSTRACT

The Queensland Police Service (QPS) operates in a complex environment. Rising calls for service and an uncertain future, created by environmental, fiscal, political, economic, and demographic factors, challenge the organisation's capacity to deliver policing services that maintain community confidence and provide public value. Moreover, there is an expectation that results are achieved through the most effective allocation of resources. Accurate and timely operational information and intelligence is therefore critical for effective decision-making and the successful delivery of organisational strategy. Through an Intelligence-Led Policing (ILP) strategy and the increased deployment of mobile technology, including QLites and personal devices, there is a capacity for police to collect and store operational information and intelligence. Whilst most information is stored using the Queensland Police Records and Information Exchange Program (QPrime), much of the information that cannot be filed according to person, location, vehicle, and property categories is often disseminated to officers by email and randomly stored in a collection of online folders that are rarely accessible to a wide group of users. This situation creates intelligence gaps and missed opportunities to add to organisational knowledge capital. This study was undertaken to determine whether there was a more effective way to manage and disseminate operational information and intelligence to police using Knowledge Management design principles that enhance the capacity to capture, manage and reuse knowledge to leverage organisational advantage by improving the efficient and effective application of resources and increasing officer safety. Findings suggest that whilst QPS email remains an effective means of communication, the management and dissemination of operational information and intelligence to police can be enhanced using Knowledge Management design principles.

CERTIFICATION OF THESIS

I Craig White declare that the PhD Thesis entitled *Managing Operational Information and Intelligence using knowledge management principles*. A work-based study at Queensland Police Service, Australia is not more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references, and footnotes. The thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

12TH March 2023

Endorsed by:

Dr Lee Fergusson

Principal Supervisor

Dr Ben Marcus

Associate Supervisor

Student and supervisors' signatures of endorsements are held at the University.

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ABBREVIATIONS

BI – Business Intelligence

BIS – Business Intelligence System

IT – Information Technology

IC – Intelligence Cycle

ICT – Information Communication Technology

IDAM- Information Delivery Assessment Model

ILP – Intelligence-Led Policing

IPC – Information processing Capacity

IPR – Information processing requirements

IM – Intelligence Management

IO – Information overload

IP – Intelligence Products

KM – Knowledge Management

KMS – Knowledge Management System

MEI – Matter Energy Information

PI – Police Intelligence

QLite – Apple iPad used by QPS

QPrime – Queensland Police Records and Information Exchange

QPS – Queensland Police Service

SSAF – SharePoint Search Analytics Function

SR App – Southern Region Application

TMS – Time Motion Study

WBL – Work-Based Learning

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I owe so much to so many people and trying to acknowledge all those that have supported me during my academic journey is an almost impossible task when given so few pages to do so.

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I know that it has only been through the Grace of God that the right people have been placed in my life at the right time to guide and encourage me. I humbly say thank-you to my God and his son Jesus Christ for guiding me throughout this journey.

"Brothers, I do not consider that I have made it my own. But one thing I do: forgetting what lies behind and straining forward to what lies ahead, I press on toward the goal for the prize of the upward call of God in Christ Jesus" Philippians 3:13-14.

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Chapter 1: INTRODUCTION AND OVERVIEW

1.0 Introduction

Chapter 1 of this thesis provides an overview of the research and includes a brief description of each chapter. Section 1.1 provides a general description of the background leading to this research including a brief description of the researcher's professional history. The background explains how the effective and efficient dissemination of operational information and intelligence to police officers is critical for operational planning and the delivery of strategy. Large amounts of information and intelligence disseminated through QPS Email and stored in a variety of online folders have created a patchwork of information assets that are often difficult to find and unable to be used to assist decision-making.

Section 1.2 defines the aim of the study to improve the management and dissemination of operational information and intelligence to police using KM principles. The outcome of this study seeks to provide officers with greater access to operational information and intelligence supporting their capacity to make better decisions and implement more effective and efficient policing strategies. This outcome ultimately contributes to a safer community and better application of resources.

Section 1.3 discusses the importance of the research in terms of the management of information and the gaps in current policing research. Research suggests that there is little academic contribution focussing on the development of KM initiatives and a general decline in practitioner involvement in KM research and publication. This includes a discussion on the different program evaluation models using various theoretical constructs. This research proposes that a Systems Thinking framework provides greater evaluation flexibility to IT artifacts and explains how Biomatrix systems theory, combined with KM principles has led to the development of the Information Delivery Assessment Model. This section also includes a brief description of the mixed methods research method and the limitations of this study.

Finally, section 1.4 provides a general outline of the thesis and a summary of each chapter.

1.1 Background

I am an Inspector of Police with thirty-three years of service with the Queensland Police Service (QPS). I have performed a range of duties including first response, investigations, prosecutions, and projects and have served throughout Queensland including several years in remote indigenous communities and larger capital centres. In the past 15 years I have been the Officer in Charge of several police stations throughout Queensland, a Patrol Group Inspector, Staff Officer to the Deputy Commissioner Regional Operations, Staff Officer to Assistant Commissioner Southern Police Region and Operations Inspector Southern Police Region. My current position is Patrol Group Inspector, Moreton District covering an area that includes the Deception Bay, Redcliffe, and Northlakes Divisions. In 2013 I was the project manager responsible for the development and implementation of the Queensland Police Service (QPS) Divisional Performance Appraisal Model. The project delivered a software solution that for the first time in QPS history provided visibility around divisional performance from a district and regional perspective, providing Officers in Charge and senior managers a clear description of policing activities including the cost to deliver front-line services. I hold undergraduate qualifications in public safety and post graduate qualifications in management and human resource management. My professional interest in the field of knowledge management is driven by my personal desire to learn more about how operational information and intelligence can be used to maximise both officer and community safety and drive organisational productivity and efficiency.

This research has been conducted as part of the Doctor of Professional Studies (DPRS) program at the University of Southern Queensland. The DPRS is based on the development of work-based learning and research outcomes with the intent of applying a multi-disciplinary and non-traditional mode of learning and knowledge development (Fergusson, van der Laan, White, & Balfour, 2019). The program applies the principles of micro and macro reflective practice as a framework to determine what area of research has both personal and professional relevance to the researcher. According to Fergusson, Shallies and Meijer (2019) work-based learning doctoral programs provide professionals with the opportunity to learn and conduct research on a professional area with the aim of developing and solving organisational, social, or work-based problems.

The QPS employs approximately 15,000 people and has an operating budget of $1.97 billion (QPS 2017). The organisation faces many challenges including the responsibility of maintaining public safety in Queensland, rising demand for service, an increase in cost of resources, alcohol-related antisocial behaviour, rising levels of reported domestic violence, increased use of technology with crime, an increase in severity of natural disasters, and a rise in terrorism (Martin, 2017).

The effective and efficient dissemination of operational information and intelligence to police officers is critical for the development of operational planning and the delivery of organisational strategy. The benefits contribute to a more responsive policing service that has the capacity to adapt to dynamic environmental changes. Ultimately and most importantly, these benefits contribute to a safer community.

Intelligence-Led Policing (ILP) involves the application of operational information and intelligence as an objective decision-making tool, that directs police operations (Ratcliffe, 2008). Information and intelligence contribute to greater organisational efficiency and effectiveness by enhancing the decision-making process by reducing uncertainty (QPS 2016). While the study of ILP is not the focus of this study, the researcher notes that a significant body of research has been conducted, for example (Carter & Fox, 2018), (Lewandowski, Carter, & Campbell, 2018) and (Burcher & Whelan, 2018)

QPrime records all police information and intelligence relating to child safety, domestic violence, custody, intelligence checking, micro dot recording, officer-in-charge reporting, offender charging, police use of force, keyholder information, exhibit management, traffic crash reporting, warrant information, weapons licensing information and crime analysis (QPS 2019). While the system is a valuable source of information, it is limited by the fact that intelligence holdings stored in Word or Pdf formats are not discoverable using the search function and information that cannot be filed according to a person, location, vehicle, or property category cannot be recorded on QPrime and is often instead stored separately and disseminated using QPS Email. Consequently, a significant amount of information being held by QPS has become fragmented and dispersed across several databases thereby reducing the capacity for information and intelligence to be found, retrieved, and re-used. This situation creates a loss in organisational knowledge assets and leads to possible intelligence gaps.

This study draws upon the principles of KM to determine whether operational information and intelligence can be managed and disseminated more effectively using SharePoint technology.

1.2 Purpose

The capacity to improve the dissemination of operational information and intelligence to police creates several benefits for both the QPS and the community. Some of these benefits include cost savings through improved decision-making, increased employee engagement by enhancing the information-sharing process, consolidation of organisational information and data mining opportunities, and improvements to public safety by enhancing the organisation's ability to prevent and solve crime.

The capacity for police to successfully use information technology (IT) systems to manage operational information and intelligence is an important component of facilitating effective decision-making and delivering ILP strategy. IT continues to improve police's capacity to disseminate intelligence and share knowledge through mobile connectivity. Wang and Zhao (2016) highlight that data mining and statistical modelling capability are essential to the implementation of contemporary policing strategy including ILP and Predictive Policing. Predictive Policing is a proactive policing strategy based on using knowledge, information, and IT to forecast crime and allocate resources (Wang & Zhao, 2016).

This research will focus on developing a more effective way of managing, disseminating, storing, and retrieving operational information and intelligence through the development of a software solution using KM principles that consolidate the storage of operational information and intelligence that would not otherwise be stored in QPrime. This new system will facilitate the sharing of operational information and intelligence and increase the opportunity for reuse. The research questions for this study are:

Research Question 1: Can the management and dissemination of operational information and intelligence to police be performed more efficiently and effectively in the Queensland Police Service (QPS)?

Sub-question 1: What types of operational information and intelligence do operational police officers prefer?

Sub-question 2: Can operational information and intelligence be delivered in a more effective and efficient way using SharePoint application technology (ie., the SR App).

1.3 Significance, scope, and definitions

The capacity to deliver operational information and intelligence to police in an effective and efficient way is critical for operational decision-making and developing effective organisational strategy. The ongoing advances in IT software and hardware platforms will continue to enhance the delivery and management of operational information and intelligence. The QPS has experienced significant benefits associated with improved mobile technology with the introduction of QLite. Police have a greater capacity to access and record information at any time or in any place, leading to the accumulation of knowledge capital and the flow of information.

While the QPS relies primarily on the QPrime system to store operational information and intelligence there are some limitations to this program. The search function does not allow users to search for key words in Microsoft Word or pdf format and unless the user has the specific name of a person, address, or vehicle the information cannot usually be filed or found. Consequently, operational information and intelligence that cannot be appropriately categorised on QPrime are often stored in separate files and disseminated via email to other officers who often replicate the storage process. This situation creates a patchwork of information holdings that are not managed nor available to be shared with a wide group of users. Email continues to be used as the primary source of information dissemination. Anecdotal feedback from officers suggests that the high amount of email often creates information overload, causing high levels of frustration. Many officers also report deleting emails before reading them or not having enough time to comprehend the information they receive by email. This is of concern because much of the information and intelligence disseminated by email often relates to officer safety or crime trends. These factors contribute to officer safety and ILP strategy.

This study, therefore, asks whether the SR App might enhance the management and dissemination of operational information and intelligence to Queensland Police through the construction of a software solution designed on the KM principles proposed by Andrew Goh (2005). The project might therefore contribute to cost

savings associated with KM and enhanced decision-making capability contributing to ILP strategy. The software solution might also improve data mining opportunities and thereby potentially provide a better understanding of KM principles that contribute to the design of future IT solutions. Ultimately the project may contribute to increased public safety through the effective and efficient management and dissemination of operational information and intelligence to Police, potentially enhancing the organisation's ability to prevent, solve and respond to crime.

KM research has historically focused on knowledge concepts that include knowledge creation, knowledge storage and knowledge transfer however there is limited research on the connection between each of these concepts and their overall relationship within a KM system (Chun, Sohn, Arling, & Granados, 2008). There has also been a general decline in KM practitioners conducting KM research. According to Hislop et al. (2018), there is a risk that this trend may lead to KM becoming a theoretical construct with limited practical application for organisations. This thesis will record the cycle of development, implementation and evaluation of a KM system contributing to practitioner-based KM academic research.

The review of the literature reveals there are several evaluation models that have been applied to the evaluation of programs/ organisational designs. These models are based on various theoretical constructs. Research conducted by Matook and Brown (2017) proposes that a systems thinking framework provides for greater flexibility in the application of information technology artifacts (ATAs). This research uniquely combines Goh's (2005) KM principles he summarises as product, process, and people with the Biomatrix systems theory activity system elements of matter, energy, and information to develop an evaluation framework that will be used to determine whether operational information and intelligence can be more effectively managed and disseminated using KM principles. This model is called the Information Delivery Assessment Model (IDAM). This research is conducted using a five-stage research design applying a mixed methods approach. The qualitative stages of the research include surveys, interviews and focus group discussions. The questions for each of these stages will be structured around the IDAM. The quantitative stages of the research include the collection of data using SharePoint software analytics and a time-and-motion study.

1.4 Thesis outline

This thesis is structured into seven chapters. The literature review in Chapter 2 defines the key themes relating to the management of operational information and intelligence. This includes a discussion of KM principles and the terms 'information', 'knowledge' and 'intelligence' and their connection within the KM framework and police intelligence cycle. The discussion also includes how effective KM principles contribute to organisational efficiency and effectiveness and in the QPS context how the effective management of operational information and intelligence contributes to better strategic, operational, and tactical decision-making. The literature review discusses the concepts of information overload, organisational culture, and organisational learning and how these impact information consumers and organisational KM principles. The literature review explains how organisational knowledge can be leveraged to improve performance through innovation using Goh's (2005) KM principles of people, product, and process. The literature review concludes with a discussion on Dostal, Cloete and Jaros's (2006) Biomatrix systems theory with a focus on how the application of this theory is used to evaluate the design of the KM principles and the capacity to manage and disseminate operational information and intelligence more effectively in the QPS. Chapter 2 concludes with a discussion on the gaps in research that include addressing the general decline in practitioner contribution to KM research and the under-researched area of organisational KM development.

Chapter 3 provides a detailed description of the design, development and implementation of the software solution called the SR App which is based on Goh's (2005) KM principles of process, product, and people. The software solution has been named the SR App, which is an abbreviation for the term Southern Region Application. This chapter provides a detailed explanation of how Goh's KM principles were applied in the deployment of the software design features.

Chapter 4 introduces the research methodology for this project. This chapter describes how the mixed methods approach using quantitative and qualitative research methods was used. The discussion includes a detailed description of the research design. This research was undertaken in five stages. Stage 1 involved the collection and analysis of data using SharePoint Analytics. Stage 2 utilised a survey questionnaire developed using KM principles and the Biomatrix systems theory framework. The survey was designed as a series of closed-ended questions based on a 10-point Likert

Scale. Stage 3 used a series of semi-structured research interviews based on themes developed using the IDAM. Stage 4 involved a series of group discussions based on themes adapted using the IDAM. Finally, Stage 5 used a time and motion study measuring and comparing the average time taken to access intelligence products disseminated by the SR App and QPS Email system using QLite and Desktop computers.

Chapter 5 presents the results of the mixed methods research. The results are reported separately for Stage 1 (SharePoint analysis), Stage 2 (survey) and Stage 5 (time in motion). The results of the thematic analysis undertaken in Stage 3 (interviews) and Stage 4 (group discussion) have been combined and summarised in a series of tables using the IDAM.

Chapter 6 includes a discussion of the results of the research. The discussion addresses each of the research questions and is framed around addressing each of the elements that make up the IDAM. The discussion draws comparisons between each of the elements of the IDAM using the results from the analysis of the SR App and QPS Email System. This analysis provides the reader with a deeper understanding of the KM benefits and weaknesses of both the SR App and QPS Email System for the purpose of managing and disseminating intelligence and operational information.

Chapter 7 concludes the thesis with a summary of research outcomes and a discussion on how this research has contributed towards student, organisational and professional benefits. This includes how the application of KM principles and Biomatrix theory have been applied as an evaluation framework that may have applications in the design and evaluation of future KM systems.

Chapter 2: LITERATURE REVIEW

2.1 Introduction

In a world of finite resources including limited budgets, competitive labour and capital markets, and rising costs, organisations in both the private and public sector continue to search for strategies that provide greater organisational efficiency and operational effectiveness. Information can be a source of effective strategy and competitive advantage for organisations when it can be used to improve the decision-making capacity of workers. The QPS is no different and in an environment that includes rising demand for service and greater community and political expectations, there is a necessity to ensure resources are used in the most efficient manner to deliver the most effective results. It is imperative that decision-makers have access to up-to-date information so they can determine where resources are best allocated in an environment that is often high-risk and dynamic. Operational information and intelligence in a policing environment are critical to the effective delivery of strategic, operational, and tactical strategy. Research has shown that the key to organisational competitive advantage includes not only the organisation's knowledge capital but also the capacity for the organisation to manage and leverage knowledge from its existing holdings (Alavi & Leidner, 2001; Arsawan et al., 2020). Traditionally much of the operational information and intelligence is managed and disseminated through the QPS Email System. While it is common practice for organisations to exchange information using email, anecdotal evidence from the organisation indicates that the delivery of operational information and intelligence using QPS email is often less effective. Some officers report that because of the high flow of emails they often do not have time to read or search for operational information and intelligence that is relevant to their duties. As a result, officers have less capacity to make the most effective strategic, operational, or tactical decisions. This research is based on identifying a more effective method of managing operational information and intelligence so that officers have better access to the operational information and intelligence they require to make more effective decisions.

This research was based on the development of a work-based learning framework with the intent of exploring whether the management of operational

information and intelligence traditionally disseminated by email could be made more effective and efficient through the development of an IT solution designed around the principles of KM. According to Lester and Costley (2010), work-based learning (WBL) is a transdisciplinary field of learning that arises directly out of workplace concerns. O'Leary and Hunt (2016) point out that WBL researchers are therefore more often concerned with real-world maps of situations rather than just pure theoretical models. This type of analysis often leads to what Fergusson, van der Laan, and Baker (2019) described as a wicked and messy work phenomenon that requires a broad scope of analysis that often lacks clearly defined variables or boundaries of research. O'Leary and Hunt (2016) suggest that work-based research requires a three-stage process that involves a solid understanding of the problem, finding a workable solution to that problem and evaluating the success or failure of the solution.

This research is conducted in line with O'Leary and Hunt's (2016) three-stage work-based research process. The literature review will cover key topics that provide the background to the research problem, a description of the concepts relating to the development of an IT solution and finally an overview of the theoretical models used to evaluate the IT solution. According to Fergusson, Allred, and Dux (2018) the Professional Studies program results in the production of artefacts. This research will contribute to the body of KM research by applying KM principles in the design and development of a software solution to manage and disseminate operational information and intelligence to the police. Further, this research will contribute to the development of an evaluation model that can be used to determine the effectiveness of the KM solution. The results of this research will be reported in this dissertation.

The literature review includes an overview of the concepts of information, knowledge, and intelligence, explaining how each of these relates to the KM process and intelligence cycle. Despite the QPS having a clear suite of 'intelligence products' the terms information, knowledge and intelligence are often used interchangeably and what is considered operational information to one officer may be intelligence to another. The purpose of this discussion is to highlight why all information managed through the software technology and QPS Email System is included in this study and why it was not within the scope of this research to define the difference when referring to KM principles.

The literature highlights that there is no consistent definition for the term 'information'. It has been described as facts (Hicks et al., 2002), data (Wilson, 1996), and a commodity or a factor that shapes context (Braman, 2011). The same may be also said for the term 'knowledge'. Lombardi (2004) suggests that knowledge relates to the concept of information. More than 60 years ago Burks (1958) described knowledge as structured and organised information. A review of the literature indicates a consensus that knowledge is made up of both tacit and explicit elements that are dependent on the skills and experience of the information user. Intelligence is also related to both knowledge and information concepts (Cody et al., 2002) (Lopez - Robles, Otegi - Olaso, Porto - Gomez, & Cobo, 2019). One of the most persuasive arguments explaining the information, knowledge and intelligence relationship in a policing context was advanced by Gottschalk's (2009) Knowledge Continuum in Policing Model. Gottschalk describes knowledge creation as a process of ongoing organisation and analysis of raw data and information. The process involves refining information to a point where it first becomes intelligence, then information and finally knowledge. The literature review discusses how these concepts are linked to the Intelligence Cycle (IC) and ILP strategy and how they guide the effective and efficient utilisation of resources.

Learning organisations are ones that can exploit their knowledge resources to generate better performance. The literature review discusses how organisations that maintain a learning strategy do so by supporting individual learning and fostering knowledge exchange. More than 20 years ago Pemberton and Stonehouse (2000), for example, argued that organisational learning is a constant process where individuals share knowledge, question it, modify it and subsequently improve upon it, creating a higher knowledge base for the next cycle of growth.

The literature review then discusses the concept of KM and explains why there is little consensus as to what the most effective KM principles are. Some organisations have more resources and greater capacity to implement better KM than others and so their systems and requirements often differ. Most KM is dependent on the complexity of the IT supporting it. Davenport and Prussak (1998) argued that KM includes capturing, distributing and effectively using knowledge.

The literature review includes a discussion on the KM principles for innovation proposed by (Goh, 2005). Goh argued that effective KM creates a greater capacity for

organisations to harness knowledge to drive innovation and better performance. Goh proposed that KM can be summarised into three principles that include products, process, and people. Matei and Nitu (2012) point out that it is common for organisations to use the 'product, process, people' model when developing strategy. The principles proposed by Goh and explained during the literature review provide the design framework for the development of the software solution subject of this research and are later also included in the evaluation model.

The research problem is then explained in the context of information overload and organisational and cultural barriers that impact information sharing and KM. The literature review highlights how the ongoing development of IT, and the capacity to develop and deliver more information to users, continues to create a situation where high flows of poorly managed information contribute to information overload, impacting the individual's ability to process information and make effective decisions. These issues highlight the importance of developing effective KM that creates the capacity for organisations to manage and disseminate information more effectively.

The literature review then examines the parallels between KM and the QPS Intelligence Cycle that involves directing, collecting, collating, analysing, disseminating, and reviewing intelligence. The researcher argues that both systems are one of the same and that through effective KM, the QPS IC may also be enhanced.

The literature review includes a discussion of the Biomatrix systems theory and its link to Systems theory. The Biomatrix systems theory is an integrated systems approach that focuses on systems processes that interact with one another through a web of interactivity where the structure is made up of interconnecting activity Systems with entity Systems. Activity systems facilitate the connection between separate entities through the flow of matter, energy, and information, referred to as MEI.

The literature review concludes by explaining how the Biomatrix activity system elements of matter, energy and information are combined with Goh's KM principles for innovation that include product, process, and people to create the Information Delivery Assessment Model, designed for the purpose of evaluating whether the IT solution (SR App) improved the management and dissemination of operational information and intelligence to police.

2.2 Information

It will become evident that many of the terms discussed at the beginning of this thesis including the terms information, knowledge and intelligence are often used interchangeably and can often be dependent on the context in which the term refers. Whilst it is not the researcher's intention to provide firm definitions it is essential that these terms are discussed so that the reader has a clear understanding of how each of them fit within KM and how they apply to the work-based software solution and the management and dissemination of operational information and intelligence.

The definition of information has changed little over the past fifty years. Information has been commonly accepted to be data that has been processed into a form that is meaningful to a recipient and is of real or perceived value during decision-making (Davis & Olson, 1985; Kelly-Rainer & Prince, 2021). Information according to Butterfield and Ngondi (2016) is whatever can cause a human mind to change its opinion about the current state of the real world. The International Organisation for Standardisation ISO 5127:2017 (2017), defines information as facts, concepts, objects, events, ideas, and processes. Twenty years ago, Hicks et al. (2002) proposed that information could be classified into formal and informal categories. Formal information is described as providing a specific context that infers knowledge, for example, numbers or letters or symbolic combinations represented as data. Informal information is described as unstructured information that follows no logical order or progression and may include incomplete information sets.

In a policing context, information is at the source of all action and strategy. Information directs operational, tactical, and strategic decision-making. At the operational level information remains crucial for all investigations and without information in the form of evidence, investigations fail. Sheptycki and Innes (2004) point out that police obtain information from victim reports, witness statements, police reports, crime scene investigations, historical police data, prisoner debriefings, technical or human surveillance, financial reporting, and covert operations. In Table 2.1, Gottschalk (2009) classified the most common information sources. These sources disclose a range of investigation strategies centred around the collection of information as evidence. The information obtained during an investigation is determined by the investigation strategy, the legislation and policy supporting the strategy, the information required and the technology and resources available to the investigator.

Table 2.1

Classification of Information Sources (Gottschalk, 2009).

Information Source	**Descriptions**
Interview	Interrogation of witnesses, suspects, experts
Network	Information is collected from other criminals, business, informants
Location	Analysis of crime scenes
Documents	Reviewing documents (financial, correspondence)
Observation	Observing persons and activities in both the physical and virtual world
Action	Provoking action by offenders to elicit a response
Surveillance	Technical and Human Surveillance
Physical Material	Collection of physical evidence through crime scene examination
Internet	Using open-source information
Media	Using media to collect information
External Data storage	Accessing external data sources

This research is based on enhancing the management of operational information and intelligence to police and to discover what operational information and intelligence police prefer. To anticipate what police, consider to be information and what they consider informative, prior to the research outcome would be counter-productive and potentially limit the innovation outcomes in the software design. For this study, the researcher supports Spang-Hansen's (2001) view that it is sometimes more useful to leave information without any formal definition. In this case, the researcher takes a pragmatic view that information in all its forms disseminated through the software application (i.e., the SR App) will be applicable for the purpose of this study. This may include for example all reports, notifications, pictures, numerical data, online discussion, and electronic posts.

2.3 Knowledge

According to Buckland (1991) knowledge and intelligence are one of the same. Schiuma (2012) points out that knowledge represents a fundamental part of any organisation and that it can be incorporated into people's abilities or ingrained into the organisation's structural and technological capital. Bowen, Evans, and Dalkir (2015) highlight that despite ongoing debate, there is still no universally accepted definition of knowledge. This discussion will not attempt to define knowledge as a single concept however instead will discuss the many interpretations and how they each relate to information and intelligence. Gultekin (2009) suggested that knowledge and information are related but they are two different expressions. Zins (2007) suggested

that data, information, and knowledge are part of a sequential order, with data being the raw material for information and information being the raw material for knowledge. Nonaka, Takeuchi, and Umemoto (1996) outline that knowledge creation occurs through the continuous interaction and accumulation of implicit and explicit knowledge, known as knowledge conversion.

From a policing perspective, one of the most influential arguments concerning knowledge was made by (Gottschalk, 2009). Gottschalk (2009) supported Zin's argument that knowledge is a continuum and proposed that whilst in a policing context data are numbers and letters with meaning, information combined with interpretation and reflection becomes knowledge. Knowledge accumulated over time as learning becomes wisdom. Gottschalk proposed that the knowledge continuum in policing is a 'ladder' that at the lowest level is in the form of raw data and through interpretation and analysis progresses through the information, intelligence, and knowledge stages. Gottschalk's argument shown in Figure 2.1 is that as the level of interpretation of data increases so does individual understanding.

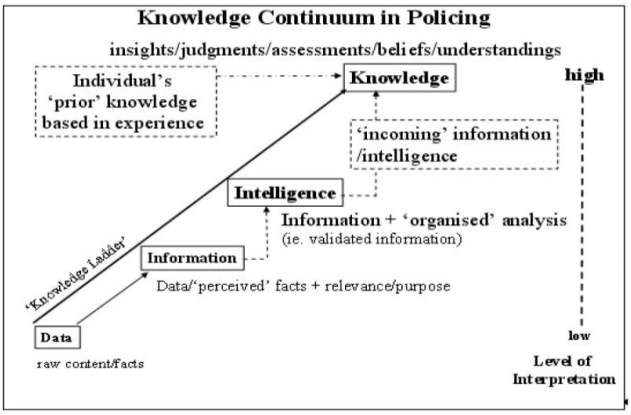

Figure 2.1. Knowledge Continuum in Policing (Gottschalk, 2009).

Knowledge has also been described as, structured, and organised information (Burks, 1958), knowing or familiarity gained by experience (Perez-Araos et al., 2007), what someone knows or what they believe (Buckland, 2012) and validated, true information which coheres with other truths (Zins et al., 2007).

Boersma and Stegwee (1996) argued that there are four forms of knowledge. These include human knowledge gained through education, observation, and

experience; mechanical knowledge that has been codified and is available to assist with the performance of routine operations; documented knowledge that has been stored in books, documents, and archives; and automated knowledge that is stored electronically and used to support specific tasks and decision support systems.

There is a general acceptance that knowledge is made up of tacit and explicit elements. Newell, Robertson, Scarbrough, and Swan (2009) define tacit knowledge as residing in the minds of employees and consists of the know-how and skills that individuals have acquired based on personal experience. This according to Rashman, Withers, and Hartley, (2009) includes beliefs, intuition, mental models, insights, values, and persuasion. Nonaka and Konno (2009) argue that because tacit knowledge is personal it is difficult to formalise and share. Waltz (2003) explains that tacit knowledge is often intangible, internal, experiential, and intuitive that is often undocumented and maintained only as a human experience. Because tacit knowledge is characterised by intangible factors such as perception, belief, values, and skill it is difficult to explicitly capture without effort (Waltz, 2003). However, according to Sharp (2006), if it is shared effectively, it can often provide an organisational competitive advantage.

Newell, Robertson, Scarbrough, and Swan (2009) define explicit knowledge as that which has been recorded in manuals or guides and is available to be shared with other employees who will then also have access to the same knowledge without having the same experience. Chevallier et al. (2016) describe explicit knowledge as the exchange of processes between partners in the same structure which is codified, structured, accessible and facilitates knowledge transfer but generates less competitive advantage. This form of knowledge is acquired through experience and features special expertise and know-how (Kogut, 2000). Waltz (2003) explains it is tangible and logical and can be documented or stored so that it can be repeated and taught becoming the basis for logical reasoning. Sharp (2006) takes the view that knowledge is a dynamic construct that changes over time and is determined by the organisation or individual's KM requirements and the value that it brings to the organisation.

The researcher accepts in this work-based study that knowledge takes many forms and therefore adopts an approach that is consistent with Sharp's (2006) assertion that knowledge is multifaceted and must be considered in the context of what is being considered and what value it creates for the organisation. This for the purpose of this

work-based study may include all forms of operational information and intelligence including for example reports, notifications, online discussion, and electronic posts.

2.4 Intelligence

Intelligence is neither information nor knowledge alone. In the past thirty years intelligence has been explained as the practice of gathering, analysing, interpreting, and disseminating data and information to facilitate effective decision-making (Lopez-Robles et al., 2019; Willmer, 1970). Warner (2002) outlines it is what people do with data and information that gives them intelligence. According to the Queensland Police Service (2018), intelligence is the objective evaluation and analysis of all types of information that can be converted into actionable knowledge. This may include, for example, raw data, crime statistics and human source reports. Butler, Chilcot, Inge, Mates, and Taylor (2004, p. 6) define intelligence as a "technique for improving the basis of knowledge". Brown (2007) highlights that raw information can also be at times of such obvious value or significance that it needs no further analysis or development to be considered intelligence.

The QPS Intelligence Doctrine (2018, p. 3) outlines "What has already occurred cannot be prevented, therefore the focus of strategic, operational and tactical decision-making must be on minimising the future risk of problems and their impact on the community". Grieve (2004) and Kleiven (2007) argued that the three main roles of Police Intelligence (PI) are to make local strategic decisions about crime and disorder, to inform tactical and operational activity and to support organisational strategy.

Cope, Fielding, and Innes (2005) suggest that PI can be divided into four categories that include intelligence relating to known offenders; crime intelligence focussing on specific crime; community intelligence relating to community issues and contextual intelligence relating to the social and economic factors that impact upon crime.

2.4.1 QPS Intelligence cycle and products

The QPS Intelligence Cycle (IC) is consistent with the intelligence methodology adopted across many intelligence agencies. The IC process is often described as cyclic however it is also accepted that at times it may be reversed to address intelligence gaps before moving forward again (Queensland Police Service, 2018). The process has remained largely unchanged since the Second World War. The

IC is believed to have origins in social science and psychology because of the linear notion of cognition and behaviour (Warner, 2002).

While the IC is widely recognised and accepted within the intelligence community, Richards (2013) argued that it has never been a particularly accurate guide to how contemporary intelligence is organised and managed. Sheptycki (2013) supports this view and suggests the IC is outdated and not an accurate reflection of how the intelligence process works. Gill and Phythian (2012) explain the limitations of the IC model in the context of what they term the challenges of complexity. These challenges include the influence of bureaucracy, technology, oversight, covert action, interactivity, comparative analysis, and risk-based approach on the intelligence process. Treverton (2003) suggest that intelligence customers will increasingly favour 'pull' intelligence and information rather than having it 'pushed' onto them. This concept is supported by advances in IT, offering intelligence consumers a choice of intelligence and information products. Richards (2013) argues that changes to the traditional transactional intelligence cycle will mean that intelligence customers will be more likely to 'Google' queries or review open-source information to fill in intelligence gaps.

Quamby and Young (2010) note that the traditional IC is not designed to be taken literally or as an exact process map and should simply represent a basic theoretical model to be used only as a training tool. Gill and Phythian (2012) propose that the intelligence process is moving away from a notion of a cycle towards a more complex notion of a web of intelligence that reflects the complexity of the intelligence process in a more non-linear form that is better able to function in a complex operating environment. Richards (2013) argues that the change from the traditional IC is necessary to cope with the uncertainty created by the dynamic economic, institutional, and technical environment, particularly in the areas of information technology and multimedia.

While there is a diversity of opinion as to whether the IC accurately represents the contemporary intelligence process, the IC does share many fundamental principles that are common to most intelligence processes. Figure 2.2 demonstrates the cyclic process of directing, collecting, collating, analysing, reporting, disseminating, and reviewing intelligence in the Queensland Police Service. The intent of this work-based research is to enhance the management and dissemination of operational information

and intelligence for police and so, therefore, relates directly to the QPS IC process and the way information, knowledge and intelligence is managed and exchanged.

The QPS IC begins at the direction stage in which the 'customer' requests intelligence on a matter, person, or crime. Waltz (2003) outlines that at this stage of the cycle, decision-makers define the knowledge that is required to make strategic or operational decisions. The QPS uses a variety of sources and methodologies to facilitate the information collection process, this may include, for example, human intelligence, telephone intercepts, surveillance, financial records, covert operations, field reports and open-source information. The sources and methodologies used to collect intelligence are considered the most sensitive elements of the entire IC and are usually subject to protection or secrecy (Waltz, 2003). Collection methods are constantly evolving in response to technical developments and improvements in investigative strategies.

It is in the analysis stage that information is transformed into intelligence. Pythian (2013, p. 38) describes the analysis stage as:

> "The conversion of basic information into finished intelligence. It includes integrating, evaluating, and analysing all available data – which is often fragmented and even contradictory – and preparing intelligence products. Analysts who are subject-matter specialists consider the information's reliability, validity, and relevance. They integrate data into a coherent whole, put the evaluated information in context and produce finished intelligence that includes assessment of events and judgements about the implications of information."

In the final stages of the IC, intelligence products are disseminated to consumers. According to Waltz (2003), intelligence products can be divided into three categories, these include operational intelligence, tactical intelligence and strategic intelligence which are distinguished in order by their past, present, and future focus.

Figure 2.2 QPS Intelligence Cycle (Queensland Police Service, 2018).

QPS intelligence products are disseminated in different formats depending on the Intelligence Product (IP) requested by the user and the purpose for which it is being used. In the QPS, there are seven specific IPs that are disseminated according to the circumstances of the intelligence and the tactical, operational, or strategic reasons for their request. Table 2.3 provides a list of these IPs including a description of their tactical, operational, or strategic significance.

Table 2.3

QPS Intelligence Products.

Intelligence Product	**Description**	**Category**
Intelligence Assessment	Commonly used to assess current and emerging trends including location, cases, and people. Designed to improve understanding and situational awareness for improved decision-making.	Tactical, Operational and Strategic
Intelligence Report (INTREP)	Used to disseminate single pieces of time-critical information and or intelligence relating to crime trends (place and case). Designed to assist with operational planning and resource allocation. Often relates to a specific police operation or special event.	Tactical and Operational
Intelligence Brief (INTREP)	Used to disseminate intelligence in a timely manner to assist decision-makers with tactical planning and resource allocation. Designed to provide more information than a **Be On the Lookout** (BOLO) report	Tactical
Information Bulletin	Used to disseminate noteworthy general information on a specific topic.	
Person of Interest (POI)	Used to identify persons who are of immediate interest to Police including wanted for arrest or wanted for questioning.	Tactical, Operational
Vehicle of Interest	Used to identify vehicles that are of immediate interest to Police including those associated with POIs or used in connection with the commission of offences.	Tactical, Operational
Intelligence Summary (Intsum)	Used as a primary means of disseminating consolidated intelligence and assessment including information generated from various functional cells and other sources. Mainly disseminated to commanders during major events and created and consolidated by Joint Intelligence Groups (JIG) or Joint Emergency Services Coordination Centre (JESC).	Tactical, Operational

2.4.2 Limitations and barriers in the intelligence process

Some intelligence professionals argue the weakness of the intelligence process is not created by the process itself but because of human involvement. Sheptycki (2013) points out that rarely does the 'customer' make a decision based on the analysis of intelligence options and instead is more likely to use intelligence to justify their own personal decision or policy position. This notion is supported by Betts (1978) who observed that historic intelligence failures arose from not a lack of intelligence but from decision-makers dismissing the intelligence or misreading it.

Pythian (2013, p. 28) suggests that for any intelligence process to function properly "intelligence collection must feed into insightful analysis that shares timely counsel with decision makers who then respond effectively". Often knowledge and intelligence become distorted as they pass through levels in hierarchy and cross-functional boundaries (Pemberton & Stonehouse, 2000) . This can often lead to sub-optimal decisions and poor strategy.

Sheptycki (2013) highlights that information flow in criminal intelligence systems is often impacted by several pathologies that affect the quality of the information in the cycle and the intelligence that is subsequently generated.

Organisations often create multiple databases used to store a range of information and intelligence leading to what Sheptycki calls a state of the digital divide. There is little interconnectivity or coordination between these databases leading to a patchwork of information and intelligence making it difficult to identify intelligence gaps and ultimately impacting their capacity to produce accurate intelligence.

Sheptycki (2013) points out that there is also often insufficient intelligence sharing between stakeholders, reducing the capacity to provide complete intelligence pictures. This can be caused by intelligence hoarding which often relates to reasons created by competition or organisational friction. However, it can also relate simply to intelligence gatherers not reporting information or intelligence. The absence of intelligence sharing is described by Sheptycki as a process of linkage blindness which he describes as a systems failure and not a technical failure created by the digital divide process.

Intelligence analysts can also be affected by the high amount of low-grade information received and circulating in the intelligence system increasing the time to analyse information and develop intelligence products. Sheptycki (2013) points out

that the volume of ‘noise’ in the intelligence system is often directly related to the size of the gap between the information reporting, intelligence analysis and dissemination stages of the intelligence cycle. The greater the gap between processes, the greater the capacity to generate more ‘noise’. Analysts who are removed from the operational component of information gathering do not always have the capacity to interpret the information accurately and are therefore more likely to generate inaccurate intelligence products. Sheptycki (2004) describes intelligence overload as being caused by the volume of outdated, low grade and irrelevant information that enters the intelligence cycle that adds to the cumulative workload of intelligence analysts which can often create a state of intelligence paralysis.

Sheptycki (2004) also points out that there is often a tendency to not report or record relevant information or intelligence because of time-consuming or inefficient reporting processes. Intelligence gatherers often fail to report information because of either competing demands or because they fail to recognise the importance of the information they have.

2.4.3 Intelligence-Led Policing

While the demand for policing services continues to rise, law enforcement agencies have traditionally relied upon increases in police numbers and larger budgets to address crime trends (Sparrow, 2016). However progressive thinking and tighter fiscal environments have forced police services to look at new ways of achieving organisational goals through greater efficiencies and organisational effectiveness (Sparrow, 2016). Intelligence-Led Policing (ILP) is an operational management model by which police organisations use intelligence to guide operational strategy. Ratcliffe (2016) explains that the ILP model uses criminal intelligence to guide operations as compared to the case where operations determine intelligence gathering priorities. Ratcliffe (2016) demonstrates in the 3-I (Interpret, Influence, Impact) ILP model shown in Figure 2.3 a non-linear relationship between the crime intelligence analysis, the criminal environment, and decision-makers. Ratcliffe proposes that crime analysts interpret the criminal environment so they can use the information to influence decision makers who then determine the strategy that subsequently impacts the criminal environment. The process is non-linear and each of the elements of the cycle impact the other.

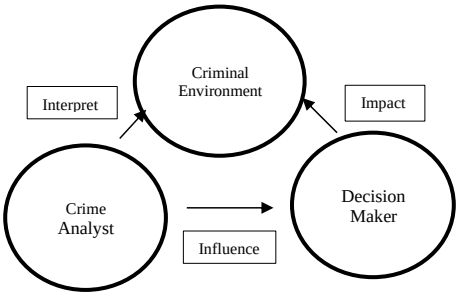

Figure 2.3 3-I Intelligence-led policing model
(Ratcliffe, Intelligence-led policing, 2003).

The ability of the police practitioner to understand the causes of crime has historically come from their personal and professional experience. The effectiveness of strategy often being influenced by factors including organisational strategic direction, bias, political influence, and resourcing. However, the ILP model requires a more scientific approach requiring a higher level of research, analysis, and evaluation. Carter (2011) defines ILP as the process of using analysed information to inform decisions, identify trends and ultimately prevent threats. Ratcliffe (2005) points out that ILP differs from other policing strategies because of the focus on recidivism and the encouragement to use surveillance and intelligence systems to detect and prevent crime. Ratcliffe (2008, p. 89) defines ILP as:

> "A business model and managerial philosophy where data analysis and crime intelligence are pivotal to an objective, decision making framework that facilitates crime and problem reduction, disruption and prevention through both strategic management and effective enforcement strategies that target prolific and serious offenders."

According to Carter (2016), ILP requires a future-orientated and strategic approach to crime prevention by placing intelligence at the forefront of crime prevention strategy. Crime prevention is defined as strategies to reduce the risk of crime occurring and their impact on individuals and society (Australian Institute of Criminology, 2012). Crime prevention is a strategic priority for the QPS. According to the Australian Institute of Criminology (2012), well planned interventions can prevent crime and victimisation, promote community safety, and contribute to a

sustainable community by reducing social costs in areas of justice, welfare, and health care.

Ten years ago, Carter (2011) observed that ILP lacked a consistent and conceptualised approach as most policing organisations tended to implement their own unique ILP strategy. This point however remains valid as many police services, particularly those in both Australia and England have undergone recent frontline service re-design, changing the way police services and crime prevention strategies are delivered to the community. This however is not a new phenomenon as organisational re-design commonly occurs among large organisations and is usually connected with a change in senior leadership.

Carter (2016) points out that ILP practice has received relatively little scholarly attention compared to other policing models. In a recent study conducted by Burcher and Whelan (2018), they identified three relational themes that inhibit the successful implementation of ILP practice, these included, incorrect recording of data, poor IT software system design that proves difficult to collect, manage and analyse data and sub-par relationships between intelligence stakeholders.

Burcher and Whelan (2018) highlight that intelligence analysts continued to be frustrated by the capacity of their current systems to share and manage the high amounts of information that often causes them information overload. They recommend that further effort needs to be directed towards organisational and technological improvements in the coordination of police intelligence including further development of software tools designed to collect, analyse, and disseminate information.

2.5 Intelligence and knowledge management

There is generally little consensus in the published literature as to an agreed definition of KM and the purpose it has in organisational and information management processes. In a 2012 meta-analysis study of KM, it was concluded that it was a field still undergoing evolution and was one that had not yet reached a state of maturity (Lee & Chen, 2012). The absence of a common definition and concept of KM was explained by (Gonzalez-Valiente, Leon-Santos, & Arencibia-Jorge, 2019) as being created by the mixture of contributions made by the many fields of business, information management science and economics having their own theory about the application of KM principles. The degree of complexity and purpose of KM also continues to vary

according to unique organisational requirements and the limitations associated with the organisation's IT and the financial capacity to support development.

It is evident that advances in IT have contributed to how knowledge can be managed and leveraged to improve organisational performance. Zhang and Zhao (2006, p. 6) define KM as "the study of strategy, process and technology to acquire, select, organise, share and leverage business-critical information" while Davenport and Prussak (1998) suggest that KM is a mix of experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating experience and information.

Macintosh (1996) argued that KM involved the identification and analysis of knowledge and the subsequent planning and control of actions to develop assets to fulfil organisational objectives. Jacks, Wallace, and Nemati (2012) suggested that KM included organising, refining, and capturing knowledge as well as the creation and application of new knowledge.

KM plays a central role in operational and organisational strategy and despite the many definitions the common purpose is that KM contributes to organisational strategy and operations. According to Waltz (2003), effective KM improves decision-making options, provides greater situational awareness, supports critical thinking, facilitates information sharing and refines information into actionable knowledge. Tiago, Couto, Tiago, and Vieira (2007) argued that KM facilitates the organisation's capacity to analyse and plan operational activity as well as maintaining operational and strategic control of assets and resources. Bitkowska (2017) suggests that KM improves organisational functioning by creating conditions that enhance knowledge sharing. It is evident that KM is a dynamic evolutionary process that continues to advance with new capabilities and processes that contribute to greater organisational efficiency and effectiveness. As KM processes develop at different rates of progress across the public and private sectors it is unlikely that KM will ever be the same for all organisations or the various fields of study.

The intelligence management process shares many similarities with KM systems for reasons explained in Section 2.4. Waltz (2003, p. 53) reported that the US National Security Agency defined KM as; 'the strategies and processes to create, identify, capture, organise and leverage vital skills, information and knowledge to enable people to best accomplish the organisational mission'. Waltz, (2003, p. 58) explained that KM was critical for information and intelligence superiority and the ability to achieve and

sustain information superiority depended upon the creation and maintenance of reusable knowledge bases.

Gottschalk (2009) explained that the focus of intelligence and information sharing should include features that include interoperable systems with information discovery and access to knowledge sharing by capturing and disseminating both explicit and tacit knowledge that according to Poell and Van der Krogt (2003) stimulated the acquisition of further implicit knowledge.

Gottschalk (2009) argued that police knowledge requirements can be divided into seven knowledge category needs, these include administrative, policing, investigation, intelligence, legal, technological, and analytical. Administrative knowledge includes the governance framework that relates to the rules, policies and procedures that allow organisations to manage decision making and ensure compliance. Policing knowledge includes the processes and practices that determine operational and organisational strategy, allowing the organisation to manage risk and guide effective and efficient performance. Investigation knowledge refers to case specific information which forms the basis of taking lawful action, including the power to arrest. Intelligence knowledge are the organisational information and intelligence holdings, applied to create competitive advantage, and relied upon for tactical, operational, and strategic decision making. Legal knowledge concerns the legislation and legal processes relevant to operational policing and organisational governance, ensuring organisations comply with their lawful obligations with both criminal and civil legislation. Technological knowledge refers to the development and deployment of KM processes to manage information and intelligence so that knowledge can be shared across the entire organisation contributing to more effective decision making. Analytical knowledge focusses on the capacity to review police actions, strategies, and tactics and to find solutions to current challenges based on experience. These categories are summarised with explanation in Table 2.2.

Table 2.2

Police Knowledge Needs (Gottschalk, 2009)

Category	Description
Administrative Knowledge	Knowledge about organisational rules, procedures, and regulations
Policing Knowledge	Knowledge about operational police work processes and practices
Investigative Knowledge	Knowledge-based on case-specific information
Intelligence Knowledge	Knowledge-based on the systematic collection of information about a person or topic
Legal Knowledge	Knowledge of law, regulations, and legal procedures
Technological Knowledge	Knowledge about development, use of information and communications technology
Analytical Knowledge	Knowledge about strategy, tactics, and actions

Gottschalk (2009) explained that in a policing context knowledge can be classified into three levels of knowledge detail. These include basic knowledge that has little value and does not significantly contribute to organisational outputs. Advanced knowledge contributes to outputs and is necessary to produce intelligence reports and crime analysis, and innovative knowledge has a high value and contributes to significant achievement. Gottschalk (2009) pointed out that police intelligence officers and investigators apply innovative knowledge to new insights in terms of crime patterns, criminal profiles, and policing strategies. Innovative knowledge contributes to the development of new methodologies in intelligence and analysis, contributing to a more effective intelligence system.

Gottschalk (2009) highlighted any police service that uses ILP as its management philosophy also uses knowledge-based management systems for strategy implementation and intelligence management. Gottschalk (2009) outlined that the challenge for these organisations is to create the capacity at a systems and officer level to gather, analyse, prioritise, and use information strategically. Collier, Edwards, and Shaw (2004) and later Gottschalk (2009) argued that effective KM is as important to policing as any public or private sector organisation in terms of improving performance.

Schiuma (2012) reported that for KM systems to work, businesses needed to adopt the right framework and tools for managing knowledge. Schiuma (2012) suggested that organisations need to put in place relevant KM processes that drive the development of strategic knowledge domains. Schiuma (2012) added that regardless

of the taxonomy of the KM system, organisations need to be able to generate new knowledge, encourage its application, and provide the facility to store it and the processes to share it.

Waltz (2003) explained that knowledge should be managed principally through its people, organisational processes, and technology. This includes taking into consideration the organisation's culture and structure ensuring that knowledge growth is supported through collaborative learning and problem-solving. Organisations can leverage upon KM processes by delivering technology that facilitates people and process strategy. According to Waltz (2003) technology leverages the organisation's KM people and process strategy to increase the size of actional knowledge. In 2005 Andrew Goh proposed a similar framework asserting that organisations adopting KM principles based on people, process and products were better structured to encourage innovation by facilitating collaborative knowledge sharing and supporting non-linear thinking. Goh's KM principles have been applied in this work-based study to design a KM System to manage and disseminate operational information and intelligence for police. Goh's KM principles are discussed further later in this thesis. Table 2.3 provides a summary of Waltz's (2003) KM principles and a brief description.

Table 2.3

Knowledge Management Principles (Waltz, 2003, p. 58)

Process	**Description**
People	Knowledge Management must deal with culture and organisation structure that enables and rewards the growth of knowledge through collaborative learning, reasoning and problem-solving.
Process	Knowledge Management must provide an environment for exchange, discovery, retention, reuse and knowledge across the organisation.
Technologies	Information Technology must be applied to enable the people and processes to leverage the intellectual asset of actionable knowledge.

One of the most difficult challenges faced by organisations implementing KM systems is facilitating knowledge sharing (Chow & Chan, 2008). Many organisations have introduced social media platforms such as Workplace to support knowledge exchange. 'Workplace' is an online software tool developed by Meta to facilitate online group work, instant messaging, and news sharing. Razmerita, Kirchner, and Nielsen (2016) outline that social media facilitates the management and externalisation of both personal and organisational knowledge through multimodal interactions

including videos, pictures, blogs, and ongoing online conversations. Majchrzak et al. (2013) argue that social media have enhanced the knowledge-sharing process by introducing continual online communal knowledge conversations. Despite these advances however some employees refuse to engage with the technology or take advantage of these tools. Rymarczuk (2016) pointed out that even in cases where people are familiar with social media technology, they do not always use it. Adamovic, Potgieter, and Mearns (2012) highlighted that for organisations to create a knowledge-sharing culture, employees need to be encouraged to use social media tools in their business practices.

Asrar-ul-Haq and Anwar (2016) concluded there is considerable academic contribution focussing on KM practices in relation to work-related outcomes, however, noted the general lack of research on KM development, process mechanisms and implementation. They noted that the nature and methods of such processes are unique for each organisation, creating an opportunity for considerable learning from each organisational experience. Hislop et al. (2018) also highlighted the general decline of practitioner involvement in KM research and academic publication, highlighting a risk that KM will simply become academic, offering limited practical relevance for organisations.

2.6 Knowledge for innovation

Knowledge is a source of competitive advantage for organisations. According to Laursen and Mahnke (2001), competitive advantage is dependent on an organisation's ability to exploit existing knowledge and to generate new knowledge. Competitive organisations have the capacity to leverage knowledge through a process of innovation to create new and better products that keep the organisation ahead of its competition.

Goh (2005) describes the term Knowledge Innovation (KI) as one where competitive organisations implement a deliberate strategy of ongoing improvement by applying KM practices that support non-linear thinking, facilitate collaborative knowledge sharing, support the synthesis of unstructured knowledge, support business process improvement, and meets the needs of knowledge customers. Goh (2005) proposed that knowledge creates value for a business in three principal areas of organisational strategy, these include the organisation's product strategy, process strategy, and people strategy. According to Matei and Nitu (2012), it is common for

organisations to use the product, process and people model when developing strategy and when assessing organizational creativity as a core issue in the reform process. Goh outlined nine organisational initiatives he considered were critical for KI and value creation. These initiatives are described in detail under Goh's product, process, and people KM principles.

2.6.1 Product strategy

Structuring and mapping knowledge

Goh (2005) posited that knowledge should be structured and mapped, replacing the piecemeal approach to information management. This approach is usually demonstrated when organisations manage multiple information databases unsystematically stored across a variety of business units. Komiyama and Takeuchi, (2006) proposed that knowledge restructuring should provide organisations with wider access to more information, facilitating their capacity to develop an effective strategy to address complex problems. Ai, Nobuo, and Akimasa (2008) highlighted that by mapping knowledge, organisations can systematically understand complex problems and identify gaps in knowledge and research shortfalls. According to Damart (2010), a cognitive mapping approach to problem-solving leads to a better understanding by facilitating a structured process of investigation that includes causal relationships, connected problems and possible solutions. MacEntee (2019) explains that by synthesising evidence from multiple sources through a process of meta-analysis, organisations are better placed to implement evidence-based policy and allocate resources more effectively.

Developing knowledge databases

Goh (2005) argued that knowledge bases should be created to consolidate information resources into larger more dynamic and collaborative knowledge centres. The database approach allows the integration of data so that it may be shared across the organisation and facilitates the capacity of users from multiple business units to contribute to the collection of knowledge (Huser, Sincan, & Cimino, 2014). Knowledge consolidation and data integration improve the consistency of information ensuring that data is not duplicated across multiple folders, preventing what Gordon (2013) called a process of data redundancy where inconsistent or outdated information

risks being used in organisational decision-making. In these circumstances, up-to-date accurate information is not always distributed evenly across business units, impacting their capacity to be responsive to organisational needs and make effective decisions. Consolidating the storage of information into one source improves the capacity for organisations to manage information security and to ensure that information remains updated and accurate (Gordon, 2013).

Embedding knowledge within new products and services

Goh (2005) argued that organisations maintaining competitive advantage do so by embedding knowledge into new products and services, creating greater value for customers by facilitating their ability to access more information and greater knowledge within new products. For example, in 2007 Apple released the 1st generation iPhone. The iPhone was the first device to combine a multimedia player, telephone, and internet capability on a touchscreen (Montgomery & Mingis, 2021). The release of the iPhone gave Apple a competitive advantage by providing consumers access to the internet without the need to use a traditional computer. The iPhone also provided consumers access to a variety of new online products and services through Apple's Mobile Application Software and the Apple Store. The emergence of the Internet of Things has created a further opportunity for organisations to use online technology to create greater customer value. There are now a variety of products branded as Smart Technology that allow customers to connect their products to online services to enhance their product experience. Technology and value creation in product design continue to occur at such a rapid pace it is evident that organisations that fail to maintain innovative capacity, risk falling behind their competition.

2.6.2 Process strategy

Capturing and reusing information as knowledge

Goh (2005) recommended that organisations seeking to maintain continuous improvement should regularly capture and reuse information as knowledge. In a study conducted by Yap et al. (2021) on the benefits of capturing and reusing knowledge, they found that construction times and cost control for development projects were improved when past project experience was recorded and used to enhance decision making on current projects. Yap, Boon, Shavarebi, and Skitmore (2021) outlined

organisations that failed to capture and reuse information as knowledge through lessons learnt often risked cost overruns, project delays or poor-quality outcomes. Tan et al. (2007) argue that the value of tacit knowledge is often underrated or overlooked when compared to explicit knowledge. Organisations risk losing valuable tacit knowledge as employees leave and move to new employment. Toor and Ogunlana (2008) highlight organisations that do not record learnings are at risk of repeating past mistakes that can often be costly. It is important to also note that while some organisations have the capacity to capture lessons learnt they often fail to use the knowledge they have collected. Tan et al. (2007) pointed out that the benefits of capturing knowledge cannot be realised or exploited unless that knowledge is reused and included in the decision-making processes or the organisation's operational or product strategy.

Sharing of knowledge or lessons learnt about knowledge processes

Goh (2005) outlined organisations should have the capacity to share knowledge or lessons learnt by distributing or disseminating information through personal interaction or other means. Yap et al. (2021) identified that organisations should be able to identify critical learning situations and to understand what knowledge is worth capturing and how best to capture it. Yap et al. (2021) in a study identified that most critical learning situations are created in team environments, collaborative working environments, mentoring relationships, or when making mistakes. Teerajetgul and Chareonngam, (2008) described how collaborative working environments lead to knowledge sharing. Eltigani et al. (2019) explain that most organisational learning occurs in face-to-face meetings where people can learn from the experience of others. Nonaka and Takeuchi (1995) noted that socialisation plays a crucial role in knowledge generation and knowledge sharing when working with others in collective working environments. There are several ways organisations can stimulate learning, Caniels, Chiocchio, and Van Loon (2019) outline organisations can create better-functioning collaborative work teams by providing a clear expectation of performance and learning goals. Mentoring is also an important learning mechanism, creating the opportunity for workers to learn and leverage their skills from other more experienced workers. There are however some barriers to learning when relying upon the mistakes or lessons learnt from others. Mainga (2017) points out that some employees are hesitant to acknowledge or highlight their mistakes for fear of sanctions

or perceptions of professional incompetence. Love et al. (2018) suggest that organisations can overcome these issues by encouraging a no-blame culture with a clear link to learning outcomes. Organisations failing to engage in critical reflection risk repeating mistakes that ultimately increase costs and reduce performance.

Measuring and managing the value of knowledge-based assets

Goh (2005) argued that organisations must be able to evaluate the benefit of their KM Systems by having the capacity to measure the value of their knowledge capital. This according to Skyme (2022) is because business needs to be able to justify their investment in knowledge programs and show evidence of their economic benefit to the organisation and its shareholders. Freeze and Kulkarni (2005) pointed out that measuring organisational knowledge as an asset is also necessary to determine the effectiveness of KM initiatives and be able to benchmark these against other organisational strategies. Measuring the value of knowledge capital can also assist organisations to predict future performance and to be able to know where in the organisation, knowledge capital is being held allowing organisations to identify key workers and to provide ongoing development and resources to support their role (Matoskova, 2016).

Knowledge can be measured through financial and non-financial methods. Financial methods quantify intellectual capital based on accounting information. Sveiby (2010) pointed out that organisations are more likely to use financial methods when undertaking a merger or acquisition in the stock market. Non-financial methods include for example the Balanced Score Card based on identifying non-financial measurements and components of intellectual capital. Ragab and Arisha, (2013) explained that in cases where organisations undertake scorecard methods, surveys or questionnaires are often used to create a more comprehensive picture of an organisation's health than financial methods.

There are several methods used to evaluate KM Strategies. The Knowledge Management Scan by Hoof, Vijvers, and Ridder (2002) focuses on providing advice to organisations about KM Strategy. The Knowledge Management Capability Assessment Instrument by Freeze and Kulkarni, (2005) captures a firm's KM capability in four KM areas that include lessons learnt, knowledge documents, expertise, and data. The Organisational Learning Scale by Lopez, Peon, and Ordas (2006) focuses on external knowledge acquisition, internal knowledge acquisition,

knowledge distribution, knowledge interpretations and organisational memory. Rashid, Hassan, and Al-Oqaily (2015) questionnaire concentrates on tacit knowledge, tacit knowledge culture, tacit knowledge conversion and tacit knowledge measurement. Chen and Chen (2005), KM Score Card based on the Balanced Score Card method using a KM framework.

Organisations can measure the level of organisational knowledge sharing through data measurement, opinion-based surveys or by using a combination of both methods (Matoskova, 2016). Data measurement can include the frequency of hits on postings, the number of documents submitted or the frequency of hits on data and information stored. Matoskova (2016) argued that this approach is supported by utilising analytic functions inside computer-based KM Systems. Opinion-based surveys are often also used, these are constructed using questionnaires evaluated by respondents on a Likert Scale. Seba et al. (2012) for example in a study measured a series of KM constructs using an employee survey questionnaire that focused on employee attitudes towards their intention to share knowledge, attitude towards knowledge sharing, leadership, organisational structure, reward, trust, time, and information technology. Respondents' opinions were measured using a 5-point Likert Scale. Yi (2009) created a survey tool that measured the behaviour of employees based on a model that focused on employees' attitudes towards written knowledge contributions, communicating knowledge in work teams, and knowledge sharing in informal interactions and communities of practice. The survey was designed to evaluate the respondents described behaviour using a 5-point Likert Scale.

2.6.3 People strategy

Creating knowledge or intellectual capital teams from multiple disciplines

According to Goh (2005), organisations must create knowledge or intellectual capital teams to help identify and audit intangible knowledge assets using people from multiple disciplines. Knowledge audits according to Handa, Pagani, and Bedford (2019) refer to an audit of the organisational processes that are designed to increase the knowledge capacity of any organisation, these may include areas associated with organisational leadership, strategy, knowledge capital, technology, and operations. Knowledge audits allow organisations to become aware of their own knowledge assets so they can be leveraged to create greater value to the organisation. This may include

for example identifying more efficient or effective operational processes that reduce operational costs (Handa, Pagani, & Bedford, 2019).

Multi-discipline work teams are often implemented by organisations operating on specific projects or organisational issues. Complex problems are inherently difficult to understand and so require multiple domains of expertise to solve (Jackson, 1996). The audit process provides a framework that facilitates the collection of ideas from people with a wide degree of technical skill and experience who represent a cross-section of the organisation. As ideas are generated the team members can discuss how these strategies impact their area of business and make suggestions according to their knowledge and expertise. According to Jackson (1996) working in teams often creates outcomes that could not be achieved by individuals working in isolation. There is no clear consensus on what organisations consider to be are intangible assets, so multi-disciplinary teams can often be used to identify and define the organisation's intangible assets so they may be appropriately resourced and supported (Diefenbach, 2004).

Forming people-orientated knowledge centres

Goh (2005, p. 15) recommended that organisations form "people-oriented knowledge centres to become the focal points for the development of knowledge skills, managing and enhancing knowledge databases and facilitating knowledge flow". Goh argued that for innovation to occur, organisations must create a learning culture where knowledge is shared, lessons are learned, best practice is identified and those seeking to make effective decisions can do so by having access to the information they require. A culture of learning and collaboration can be facilitated through several strategies that may include for example delivering workplace employee mentoring and training programs, introducing online workplace forums where ideas can be exchanged by employees working in various areas of the organisation, recording, and reviewing workplace case studies to identify benchmark processes and incentivising KM practices by rewarding employees who contribute or use KM systems (Valamis.com, 2021). Goh (2002) reported that organisational leadership has the greatest influence over the success of any KM strategy. Leadership has the capacity to shape an organisation's culture that supports KM collaboration, knowledge transfer and organisational learning.

Organisational culture is defined as the "core beliefs, values, norms and social customs that influence the way individuals act and behave in the organisation"

(Martensson, 2000, p. 2). Shaping organisational culture is often the greatest challenge for most organisations attempting to implement a successful knowledge-based strategy (Chase, 1997). Lee and Choi (2003) described how a collaborative culture is essential for knowledge transfer and knowledge creation. Through collaboration, organisations can exploit their core competencies in all areas of the business, ensuring they are integrated and form a strategic alliance (Choudhary et al., 2013). Goh (2002) pointed out that trust is an important element of organisational culture emphasising that employees must feel supported to contribute new ideas without the fear of negative consequences when mistakes are made. Building a relationship of trust helps facilitate a proactive and open knowledge-sharing process (Pemberton & Stonehouse, 2000).

By supporting employee engagement in the KM process, organisations can more effectively adapt their strategies, operations and management systems with changing risk and competition (Choudhary et al., 2013). Wong (2005) argued that IT is also a key enabler for implementing KM strategy that supports the capacity to store, search, access and share information. Organisations implementing KM strategy must establish clear roles and responsibilities for teams and individuals who perform knowledge-related tasks so that knowledge is efficiently and effectively exchanged. This includes a clear process for knowledge creation, storage, retrieval, and transfer (Alavi & Leidner, 2001).

Using collaborative technologies for knowledge exchange

Technology plays an essential role in the KM process as it allows users to capture and share knowledge that supports effective strategic and operational decision-making. Goh (2005) recommended organisations implement collaborative technology that supports knowledge exchange between people and business units. Choudhary et al. (2013) explained that collaborative networks improve organisations' competitive advantage by improving their capacity to adapt to changes in market conditions by integrating information and resources into key activities. Parnby (2002) argued that it also supported better decision-making with quicker responses to key business issues that results in better customer service. The most recent example of technology shaping work practices has been the increase in video conferencing resulting from the Covid 19 pandemic. Video conferencing has created efficiency gains relating to time and travel as well as possible environmental benefits. O'Dell and Grayson (1998) argued that to set up an appropriate collaborative technology the project must meet the aims

and objectives of the organisation and its users, not simply be a superimposed practice. Many technology products are engineered to work effectively but are not designed to be easy to use. Sharp (2007) explained that designers often fail to understand how users interact with technology nor how human cognitive aspects can be impacted by design implications and technology usability. Human cognitive processes affect the user's attention, perception, memory, learning, reading, speaking, listening and problem-solving approaches to technology.

Sharp et al. (2007) described the extent to which our attention is effective depends on whether the user knows what information they are looking for and how the information is presented. Attention refers to the process of selecting things to concentrate on from a range of possibilities and involves auditory and visual senses (Sharp et al., 2007). Technology users' attention is also often diverted across multiple interfaces when performing one primary task. Sharp et al. (2007) suggested that designers should ensure that the most important information is found easily by avoiding a cluttered interface and using graphics, colour, underlining, ordering, and spacing to enhance the presentation of information.

Perception is defined as our recognition and interpretation of sensory information and stimuli within the environment (Levitas, 2021). It refers to how information is acquired from the environment using different senses including sight, sound, and touch (Sharp, Rogers, & Preece, 2007). Sharp et al. (2007) argued that information needs to be perceptible and recognisable by ensuring icons and graphical representations are distinguishable. This also includes ensuring bordering, and spacing are used to group information, making it easier to be found, text should be legible, and sounds and speech should be clear and distinguishable.

Memory, according to Slotnik and Vansintjan (2019), is a neurochemical process that includes conditioning and any form of stored experience, it is the capacity to store and retrieve information. Studies conducted by Kandel et al. (1981) demonstrated that classical conditioning was a basic form of memory storage that can be observed at a molecular level. Squire (2009) defined memory as the faculty of encoding, storing, and retrieving information. Memory storage is non-linear and subject to complex interactions that affect our ability to remember and process large amounts of information (Slotnik & Vansintjan, 2019). Sharp et al. (2007) explained that individuals have a filtering process that is used to decide what information is to be processed and memorized. Lansdale and Edmonds (1992) suggested that memory

and search function could be divided into two separate processes. These include the Recall Directed Process where information is memorised accurately and the subsequent search for information is conducted using the exact search criteria. This search process will often find the intended information quickly and accurately. Recognition Based Scanning is where the searching function is conducted using a list of possible options, that may bring the user to the intended search result. This process often takes more time for the user to find the intended information.

When considering these issues, system developers should design interface technology that provides users with multiple pathways and encoding options to find files and documents. This may include for example using search functions that include time stamping, categorisation or flagging files. Designers can also use colour, sound, and images to promote recognition or use menus and icons to assist the search function (Sharp, Rogers, & Preece, 2007).

The major theoretical views on learning are summarised into four categories that include behaviour, understanding, knowledge construction and social practice. Learning is impacted by several factors that are not necessarily related to Learning Theory but the context of the learner (Reynolds, Caley, & Mason, 2004). This may include for example the learner's motivation, the organisational culture in which they work, the support mechanisms available for the learner and the physical environment in which they live. Learners also have characteristic learning styles that determine how effectively they process information. People often find it difficult to learn by following a set of instructions in a manual and instead often learn better by doing (Farkas & Williams, 1990). Sharp et al. (2007) suggested that technology can be designed to facilitate learning by allowing learners to progressively discover new functions through self-exploration. This gradual approach, limiting the amount of new information facilitates a self-directed learning style and learning pace. This can be done by designing interfaces with simple but restricted functioning that allow less experienced users to master the system before seeking greater access to information and more functionality.

Listening, speaking, reading, and writing are critical language skills that facilitate the communication process and ensure that the message is correctly received and interpreted by the receiver. Unfortunately, there are also a significant number of barriers to the communication process that has the potential to distort the intended message. According to Nutting and White (1994, p. 26), the message received is

influenced by the receiver's hopes, experiences, expectations, thoughts, and emotions. Writing style can also be structured to convey different meanings. For example, figurative language style, emotional language, technical jargon, non-standard wording, slang or colloquial terms and generic language can often change the meaning of the message depending on style and the way it is interpreted by the receiver. Similar barriers to communication exist when the message is communicated in speech format.

Non-verbal language cues can distort an intended message. For example, if the sender smiles when delivering a serious message this may create a conflicting message for the receiver. Other barriers to communication may include social factors, cultural issues, rank, and power influences. When designing technology Sharp et al. (2007) suggested that multi-modal forms of communication can often be used to overcome communication barriers and differences in users' language skills by offering a variety of methods to read, hear, process, and interpret information. Practical design features for technology may include reducing the length of speech-based menus to reduce interpretation options, providing in-program text to speech functionality, using larger text to assist reading, or using graphical images to support in-text information.

Problem-solving, planning, reasoning and decision-making involve a process of reflection that often takes time to consider information, analyse it and identify possible decision options. Often the time it takes to work through the problem-solving process increases with the complexity of the problem. Technology can be designed to facilitate the problem-solving process by identifying problems early and providing more time to analyse the issue and identify options. Technology interfaces can be designed to improve this process through enhanced search functionality and categorisation (Sharp, Rogers, & Preece, 2007). Mobile technology has assisted the problem-solving process by allowing access to information remotely and whilst on the move. Databases are often used to provide lessons learned from past experiences and access to organisational policy and procedures to facilitate decision-making (Goh, 2005).

The knowledge-based initiatives proposed by Goh and discussed in this chapter will later be applied in this work-based study as a design framework in the development of a software solution with the intention of making the management and dissemination of operational information and intelligence for police more effective. During this study Goh's people, product and process principles will then later be combined with Biomatrix systems theory to create an evaluation tool to evaluate the

effectiveness of the software solution. Goh's KM principles and knowledge-based initiatives are summarised in Table 2.5.

Table 2.4
Knowledge Based Initiatives promoting organisational innovation (Goh, 2005)

KM Principles	**Knowledge based initiatives**
Products	Structuring and mapping knowledge Developing knowledge databases Embedding knowledge in new products and services
Processes	Capturing and reusing information as knowledge Sharing of knowledge or lessons learnt about knowledge processes Measuring and managing the value of knowledge-based assets
People	Creating knowledge or intellectual capital teams from multiple disciplines to help identify and audit intangible knowledge assets and to develop new KM practices Forming people-orientated knowledge centres for the development of knowledge skills, managing, and enhancing knowledge databases and facilitating knowledge flow Using collaborative technologies for knowledge exchange

2.7 Organisational culture and knowledge sharing

Culture can impact the organisation's capacity to successfully implement new technology, particularly KM systems (Abrahamson, 2013). Culture is generally described as the collective perceptions, beliefs, and values of employees (Birasnav, Goel, & Rastogi, 2012) (Schein, 2010). Flamholtz and Randle (2011) suggested organisational culture can be either functional or dysfunctional depending on the level of organisational support and how clearly it is defined, communicated, and managed in connection to organisational goals. According to Abrahamson (2013), organisational leadership is essential in this process through the communication of a clear vision and implementing strategy that supports creativity, risk-taking, tolerance of mistakes and ongoing communication (Pemberton & Stonehouse, 2000).

Tate (2017) reminds us that organisational culture is made by the people within the organisation and so their values, decision-making, and behaviour ultimately drive the direction of the organisation. The strength of this culture depends on many factors

including the length of the organisation's history, the stability of its employees, and the type of experiences the members have shared (Whelan, 2016).

A knowledge-sharing culture is one that is created through a shared sense of community, values, purpose, rewards, and motivations (Hassell, 2007). Organisations with a culture of information and knowledge sharing are supported through robust knowledge management systems (Birasnav, Goel, & Rastogi, 2012) that deliver a better capacity to capture, share and develop new knowledge that enables the organisation to respond to changes in the environment and identify new market opportunities (Nonaka & Konno, 2009), (Newell, Robertson, Scarbrough, & Swan, 2009).

Whelan (2016) highlighted that due to the nature of the policing culture, there is often a high level of resistance to change, which according to Loftus (2010) is because the principal role of policing has not changed despite the many social changes that have occurred. Cope (2004) and Manning (2001) explored the impact policing culture had on the management of information and intelligence. Manning (2001) argued that police are less likely to trust information that is abstract and outside of the officer's own experience. Cope (2004) pointed out that police culture can often contribute to preconceptions and prejudice that can often suppress open-minded thinking that is required for intelligence processing. Kleiven (2007) noted factors creating a negative intelligence culture included, poor governance structures, absence of cooperation between partner agencies, insufficient knowledge of intelligence users and confusion about the sources of intelligence and the purposes for gathering and using intelligence.

Ericson and Haggerty (1997) argued that any police intelligence or information management system initiative is likely to encounter resistance to change, either through misunderstanding of the new technology or the perceived impact on the working conditions of officers. In a New Zealand Police (NZP) case study conducted by Ratcliffe (2005), police managers identified that many front-line officers including operational supervisors demonstrated resistance to using intelligence that contributed to more efficient work practices or intelligence-driven patrols. Ratcliffe (2005) contended that this may have been caused by the perception that the quality of intelligence was low and of little value to officers. Ratcliffe goes on to further explain that front-line officers retain a high level of autonomy and are more influenced by intelligence that is simple to comprehend, not time-consuming to act upon, tactical in

nature and arrest focussed. This argument was supported by NZP Intelligence Officers who believed their higher-level intelligence products were rarely read and therefore devoted more time to providing tactical and operational intelligence for front-line police. Chan (1997) argued that many of these issues are representative of the general inflexibility of the police culture. Crank (2014) highlighted that front line-officers share many cultural similarities because of the nature of their working environment. One of these similarities is their pattern of rotational shift work which often means officers are unable to form relationships with people outside their immediate work units. This often causes isolation from family and friends and may contribute to their polarised views and inflexibility. Chan (1997) suggested changing a police culture requires the creation of a governance structure that supports the change and addresses the habits of officers. Ratcliffe (2008) suggested that to improve the police culture in relation to Intelligence Management there must be an improvement in the Information Technology tools available to support the management and dissemination of information as well as the training structures to support the implementation of new technology.

Nemati (2002) posited that prior to implementing any organisational KM system one must first understand the organisation's culture. Jacks, Wallace, and Nemati (2012) and Alavi, Kayworth, and Leidner (2006) outlined the factors affecting KM processes are complex and include issues relating to organisational trust, supportiveness, power, ownership, learning, freedom, and information sharing. Jacks et al. (2012) pointed out that historical studies tended to focus on the cultural impact on the knowledge transfer process with less research on the cultural aspects of knowledge creation, storage, and management. Jacks et al. (2012) suggested that for organisational culture to support the implementation of KM systems an environment that emphasises trust and openness is more important than any technology artifact. They argue that a trusting open organisational environment is created by upper management setting a clear strategic direction with KM processes. Tate (2017, p. 156) suggests that organisations with a successful cultural management program are led by example, maintain effective communication, encourage transparent debate, have a merit-based performance strategy supported by governance systems that guide decision making.

2.8 Information overload

Information sharing is essential to the operational outcomes of any organisation. Zhuang, Qiu, and Peng (2011, p. 69) and Johnson, Scholes, and Whittington (2006) highlight that information is one of four important corporate resources, the other resources being physical, human, and financial. Zhuang et al. (2011) pointed out that information is critical for decision-making and the development of organisational strategy. While accurate, timely information is an asset for any organisation, high volumes of information can often be overwhelming, causing poor decision-making and leading to high-cost outcomes. Bettis-Outland (2012) highlighted that at some point, individuals acquiring new information can often become overwhelmed by excessive information causing them to reach a state of information overload (IO). Bawden and Robinson (2008, p. 182) defined information overload as "where an individual's efficiency in using information is hampered by the amount of relevant and potentially useful information available to them". Roetzel (2017) similarly explained that information overload occurs when decision-makers face a level of information that is greater than their information processing capacity. Eppler and Mengis (2004) pointed out that IO has many constructs which can include cognitive overload (Vollman, 1991), sensory overload (Libowski, 1975), communication overload (Meier, 1963), knowledge overload (Hunt & Newman 1997) and information fatigue syndrome (Wurman, 2001).

Roetzel (2017) points out that since the work of Eppler and Mengis in 2004 there has been no comprehensive study of information overload other than that relating to specific disciplines. In a policing context, research undertaken by Genovese, Mazur, and Collins, (2022) highlighted the impact of Covid 19 on information overload conditions for police and the amplification of operational stress factors that were likely to contribute to a higher risk of mental health injuries. Eppler and Mengis, (2004) described that generally, the quality of decisions improves as a person receives more information reducing their level of uncertainty. Schick, Gorden, and Haka (1990) observed however that at some point an individual is unable to process additional information creating a state of confusion and reducing their effective decision-making capability. Keller and Staelin (1987) described how IO is often dependent on a person's cognitive ability and those with greater cognitive ability have a higher capacity to process larger quantities of information in less time. In the results of a more

recent study conducted by Hong and Kim, (2020) showed that cognitive capacity and the frequency of online news use and interpersonal communication in relation to Covid 19 were significant predictors of information overload.

Tushman and Nadler (1978) explained that a person's capacity to process information and the time it takes for them to reach a state of information overload can be affected by time limitations. In general terms, the more information required to be processed with less available time increases the risk of IO. Based on a comprehensive review of factors affecting decision quality Phillips-Wren and Adya (2020) concluded that information overload was impacted by time pressure, task complexity and uncertainty. Task complexity was also previously researched by Schneider (1987) who concluded that the type of information including its novelty, uncertainty and subjective significance impacted the processing capability of the individual. In a historic study conducted by Keller and Staelin (1987), they found that the capacity to process information was often enhanced by the quality of the information and the degree the user finds the information useful. However, Eppler (2015) identified that high volumes of quality information aided by the processing and dissemination capability of IT Systems can also negatively impact decision quality and cause IO. In a more recent study of information flow to emergency medicine physicians conducted by Sbaffi, Walton, Blenkinsopp, and Walton (2020) they concluded that IO was linked to the high flow of important information communicated through email and other forms of IT often causing fatigue, stress, impaired decision making and tension among clinicians.

It is noted that some individuals have a greater capacity to process more information than others. In a study conducted by Chae, Lee, and Jensen (2016) on cancer information overload (CIO) they concluded that CIO was partly dependent on the individuals' ability and their motivation. The research demonstrated that CIO was influenced by both personal characteristics as well as environmental factors.

Figure 2.4 illustrates the relationship between decision-making accuracy and information load and the point at which the increase in information load reduces decision-making accuracy. An individual with greater cognitive capacity can tolerate a large information load with greater decision accuracy compared with someone with less cognitive ability.

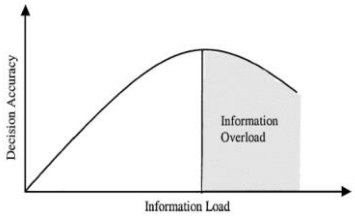

Figure 2.4 Decision-Making accuracy vs Information Overload (Eppler & Mengis, 2004)

Due to the proliferation of smartphones and other connected devices, most people receive a constant stream of information from multiple sources including social media, email, television, text, and websites. Feng and Agosto (2017) highlighted that mobile technology can contribute to IO. Tarafdar, D'Arcy, Turel, and Gupta (2015) outlined in a study of IT use, 43% of users described the use of smartphones as stressful due to the constant pressure of checking messages and remaining up to date with news and push notifications. Tarafdar et al. (2015) point out that technology-related stress impacts workplace productivity by contributing to work overload and associated feelings of reduced job satisfaction. Tarafdar et al. (2015) also highlighted that these issues also contributed to conflict in the workplace and at home.

2.8.1 The causes of information overload

In a historical study on information overload conducted by Eppler and Mengis (2004), they proposed that IO is influenced by two fundamental variables. These include information processing requirements (IPR) and information processing capacity (IPC). IPC refers to the individual's capacity to process information in its various forms. IPR refers to the operational conditions that exist during information processing, including for example time limitations or complexity of processing tasks. In general terms, a person with greater IPC is likely to have a greater capacity to tolerate a higher information burden. However, if the IPR conditions change for the same person and they were for example placed under greater time restraints to process the same quantity and quality of information, they would have a greater information burden and possibly more likely to reach a state of IO sooner.

In their information overload research framework, Eppler and Mengis (2004) summarised the causes of information overload into five main categories. These categories include the personal factors affecting the decision maker, the information characteristics of the message being communicated, the task and process parameters relating to the decision, organisational design, and the impact of IT.

There are several factors that impact personally upon the individual and their capacity to make decisions. Griffiths (2020) argues that human cognitive capacity is impacted by three fundamental limitations relating to time, computation capacity, and communication capacity. Herbig and Kramer (1994) highlighted the unique nature of human capacity. Individual factors include for example personal traits (Byrne, Silasi-Mansat & Worthy 2017), individual skill level, personal ideology (Owen, 1992) motivation and attitude (Muller, 1984), environmental conditions including noise and heat (Haka, 2008) amount of sleep (Swain & Haka, 2008) knowledge of IT (Owen, 1992) and memory recall ability (Giguere & Love, 2013).

The volume of information also impacts the individual's capacity to effectively process information in required time frames (Bawden, 2001). Tushman and Nadler (1978) describe how this is often linked to the number of decision options, where a high volume of information may often provide more options, creating a state where the individual seeks further information. Schneider (1987) reported that this often leads to an over-abundance of complex or irrelevant information, making the decision options more complex. Voorberg, Eshuis, van Jaarsveld, and van Houtum (2021) pointed out that gathering all possible pieces of information results in high-quality decisions but also yields high cost and effort. They argue that ultimately decision-making relies on a continuous trade-off between the effective acquisition of more information with the process of cost-efficient decision-making.

Tasks and parameter considerations relate to the operational conditions of the decision maker and their impact on information overload. Tushman and Nadler (1978) described how as the task becomes more complex, more thoughtful effort is required to make the decision. Tasks that require less decision-making effort are less likely to create a state of information overload. Schick et al. (1990) described how time restraints impact the quality of the decision and the point of information overload. As decision timelines compress, there is greater pressure to make the decision based on the information available whilst simultaneously having less time to effectively process the information. In research conducted by Paquette and Kida (1988), efficient

decision-makers faced with complex tasks used a reduced processing strategy, eliminating aspects not considered relevant to the immediate task, ultimately achieving time savings without compromising decision accuracy. In a more recent study of information overload with emergency physicians conducted by Sbaffi, Walton, Blenkinsopp, and Walton (2020) they found that the coping mechanisms by physicians experiencing IO included briefly pausing from the decision, summarising the issues by writing them down, prioritising the issues, delegating roles, keeping a to-do list and taking sufficient rest away from work.

Speier, Valacich, and Vessey (2007) highlighted the impact interruptions have on the decision-making process and the relationship with time constraints. As one might expect, the more interruptions or the more complex the interruption, the less time is available to work through the decision-making process on the original issue. Grise and Gallup (1999) discussed the impact that interdisciplinary work requirements have on the decision-making process, pointing out that often more than one unrelated decision is being made at any one time creating greater decision complexity. Bennet and Bennet (2008) argued that as the complexity of decisions builds upon further complexity, there is a general tendency for decision-makers to rely upon intuition and judgement. In research undertaken by Drugowitsch, De Angelis, Klier, and Angelaki (2014) they found that decision-makers continue to accumulate evidence to support decision-making over time and across sensory modalities when reaction time remains under the control of the decision-maker.

Organisational design factors often create an environment where decision-making is supported and the degree of collaboration in the workplace facilitates effective decision-making. Wilson (1996) highlighted organisations with a high degree of collaboration provide the tools and assistance to support decision making this includes for example KM technology or policy and procedural support. Edmunds and Morris (2000) discussed how the distribution of power and the sharing of information within an organisation makes organisations more adaptable to changes in the operational environment. In a recent case study conducted by Roetzel and Fehrenbacher (2019), they found that IO adversely affected management performance and that organisational structure supported by quality decision support systems can positively influence IO outcomes.

IT and the tools to assist the management and dissemination of information can impact on workers and their capacity to process information. Technology including

email, intranet, television, social media, and the push notifications associated with these platforms have the capacity to create a state of information overload (Bawden, 2001). Whilst technology often contributes to high volumes of information, it can also be used as a tool to manage information more effectively. Schultz and Vandenbosch (1998) highlighted that technology provides greater speed and access to higher amounts of information. More recently Bawden and Robinson (2020) argue that modern digital technology should not be blamed as the cause nor seen as the ultimate solution to IO and instead suggest that the solution is a combination of better-designed information management systems and effective personal information management strategies. This includes filtering, withdrawing, queuing and satisficing information so that a balance between information consumption and information understanding can be achieved.

2.8.2 Strategies to reduce or prevent information overload

Eppler and Mengis (2004) described four strategies to prevent information overload. These included adopting personal management strategies to manage information flow, introducing task and process parameters, structuring information so that it can be easily managed and interpreted, designing organisational processes that facilitate the flow of information across many levels and implementing IT systems that facilitate access to information.

Bawden (2001) explained that IO can often be prevented by managing information differently and that due to the complexities of the information environment, a broad form of information literacy is required. Jones and Willett (1997) suggested that information management training can often improve the ability to manage high flows of information and make better decisions. Edmunds and Morris (2000) described these processes as personal information management strategies. According to Jajibayova (2019), personal information management refers to the practice and study of activities that people perform to acquire, organize, maintain, retrieve, use, and control the distribution of information items to accomplish work-related tasks. These include for example structuring information into manageable packages (Koniger & Janowitz, 1995), prioritising information into importance and relevance to the decision being considered (Schick et al., 1990), and screening information to determine what information should be given priority (Van Zandt, 2001).

In an evaluation of usability methods for web development, Mvungi and Tossy (2015) highlighted that information should be structured using three principles. They pointed out that web content should be created so that users have the capacity to quickly identify the main concepts, information should be structured so that it can be easily found through browsing and filtering and information should be easy to access and share with other users.

Studies have shown the use of email as a prevalent method of file sharing (Whittaker, 2011). Hajibayova (2019) summarises a range of personal information management approaches to organising emails, these include regularly saving and deleting emails to ensure that only relevant information is retained (Balter, 1997), filing necessary information in folders so that it may later be used (Fisher, Brush, Gleave, & Smith, 2006), and archiving and filtering information into relevant topics so that it may be found later (Bellotti, Ducheneaut, Howard, & Smith, 2005).

By developing task and process parameters information can be managed more effectively. Schneider (1987) suggested that by implementing standard operating procedures, organisations provide clear decision-making direction for employees reducing the time they would otherwise spend on gathering information, considering options, and making decisions. Policy frameworks provide governance over areas including information management. Policies ensures information is shared and managed effectively whilst still complying with information privacy and human rights principles (Office of the Information Commission Queensland, 2023). Baldacchino, Armistead, and Parker (2002) highlight that communication and information expectations should be made clear to employees in the same way their performance management outputs are communicated. In Queensland for example the Right to Information legislation is the Queensland Governments' approach to giving the community greater access to information across all sectors of the community whilst providing an appropriate level of privacy protection for individuals (Office of Industrial Relations Queensland, 2023). Davenport and Beers (1995) reviewed how businesses implemented their information management processes. They noted that successful businesses integrated information systems into their business process ensuring the right information was being received only by the relevant business unit, reducing the flow of unnecessary information across the entire business.

Structuring information so that it remains relevant to the recipient reduces the volume of unnecessary information that often requires considerable time and effort to

read and consider. Arnold et al. (2013) describe information structure as the way human language is organised to reflect the content and purpose of information including the words and structures that make up sentences. Simpson and Prusak (1995) suggest information should be structured by the information provider so that it adds value. Arnold et al. (2013) point out that the linguistic form of information varies as a function and will depend on what the speaker wishes to focus on, what is already known, what information is considered the most important and what is considered background information. Hyland (2006) argues that effective writers consider their audience and adopt strategies that suit the purpose of their communication. Academic writing includes a wide array of communication practices and includes journals, reports, conference papers, essays and dissertations. According to Guerid (2021), academic writing should apply several main standards to ensure that writing is characterised by precision and clarity. These standards include ensuring the content of the report is relevant to the title or topic, the report follows a logical sequential argument that maintains clarity, ideas are clearly ordered and have an introduction, body and conclusion. The report should apply consistent word size, font, indentation, headings and placement of graphics and language should be well structured and apply the appropriate use of grammar.

Organisation design often determines the quality and quantity of information received within the organisation and externally. Burke (2009) explains that the shape of an organisation can impact productivity, culture, and management. In a study conducted by Andersson and Zbirenko (2014), organisational structure was found to impact how leadership and workers communicate and how quickly information flows between organisational hierarchies and departments affecting production and operational processes. In a study of an automotive parts organisation undertaken by Liebel, Tichy, Knauss, Ljungkrantz, and Stieglbauer (2018) they found that many of the organisational production and supply problems came from interpersonal challenges emanating from communication and coordination breakdowns, fluctuating and conflicting requirements and low product knowledge. In a study undertaken by Long, Perumal, and Ajagbe (2012) organisational structure and effectiveness can often depend on organisational information processing requirements determining whether employees receive either too little information or too much irrelevant information.

According to Bjarnason (2013), organisational communication gaps often depend on the complexity of the product, the size of the organisation, low

understanding of organisational and individual roles and unclear strategic goals. Hill, Jones, and Galvin (2004) argue that organisations grouped into functional structures benefit from knowledge exchange between people with common expertise and experience using the same resources. This improves the quality of coordination as managers have greater control over resources in the work unit and are more aware of performance outputs. Hill et al. (2004) highlight that as organisations grow and become geographically diverse, functional organisational design can often lead to control and coordination issues that lead to impaired communication and information sharing, reducing the coordination of organisational strategy. Most large organisations however use a multi-divisional structure. Multidivisional structure overcomes many of the functional structure issues as each business unit maintains its own support functions whilst the corporate office monitors divisional activities and exercises financial control over each division. Hill et al. (2004) point out that the bureaucratic costs of operating multi-divisions can be higher than functional organisational structures however they provide the benefit of enhanced financial and strategic control. The disadvantage of a multi-divisional structure is the added layer of bureaucracy at the corporate level which can often lead to an increase in bureaucratic cost, distortion of information flowing both up and down the organisation, competition for resources and competitive rivalry among divisions (Hill et al., 2004).

Technology is often delivered as a solution to KM and the prevention of information overload. Information technology is commonly deployed throughout organisations to support key organisational functions including management, accounting, finance, operations, and marketing (O'Brien & Marakas, 2006). Technology is essential for the management and communication of information across organisations and their external environments to support effective decision-making and the efficient application of resources. For reasons previously discussed the demand for information often exceeds the individual's and organisation’s capacity to manage and process. Technology in the form of decision support systems or KM systems often assists organisations and employees to manage the information burden. Knowledge workers in the United States (U.S.) average 20 hours a week managing email (Hemp, 2009) According to a study by Microsoft U.S. workers interrupted by email notifications take an average of 24 minutes to return to their suspended task (Hemp, 2009). Consequently, there are several programs designed to manage and reduce email burden through monitoring, archiving, prioritising, and spam blocking.

2.9 Organisational learning

According to Wang and Ahmed (2003), organisational learning is the collective individual learning of its workforce. Argyris and Schon (1978) considered individuals are agents for organisational learning and change. Organisational learning is an integral feature of all organisations that exploit their knowledge resources using effective KM to generate superior performance. This includes learning at an individual level and organisational level and is reliant on individual outcomes that contribute to organisational learning outcomes (Pemberton & Stonehouse, 2000) (Wang & Ahmed, 2003). According to Ikehara (1999), individual learning does not always necessarily lead to organisational learning. Successful learning organisations combine their learning strategy with their knowledge management process so that knowledge can be shared and leveraged across an organisation (Pemberton & Stonehouse, 2000). According to Swan, Scarborough, and Preston (1998), learning organisations focus on valuing, managing, and enhancing the individual development of employees. Dewah and Mutula (2018) argue that organisations with a learning culture favour the development of collective organisational memory so that knowledge and competencies gained through experience are transferred to new employees. Wang and Ahmed (2003) pointed out that an organisation's learning strategy should be to make competition irrelevant by opening new market opportunities through creative and radical innovation through knowledge creation. Learning organisations must be committed to maintaining a culture and vision that reflect a commitment to learning values and communicating this with employees (Giesecke & McNeil, 2004). According to Sleegers and Leithwood (2018), organisational learnings are the activities through which workers construct new knowledge or reconstruct existing knowledge to improve business processes and productivity. Pemberton and Stonehouse (2000) argued that the learning organisation is evolutionary by nature as workers and organisations share knowledge that is questioned, modified, improved, and amplified to produce a new higher knowledge base for the next cycle of growth.

Huber (1991) described five types of organisational learning; these include congenital, experiential, vicarious, grafting and searching. Congenital learning refers to the knowledge base of the founders of an organisation obtained during start-up and international experience (Brunell, Yli-Renko, & Clarysse, 2010). Experiential learning refers to knowledge obtained through direct experience; this includes the social aspect

of inter-organisational learning that takes place through knowledge transfer when new employees bring knowledge from their former employers to their new organisation (Huber, 1991). Vicarious learning includes knowledge-based strategy, practices and technologies gained through the indirect experience of others and derived from listening and observing rather than direct hands-on instruction (Baskarada, Chandran, Shokr, & Stewart, 2016) (Roberts, 2009). Grafting refers to knowledge gained during organisational mergers when knowledge resources are combined (Baskarada & Koronios, 2018). Searching refers to the process of knowledge acquisition through environmental scanning and research (Baskarada & Koronios, 2018).

Pemberton and Stonehouse (2000) described three organisational factors that impact organisational learning and the efficiency and effectiveness of KM Systems. These are culture, structure, and infrastructure. Creating a learning culture involves focusing on learning and knowledge creation through values, attitudes, and beliefs. Pemberton and Stonehouse (2000) explained that it includes an emphasis on learning and knowledge creation in an atmosphere where individuals feel empowered and trust new approaches to business. This creates new competencies that increase organisational capacity. Pemberton and Stonehouse (2000) explained that an organisational structure that supports learning empowerment encourages cross-functional communication and facilitates knowledge management. It involves designing a system that encourages information sharing and the creation of new knowledge. This includes training workers to participate in information exchange and to be aware of factors that limit information exchange.

IT plays an important role in providing the infrastructure needed to support network structures and organisational learning. Media and communications technology provide the functionality to support the creation, storage, sharing and transfer of knowledge in a learning organisation.

The framework by (Pemberton & Stonehouse 2000) shown in Figure 2.5 demonstrates how knowledge management and organisational learning inputs and outputs are generated from within an organisational context. The organisation context includes structural, cultural and infrastructure components. This work-based study will focus on the development of technology within the organisation’s infrastructure component. Whilst this research will not focus on cultural or structural elements of KM research, it is important that these contexts are acknowledged as contributors to the KM process.

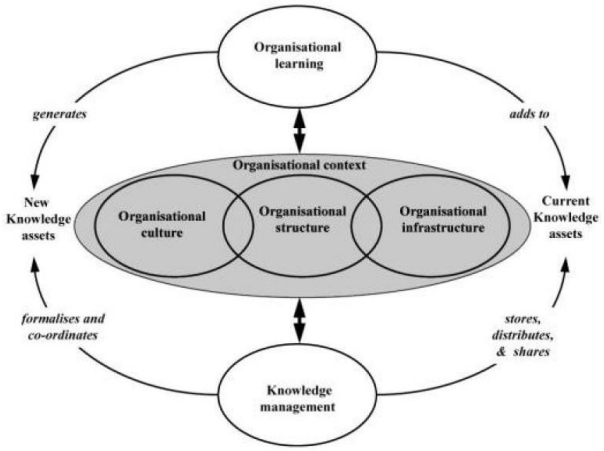

Figure 2.5 Organisational Learning and knowledge management. (Pemberton & Stonehouse, 2000, p. 186)

Understanding the role of organisational learning in IT development and business process design is important for managers and human resource practitioners. Bala and Venkatesh (2007) highlighted that IT assimilation into organisational business processes creates significant change management challenges that often impede IT or business process rollout. Purvis, Sambamurthy, and Zmud (2001) argued that the value of IT innovations cannot be fully realised until they are assimilated into organisational processes and routines. Roberts et al. (2010) described how managers often commit substantial resources designed to assimilate IT into the business' processes without achieving the intended business outcomes. There are several factors that affect the ability of an organisation to assimilate its IT innovations into its business processes. Chatterjee, Grewal, and Sambamurthy (2002) pointed out that in some cases top-level managers fail to support the development and implementation of new IT and so this level of commitment is reflected equally across the organisation. Karimi, Somers, and Bhattackerjee (2007) highlighted that organisations often fail to provide sufficient training or business process support during the implementation of a new IT platform. Ramamurthy and Sinha (2008) suggested that IT solutions often fail to meet organisational or user needs by failing to provide the required functionality or designing the system with features that are overly complex and difficult to use.

Wang and Ahmed (2003) argued that for organisations to have a successful learning strategy they need to have effective KM processes that focus on capturing and

leveraging upon the collective learnings of individuals, an organisational culture that supported a learning environment and encouraged continuous improvement. An effective KM System is supported by a system that facilitates the acquisition and creation of knowledge. This includes the capacity to refine and disseminate knowledge so it can be shared later to be exploited for organisational benefit (Fiol, 1994). Collective organisational learnings occur when individuals within the organisation develop solutions to organisational problems. Individual learning activities are facilitated by a series of factors described as an organisational learning system. The lessons learnt by the individuals then become the organisational learnings (Argyris & Schon, 1978).

Creating a culture of learning is important for any organisation seeking to implement a supportive learning environment. According to O'Reilly and Chatman (1996), culture guides and shapes the values, behaviours, and attitudes of employees. Culture enables an organisation to use its knowledge to achieve organisational goals, creating a cohesive structure and understanding of organisational learning principles for its employees (Wang & Ahmed, 2003).

Organisations are considered information processing systems, acquiring, interpreting, distributing, and storing information (Wang & Ahmed, 2003). There are two streams of System theory, these are closed and opened systems. In a closed system, knowledge is acquired only from within the organisation. In open systems, knowledge is acquired both from within the organisation and its outside environment, ultimately leveraging organisational capacity by exploiting knowledge from both the internal and external environment. According to Pedler, Burgoyne, and Boydell (1991), the highest level of organisational learning is adapting to the environment, learning from their workforce, and contributing to the learning of the wider community. Learning organisations with a culture of continuous improvement achieve ongoing innovation through effective learning mechanisms (Wang & Ahmed, 2003). By creating a state of constant innovation, organisations identify operational efficiencies reducing input costs and improving product quality. By implementing a constant state of improvement through a culture of ongoing learning, organisations can be better placed to achieve competitive advantage.

2.10 Systems theory, systems thinking and application design

Knowledge is expressed within multiple organisational systems (Chun, Sohn, Arling, & Granados, 2008). Goh (2005) proposed that systems can be synthesised into three main organisational knowledge-based areas that include the organisation's 'products, processes, and people'. 'Products' refers to the way knowledge is structured and mapped. This includes the development of knowledge databases and embedding knowledge in new products and services (Goh, 2005). 'Processes' refers to the way knowledge is captured and re-used, including information-sharing processes, and capturing lessons learned. This includes measuring and managing the value of KM (Goh, 2005). 'People' refers to the creation of knowledge or intellectual capital teams, the formation of people-oriented knowledge centres and using collaborative technology for knowledge exchange between people and work units (Goh, 2005).

This study will draw upon the theoretical framework of Systems Thinking by conceptualising the SR Application as an integrated system that is comprised of several sub-systems that have a combined purpose to deliver operational information to police in a more efficient and effective manner. According to Hirschheim (1983), the Systems Thinking framework allows researchers to examine the structures and behaviours of systems and the way they interact with the environment. Systems Thinking originated from General systems theory proposed by Ludwig von Bertalanffy (1968). Matook and Brown (2017) argue that despite the concepts being related it is important to distinguish the difference between Systems theory and Systems Thinking. Hirschheim (1983) describes Systems theory as concerned with the General theory of systems whereas Systems Thinking attempts to study the behaviour and properties of actual systems. Matook and Brown (2017, p. 313) state: "At the core of Systems Thinking is the understanding of a system as an organised whole that interacts with the environment for the purpose of exchange". Aristotle first claimed that knowledge is derived from the understanding of the whole and not that of the single parts. Systems theory is an interdisciplinary theory that provides the framework with which phenomena can be investigated from a holistic approach (Capra, 1997). According to Matook and Brown (2017), information systems researchers have used Systems theory as a foundation for study because it offers a theoretical grounding to the way different systems are described by using a common set of characteristics and definitions.

Systems Thinking focuses on the study of the whole of the system and not the individual parts that make up a system (Mele, Pells, & Polese, 2010).

Ng, Maull, and Yip (2009) define a system as a defined entity that is a coherent whole made up of internal elements and separated by a perceived boundary that distinguishes the system from external elements. Von Bertalanffy (1968) defined a system as a complex set of interacting elements. Mele, Pells, and Polese (2010) submitted that systems exist in different forms and with different levels of complexity and are found in nature, the economy, science, society, and information systems. Figure 2.6 illustrates the parts of a system illustrating the internal environment is made up of organisational processes that ultimately deliver an output. The output ultimately provides feedback into future inputs that make up the external environment. The system boundary can be closed or open, separating the system from the outside environment. Systems open to the external environment are called open systems while the opposite is described for closed systems. Each element inside the system may be a sub-system of the larger system. According to Matook and Brown (2017), all systems are combined in hierarchical levels that correspond with a lower-layered sub-systems or higher-layered super systems. Systems open to the outside environment are subject to inputs that can influence the system sub-systems and may lead to a change in the entire system (Ackoff, 1971). System complexity is determined by observing the number of parts in the system and the interrelationships (Klir, 1991). Ackoff (1971) outlined that to account for the behaviours of systems one needs to examine the state of a system at a point in time. Hirschheim (1983) argued that using Systems Thinking enables researchers to examine structures and the behaviour of systems.

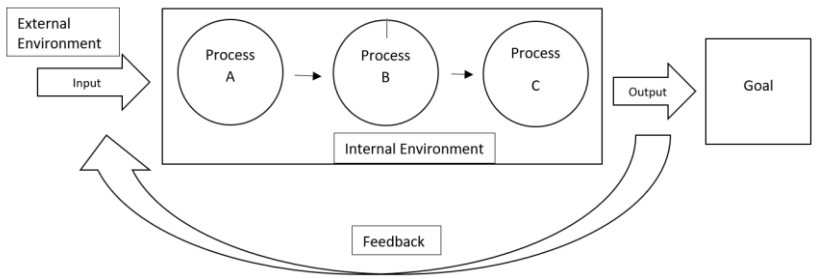

Figure 2.6 Elements of a System

Systems theory acknowledges that the traditional form of scientific enquiry through reductionism is not obsolete but is only a portion of the Systems theory of research that also considers the interaction and relationship of the parts of a system (Bridgen, 2017). According to Luhmann (1990), Systems theory focuses on the interaction between the parts and the results of the events they produce through shared purpose. Mele, Pells, and Polese (2010, p. 126) stated it is a "consideration of the observed reality as an integrated and interacting unicum of phenomena where the individual properties of the single parts become indistinct." Von Bertalanffy (1968) argued that to fully comprehend a system in its entirety it must be observed not only from an analysis of its individual parts but also from its entirety where it can be observed from a holistic perspective.

2.11 Biomatrix systems theory

The Biomatrix systems theory is an integrated systems theory that combines many of the concepts previously introduced by Systems Theorists as well as introducing several additional principles into a single framework (Dostal, Cloete, & Jaros, 2006, p. 2). The term Biomatrix comes from the Greek word bios meaning life and matrix meaning mould, representing an abstraction for the pattern of life and its organisation (Dostal et al., 2006, p. 21). According to Wigger (2008) while many of the views and systems models mostly focus on one area of systems theory the Biomatrix systems theory provides a theoretical framework that integrates all, uniting the variety of systems concepts to meet the demands of the information age.

Systems theory is an interdisciplinary theory that provides the framework with which phenomena can be investigated from a holistic approach (Capra, 1997). According to Matook and Brown (2017), information system researchers have used systems theory as a foundation for study because it offers a theoretical grounding to the way different systems are described by using a common set of characteristics and definitions. The fundamental focus of the Biomatrix systems theory is that it is a web of interacting activity systems that converge into larger entity systems. Any change to an activity system ultimately causes observable change within the entire system (Dostal et al., 2006).

The Biomatrix systems theory focuses on system processes whereas General systems theory tends to emphasise structure (Dostal et al., 2006). Ng, Maull, and Yip (2009) define a system as a defined entity that is a coherent whole made up of internal

elements and separated by a perceived boundary that distinguishes the system from external elements. The Biomatrix system asserts that everything we observe in the universe is connected by a web of interacting systems entwined by a web of activity systems (Dostal et al., 2006). The Biomatrix system illustrated in Figure 2.7 is described using the analogy of a fishing net that is made up of threads representing activity systems that are entwined together to form knots that represent entity systems. The analogy of a knot according to Dostal et al. (2006) illustrates a worldview in which entities emerge from the interaction and focalised fields of activity systems. Figure 2.7 illustrates the distinction between the General systems theory and Biomatrix systems theory, highlighting system structure through the separation of boundaries and the interconnection of activity systems with entity systems.

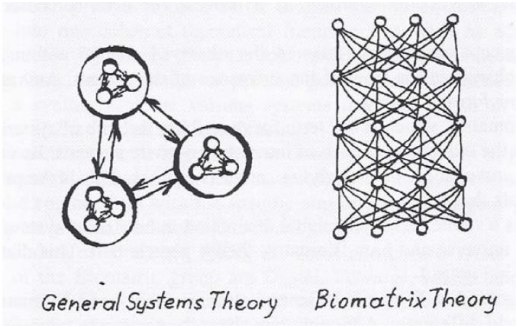

Figure 2.7 Distinction between the General systems theory and the Biomatrix systems theory (Dostal, Cloete, & Jaros, 2006, p. 4)

Activity systems are organised processes that are structured to achieve specific aims (Dostal et al., 2006). Entity systems are special structures that emerge from the interaction of activity systems they include for example a person, group, or organisation (Dostal et al., 2006). Wigger (2008) describes how activity systems can often shape the establishment of a new entity system and that making a change to any one Activity system can create a flow-on effect that can impact the entire system. Activity systems consist of interacting fields of matter, energy, and information. Using the SR App and QPS Email systems as examples of activity systems, they are both uniquely made up of matter, energy, and information (MEI) when combined become a KM System where operational information and intelligence are managed and

disseminated. Operational information and intelligence are the outputs created by the activity system. 'Matter' is represented by the hardware and software technology that supports the management and dissemination of operational information and intelligence. 'Energy' is represented by the energy required in the activity system to manage or disseminate operational information and intelligence. This includes for example the level of effort or enthusiasm by the user to participate in the activity system by using the technology to manage or disseminate operational information and intelligence. 'Information' is represented by the type of operational information and intelligence managed and disseminated in the activity system (SR App and QPS Email).

Entity systems are formed by the interaction of activity systems. Dostal et al. (2006) explain that the entity system is more than the sum of the interacting activity systems as each entity system has a unique pattern of organised activity systems. The structure of the activity system refers to the stable interaction of matter, energy, and information (MEI). The configuration of MEI is determined by the elements of the system. 'Structure' provides a regulatory force on process, ensuring the system operates according to a stable pattern of behaviour (Dostal et al., 2006). Entity and activity systems both exhibit structure. This research will focus on the SR App and QPS Email as activity systems. This thesis argues that using Goh's KM design principles based on people, process and products in the development and design of the SR App might optimise the flow of MEI, thereby potentially facilitating the more effective management and dissemination of operational information and intelligence to police.

2.11.1 Development of the Information Delivery Assessment Model using Biomatrix activity system and KM Principles

The review of the literature shows that there are several models that can be used to evaluate a program or organisational design. These models are based on a variety of theoretical foundations that include Systems theory, Process theory, Result theory, Economic theory, Actor theory and Program theory (Hansens, 2005). The Biomatrix systems theory has been applied as an evaluation tool to evaluate organisational re-design Wigger (2008) and more recently as a proposed framework for Covid 19 response (Hassan et al., 2020). These approaches however have focused on the

application of the seven aspects of Biomatrix system design that include ethos, aims, process, structure, governance, environment, and substance as an assessment framework. This research is unique in that it combines the Biomatrix activity system elements of matter, energy, and information (MEI) with Goh's KM principles of people, process, and product to create a model that will be used to evaluate the management and dissemination of operational information and intelligence to police. This model has been named the Information Delivery Assessment Model (IDAM). By applying this model, researchers will be able to critically evaluate the capacity of the SR App and QPS Email systems to effectively manage and deliver information. This model will provide researchers insight for the future design of KM systems.

2.12 Summary and implications

The literature review first discussed and contrasted the concepts of information, knowledge and intelligence explaining how each of these overlaps depending on the context to which the term applies. One of the most persuasive arguments that combine the concepts of information, knowledge and intelligence has been provided by Gottschalk's (2009) Knowledge Continuum in Policing Model. This model describes knowledge as data and information that has undergone a process of analysis and refinement, leading to a higher state of understanding and knowledge.

There is a wide degree of interpretation as to what the definition of information is and how it conceptually applies to other terms including knowledge, data, and intelligence. Information has been described as facts or concepts by Hicks, Culley, Allen, and Mullineux (2002), anything that can change a person's mind by Butterfield and Ngondi (2016) the transfer of knowledge by Hicks et al. (2002), and as data that includes facts or numbers by Wilson (1996). Information is often considered a resource, a commodity, a perception, or a casual factor that shapes context (Braman, 2011). Information is essential in a policing environment and plays a critical role in the decision-making process and the development of operational, tactical, and strategic planning.

According to Lombardi (2004), knowledge relates to the notion of information, and it is assumed that information provides knowledge to those who receive it. Knowledge is an abstract concept that has many interpretations. Knowledge was defined as structured and organised information by Burks (1958), as experienced by

Perez-Araos et al. (2007) and as validated truth by Zins (2007). Sharp (2006) described knowledge as being a transient concept that constantly changes over time and is that which is most important for the organisation depending on their own knowledge and information needs. There is a consensus, however, that knowledge is made up of tacit and explicit elements that depend on the personal values and skills of the information user. Intelligence is conceptually considered the acquisition of knowledge through the processing of information. Organisations use knowledge to increase the effectiveness of their decisions ensuring corporate strategy accomplishes organisational goals. In a policing context, intelligence contributes to operational, tactical, and corporate strategy.

Effective KM creates organisational value by capturing, sharing, and disseminating both explicit and tacit knowledge ensuring all employees have access to the same information. These allow organisations to harness knowledge for innovation leading to the creation of new more effective and efficient processes that ultimately contribute to improved performance and in a policing context greater public safety. While the benefits of effective KM are generally well understood, the challenges of facilitating information sharing remain. Organisations must maintain KM processes that have a clear connection with organisational needs and have the technical capacity to develop and maintain supporting IT systems that encourage information sharing.

The QPS intelligence cycle is generally accepted as a linear process of directing, collecting, collating, analysing, and disseminating information. There is also a counterargument that the intelligence process is in fact non-linear and that due to the complexity of contemporary intelligence environments, the traditional cyclical model is outdated. This thesis makes no attempt to delineate, define or change the terms of the intelligence cycle, information, knowledge, or intelligence and for the purposes of consistency will refer to these concepts generally as ‘operational information and intelligence’.

This thesis discusses organisational and environmental barriers associated with KM and the impact on decision-making processes. High volumes of disorganised information can often be overwhelming and contribute to information overload. This can often contribute to poor decision-making and potentially create unnecessary organisational costs. Information overload can be affected by several factors, including the individual’s cognitive capacity and personality traits. Environmental conditions can also impact the individual and their capacity to make decisions. Many of these

factors however can be mitigated through technology, organisational design and/or the application of personal information management strategies that prioritise and sort information into small amounts of processable information. Technology can also be designed to manage and disseminate information better by improving users' information processing capacity and information processing requirements. However, technology that is poorly designed can have the opposite effect.

Organisational culture can play a significant role in the introduction of new KM practices and technology. Organisations that fail to support the implementation of new technology by promoting a knowledge-sharing culture will often fail to achieve the intended benefits. According to Whelan (2016) policing culture often creates a high level of resistance to organisational change, making the implementation of new strategies difficult to achieve. Information and knowledge that are provided from an outside source are generally not trusted and according to John and McQuire (2016) can often contribute to a lack of an 'intelligence culture' that leads to more inefficient work practices. Law enforcement agencies may therefore be slow to adopt new KM technology designed to enhance information sharing and promote organisational learning. This phenomenon will ultimately impede the organisation's capacity to keep up with environmental change affecting service delivery and operational cost.

Intelligence-Led Policing (ILP) relies on the accuracy of intelligence and operational information to formulate a strategy so that resources are used in the most effective and efficient way. According to Burcher and Whelan (2018), ILP is often inhibited by inaccurate information recording, poorly designed supporting software systems and ineffective intelligence stakeholder relationships. This research seeks to enhance the capacity to manage and disseminate operational information and intelligence to police through the design of a software solution that applies KM principles to enhance decision-making capability and the delivery of ILP strategy.

Biomatrix systems theory is based on Systems theory and Systems Thinking concepts. Systems theory is based on the study of interacting actors within a system and the subsequent outcome of the interaction (Mele, Pells, & Polese, 2010). Systems Thinking is an approach to understanding how the system interacts with its environment (Matook & Brown, 2017). The Biomatrix Systems theory is an integrated systems theory that according to Wigger (2008) combines many of the systems concepts to meet the contemporary demands of the information age. The fundamental concept however of Biomatrix systems theory is that it is a web of interacting activity

systems that converge into larger entity systems. The Biomatrix systems theory proposes that activity systems are made of elements of matter, energy, and information.

Currently, the QPS Email System is the primary method used to disseminate operational information and intelligence to police. QPS Email is also used for many other matters, creating a high volume of unmanaged information. This system makes it difficult for police to find the operational information and intelligence they require and contributes at times to individual states of information overload. To enhance the management and dissemination of operational information and intelligence to police this research will apply Goh's (2005) KM principles to the design of a new software solution.

This research will also lead to the development of an evaluation model to determine the effectiveness of the SR App and QPS Email system in managing and disseminating operational information and intelligence to police. This model will be developed on the theoretical foundations of Dostal et al. (2006) Biomatrix systems theory and Goh's (2005) KM principles. Evaluation using this model will determine whether operational information and intelligence can be managed and disseminated more effectively using KM principles.

Hislop et al. (2018) noted that there has been a general decline in the level of practitioner involvement in academic publications on KM research and therefore there is a risk that KM may become purely academic with limited practical relevance to organisations. This study seeks to contribute to KM research by applying KM principles to the design of new KM technology. The results of this study and the lessons learnt from the practical application of Biomatrix activity systems theory and KM principles will provide the foundation for future research and the practical application of future KM design.

Chapter 3: DEVELOPMENT OF SOFTWARE SOLUTION SR APP

3.1 Introduction

Goh (2005) proposed that effective KM strategies create a greater capacity for organisations to use their knowledge assets to drive performance and encourage innovation. Goh proposed nine KM initiatives that he summarised into three principles he lists as products, processes, and people. In the product design category, he argued that knowledge must be structured so that it can be easily found and searched. He also suggested that knowledge should be embedded into new products, reducing the duplication of information, and consolidating information so that it may be found in one place. This included capturing information that created greater organisational value and can be added to the organisation's knowledge assets.

In the process design category, Goh argued that KM systems should be designed to increase the capacity to collect and reuse information so that organisations can maximise decision-making potential. This included recording lessons learnt and the capacity to measure the value of knowledge resources. In the people design category Goh suggested that KM Systems should facilitate the formation of intellectual capital teams so knowledge can be shared throughout the organisation and the organisation is able to leverage upon the skills and experience of the entire workforce. This chapter describes the application of Goh's KM principles in the design and construction of the software solution developed for the purpose of managing and disseminating operational information to police. The software solution has been named the SR App which is an abbreviated term referring to the Southern Region Application.

3.2 Product design

3.2.1 Developing knowledge databases

Access to the SR App is obtained through a desktop icon that has been developed through Microsoft PowerPoint. The icon was designed to be a memorable logo that was distinctive to the Southern Region. The logo was also designed with the foresight that it could be used as a theme for other regions seeking to implement a similar KM

System. The logo was designed with bold white writing with the letters SR on a red background. A logo is an important part of developing a brand for Lievens (2007) who argued the importance of branding because it highlights the organisation's value proposition to attract a targeted audience and involves carrying a ‘promise’ to deliver a product or service. The researcher then engaged with the QPS Mobile Capability Centre, Organisational Capability Command who through the appropriate chain of command authorised a website shortcut to be added to Apps@Work so that the SR App icon and weblink could be pushed to all QPS desktop computers and mobile devices. Apps@Work is a storefront enterprise app. It is an application distribution library used to publish approved in-house and third-party mobile apps to end users (mobileiron.com 2019). Because the website shortcut links directly back to the QPS SharePoint environment there was no requirement to have the application QPS whitelisted as would have been the case for other third-party applications.

The SR App was built on a Microsoft SharePoint platform that provides the technical infrastructure to support a KM system. SharePoint is a web-based collaborative platform that integrates the Microsoft Office suite of products; it is primarily a document management and storage system being used by the QPS. SharePoint is highly configurable and can be designed to meet several organisational needs and functionality including event handling workflows and searchability (SharePoint-Wikepedia, 2018). Sharepoint incorporates a variety of collaboration and communication technologies into a single web-based environment that provides the opportunity for members to contribute to site content (PCMag Australia, 2018). SharePoint has the capacity to host several environments including external web pages, internal intranet sites or access to folders from different sections of the organisation with its document management capability (PCMag Australia, 2018). SharePoint provides a toolset for organising content, managing documents, sharing knowledge, providing collaboration between individuals and teams and finding information and people (Ameexusa.com, 2018). SharePoint allows the developer to focus on forward development knowing back-end development is already established (PCMag Australia, 2018). SharePoint allows members across a large dispersed organisation, to view, share and contribute to documents. The default site in SharePoint is called a team site which provides the infrastructure for members to view files, other applications and web pages and to track site activity. Access to documents can also be limited to specific

team members if required. The SharePoint platform offers a flexible knowledge structure that allows the developer to include various topics and subject title options within team sites, subsites and pages. The application portal was designed to remain as a desktop icon on the home screen of a computer or mobile device. The application can be seen in Figure 3.1 which shows a screen image of the SR App on a computer desktop. In Figure 3.1 the SR App has been highlighted with a yellow circle. Access to the SR App can be made by double-clicking on the desktop icon. The SR App opens by default to the intelligence site homepage.

Figure 3.1 Desktop image of SR App icon

Figure 3.2 shows an image of the SR App intelligence page. The intelligence page incorporates several design features that facilitate the searching and filtering of information. These include a subject/area filter function that allows intelligence to be filtered according to the police district or topic area most relevant to the intelligence or information product being searched. The intelligence page also includes a social media blog function that allows for high-priority intelligence to be posted. This feature allows for intelligence or information to be immediately viewed without the necessity of opening new intelligence submissions as a separate file or requirement to search for it via the filtering function. Users can scroll through the blog site using the same method adopted by mainstream social media platforms. This allows users to review and absorb large amounts of information without the necessity of individually opening

numerous separate documents that can often take time to download and open. Not all intelligence or information is blogged, and the urgency or importance of the intelligence product is often considered before posting or using this function. The decision to post this information on the blog is usually determined by an intelligence officer however the functionality is available to all officers. The search filter options in the home page include the location of intelligence in the relevant police districts (Darling Downs District, Ipswich District, Moreton District, South West, Regional Office) or the topic where the intelligence or information is most relevant. Examples of topic areas include; Be on the lookout for intelligence updates (Bolo), Catch Intelligence (Crime and Traffic Connecting on Highways), Counter Terrorism, Crime Prevention, Criminal Motorcycle Gangs (Criminal MCG), Events, Infrastructure Maps, Missing Persons, News, Officer Safety, Road Safety, Strategic Intelligence, Video Images of CCTV and Wanted Persons. The blog and intelligence filters are circled in yellow in Figure 3.2

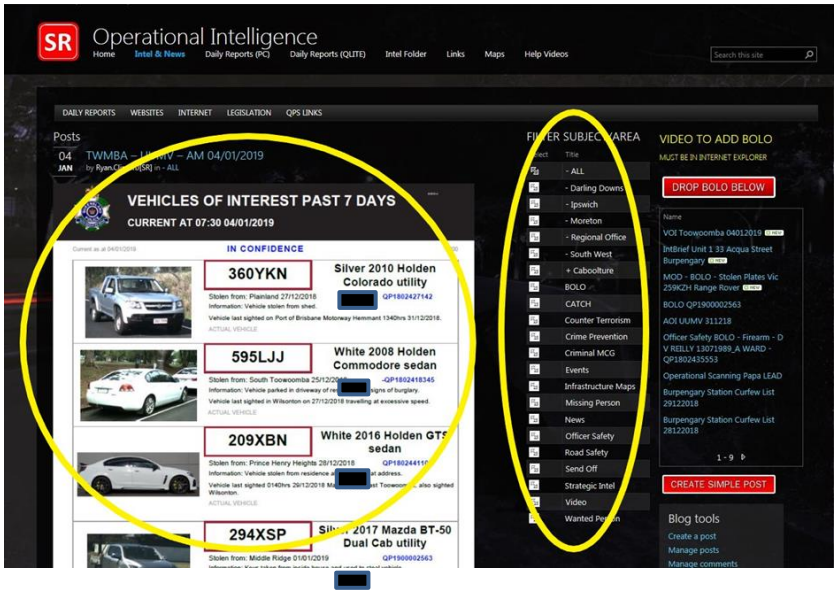

Figure 3.2 Intelligence home page

In the top right corner of Figure 3.3 is a search field (circled by yellow) that has the functional capacity to search keywords in all intelligence documents including both

the title of a document and its content. The search function can read both word and pdf documents as well as the titles and metadata of videos, photographs and other files. This function allows users to search and find multiple documents that match specific keywords allowing intelligence and other information from multiple sources to be connected. If for example, police officers were searching for information in relation to a silver-coloured Commodore sedan they would type the details of the vehicle in the search field using the following format, *silver commodore sedan*. The search function would then list all intelligence and information files that include the combined words silver Commodore sedan in either the document title or its content. The search is not word order dependent and the query can be done using all or part of the key search words. The words must however start and end with a * icon so the search is limited to only documents where the words ‘silver’, ‘commodore’ and ‘sedan’ are used in part or full combination.

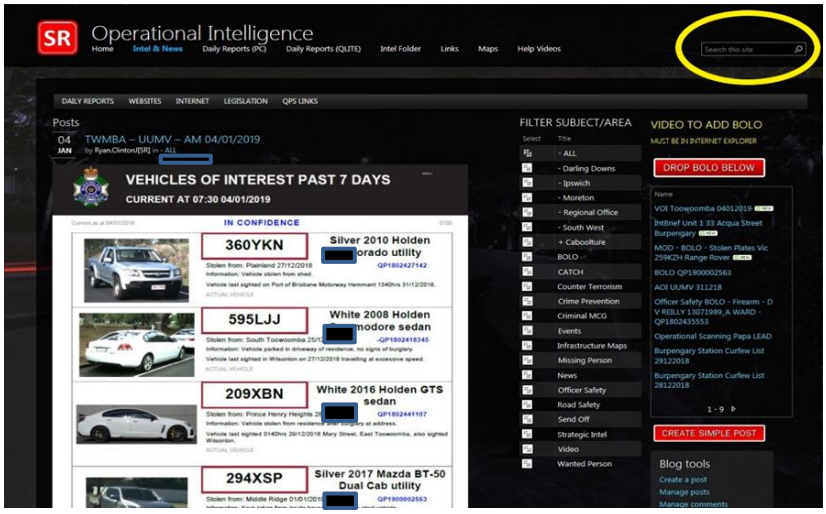

Figure 3.3 Intelligence home page search function of the SR App

Figure 3.4 shows the results of the search using the search function highlighted in Figure 3.3. The search provides results from several different intelligence and information sources and lists them in order from the most recent to the oldest intelligence or information submissions.

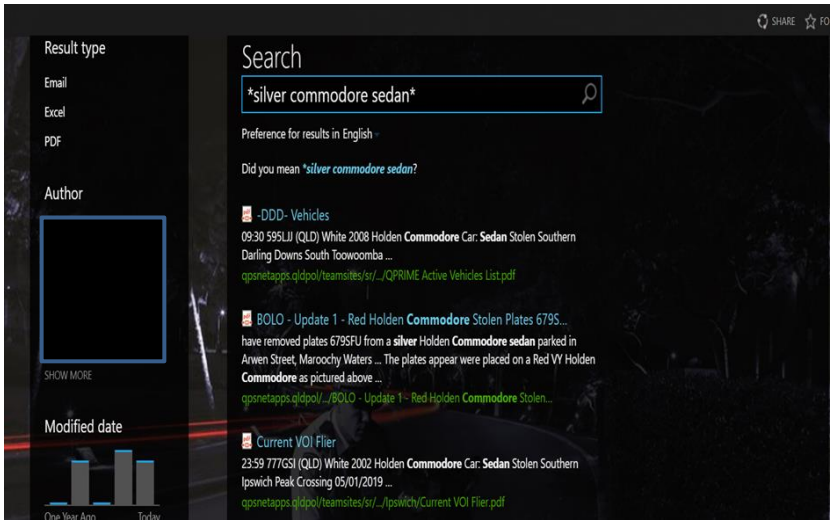

Figure 3.4 Screenshot of SR App search function results

Figure 3.5 demonstrates the drag-and-drop function that allows users to drop intelligence or information documents into the SR Intelligence database. This function was designed to facilitate the process of information sharing by adopting a simple process to upload information that involves dragging any file from the desktop directly into the drag-and-drop window. The window highlighted with the yellow circle in Figure 3.5 shows the most recent documents added to the database and allows officers to confirm they have uploaded their documents successfully. Officers can quickly determine what intelligence or information products are new to the database and determine whether they are relevant to their operational duties. These products can easily be reviewed by intelligence analysts and posted on the blogging site if necessary.

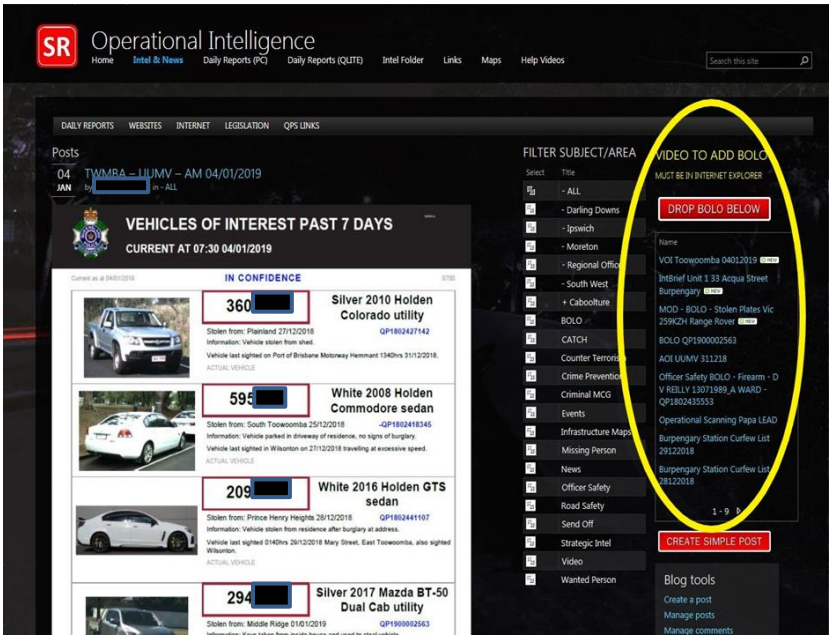

Figure 3.5 Screen shot of SR App drag and drop function

Figure 3.6 displays a screenshot of the SR App page highlighting with a yellow circle the top channel search bar that provides links to intelligence documents and other files. These links include access to a Home page, Intelligence and News page, Daily Reports (PC) page, Daily Reports (QLite) page, Intelligence Folder Page, Links page, Maps page and Help Videos page.

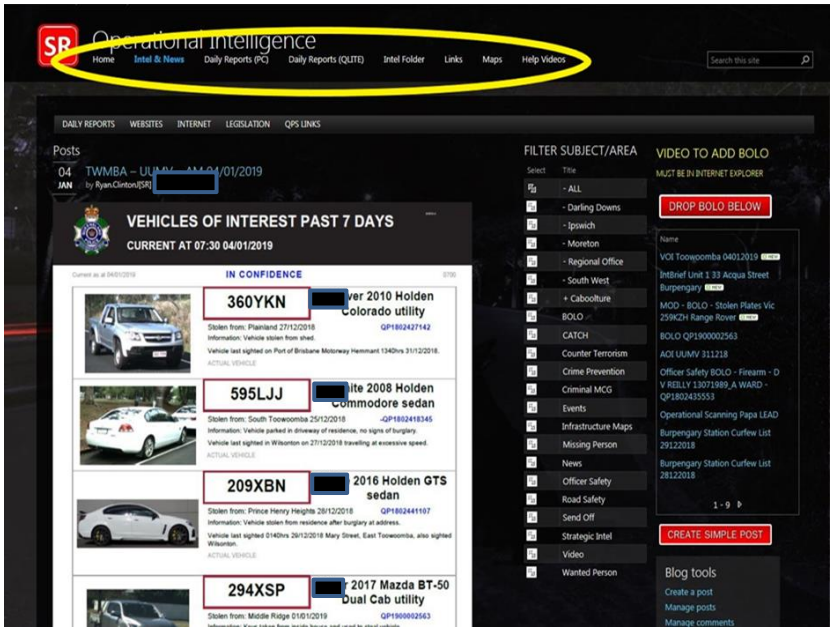

Figure 3.6 Screenshot of SR App operational intelligence home page highlighting top channel search bar

The Daily Reports (PC) and Daily Reports (QLite) pages have been designed in the same format. These pages provide access to the same information and intelligence products however the information platforms have been separately designed to suit the type of device the information is accessed from. A screenshot of the Daily Reports (QLite) is displayed in Figure 3.7. The Daily Reports (PC) page provides better photo and document image quality because of the capacity to download larger files and information from a desktop computer. The Daily Reports (QLite) page has been designed to use less memory to enhance remote downloading capacity from a mobile device. The Daily Reports folder (QLite and PC) is divided into the four Southern Region Police Districts and a recent folder. Each district maintains their own operational intelligence products which have been designed to meet its unique operational needs. These documents follow a standard format and are uploaded daily to the relevant district folder by their intelligence sections. The most recent intelligence or information product uploaded by each district also appears in the recent folder which appears on the same site next to the district folders. Officers can either search

and review intelligence or information products in specific district folders or choose to review all intelligence and information products uploaded across the entire region and located in the ‘recents’ folder.

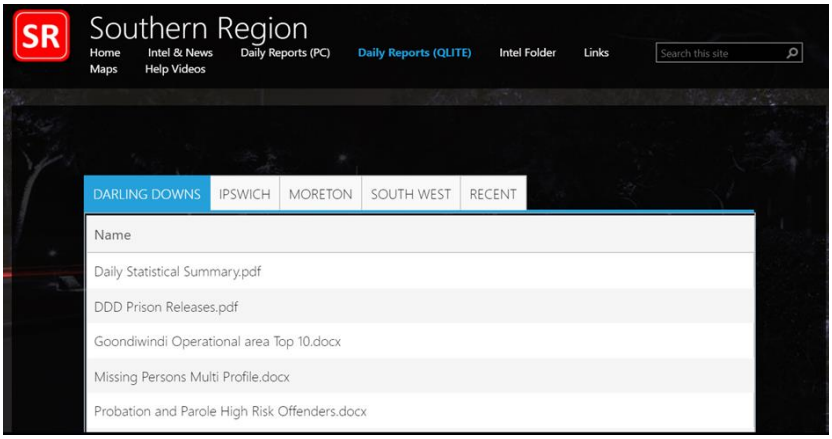

Figure 3.7 Screenshot of daily operational information and intelligence reports (QLite)

3.2.2 Embedding knowledge in new products and services

During the development of the SR App, it was important to consider that the intelligence sections in each district were able to continue to identify their own intelligence that was unique to their areas and relevant to the demand drivers of operational officers and managers. Table 3.1 provides a list of the titles of all intelligence and information products developed and uploaded by each district. These products are developed and uploaded daily so that the information remains up to date and is trusted by users as the single point of truth. Whilst the topic of the product does not change, the content does. New intelligence products can be uploaded onto the SR App and included in district folders as when is necessary.

Table 3.1 *Summary of intelligence products by police district*

Darling Downs	**Ipswich**	**Moreton**	**South West**
Daily Crime Summary	Current Curfew Flier	Curfew Sheet Juveniles Moreton North Patrol Group	Charleville Patrol Group Briefing Sheet
Prison Releases	Daily Briefing Sheet	Curfew Sheet Juveniles Moreton South Patrol Group	Dalby Burnett Patrol Group Briefing Sheet
Goondiwindi Operational Area Top 10 Offenders	Prison Releases	Moreton North Patrol Group Hot Spots	Dalby Persons of Interest
Missing Persons Multi Profile	Return to Prison Warrant List	Moreton South Patrol Group Hot Spots	Dalby Warrant List
Probation and Parole High Risk Offenders	Top 10 Offenders	Consorting Daily Information Report	Longreach Patrol Group Briefing Sheets
Q Prime Active Vehicles list	Vehicles of Interest	Moreton Daily Statistical Summary	Curfew Flier
Stanthorpe Operational Area Top 10 Offenders	Weekly Crime Bulletin	Moreton Operational Summary	Parole Check List
Country West Top 10 Offenders	Weekly Projection Sheet	Vehicles of Interest	
Lockyer Valley Top 10 Offenders	Missing Persons	Active Vehicles	
Toowoomba-Drayton Top 10 offenders	Parole Conditions	Moreton South Persons of Interest	
Top 5 Juvenile offenders		Moreton Top 10 Prison Releases	
Wanted Persons – Return to Prison Warrants			
Warwick Operational Area Top 10 Offenders			
Warwick Patrol Prison Releases			
Weekly Crime Projections			

The Quick Links page provides a link to all stations and districts within the Southern Region that wish to link their organisational unit to the SR App. Each station and district has commenced the development of sites that provide unique tools and information products that enhance the operational capacity of their division or district. This includes for example tools to manage shift equity, special duties allocation, access to local station instructions, contact lists, and station auditing records. These sites have not been included in this conclusion as they do not relate specifically to operational intelligence capacity however their development, independent of this research, supports Goh's argument that effective KM systems facilitate constant innovative outcomes. Figure 3.8 displays a screenshot of this page in its current format for information.

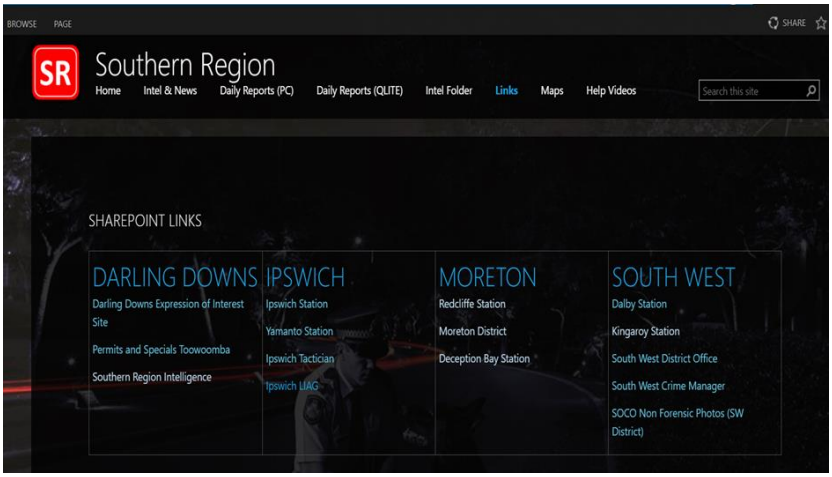

Figure 3.8 Screenshot of Southern Region quick links page

The Maps Site Page provides access to maps, floor plans or satellite images of all major shopping centres, schools and critical infrastructure within the Southern Region. This information is available on desktop and mobile devices. This information also includes the contact details of key stakeholders. Figure 3.9 displays a screenshot of the Map Site Page. Figure 3.10 displays an example of a floor plan of a major shopping centre that has been uploaded onto the Map Site. Figure 3.11 displays an example of a satellite image of an education facility that has been uploaded onto the Map Site. Figure 3.12 displays an example of a map of an educational facility that has been uploaded onto the Map site. The Map Site can be used to assist tactical planning in response to emergent situations or for more routine jobs such as alarm activations where it is often unclear where buildings, classrooms or the location of alarm systems are. The time taken for police to orientate themselves with unfamiliar buildings, infrastructure and school grounds is often time-consuming and can contribute to delayed response times. The maps provide practical information on the topography of the area, entrance and exit points, lines of fire, cover and concealment locations, staging areas, emergency rally points and key features. These elements are all essential for tactical planning and can contribute to safer and more effective operational deployment for police and other emergency responders.

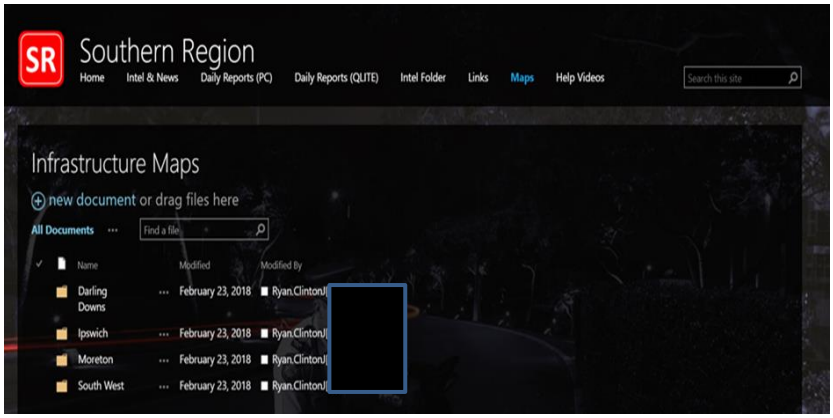

Figure 3.9 Screen shot of infrastructure maps page

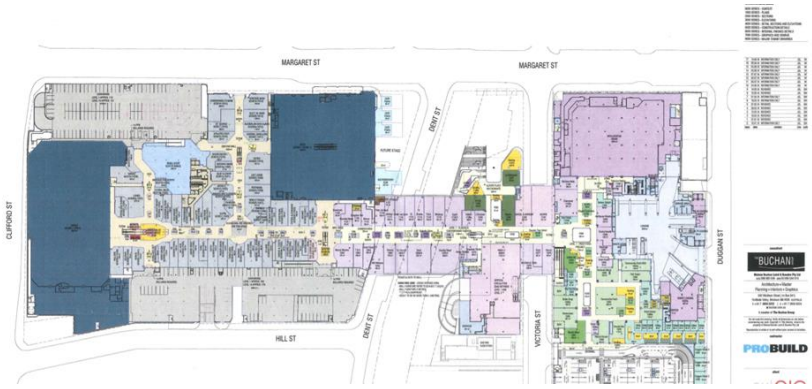

Figure 3.10 Example of floor plan of shopping centre

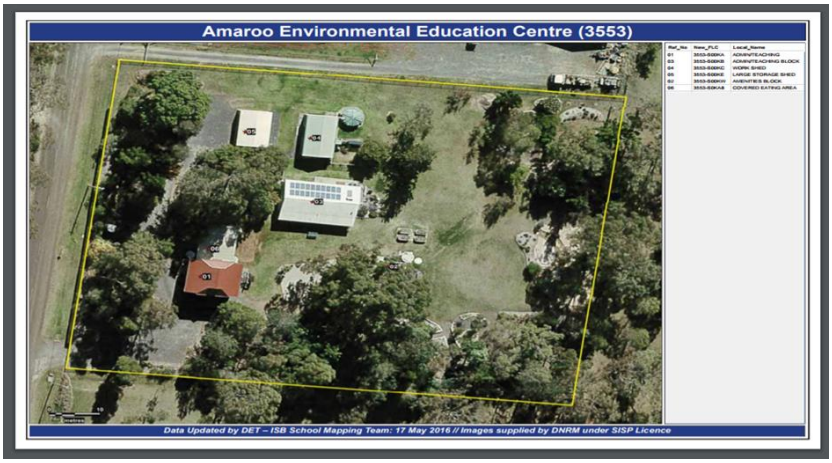

Figure 3.11 Example of satellite image of education facility

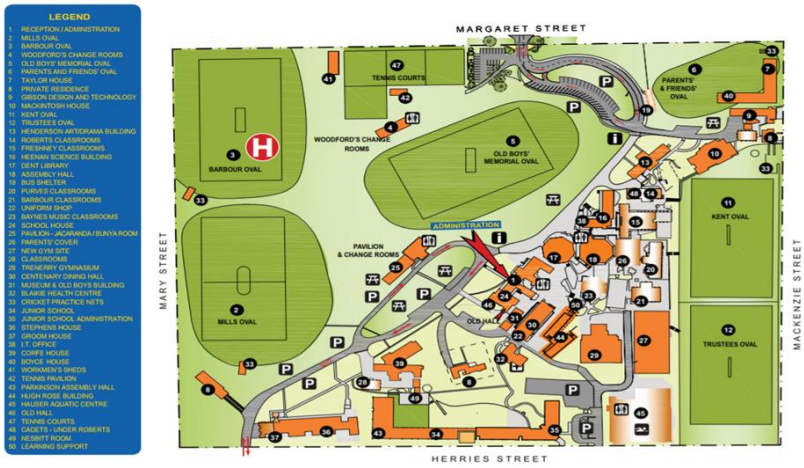

Figure 3.12 Example of map of educational facility

The help videos page provides guided assistance through an online video tutorial for officers seeking information on many of the SR App functions. Examples of help videos available include how to add a BOLO, how to add a blog post and information concerning general site usage. Figure 3.13 shows a screenshot of the help video page.

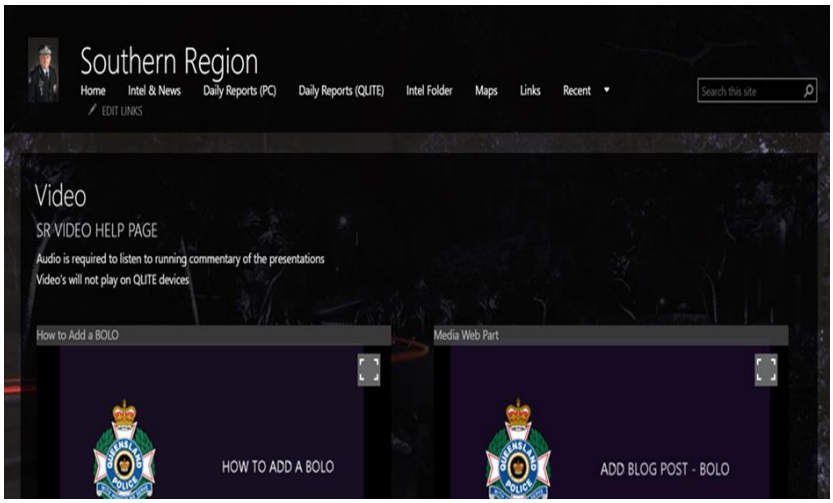

Figure 3.13 Screenshot of help video page

Figure 3.14 displays a screenshot of the Intel Folder page. The Intel Folder page contains several folders that relate specifically to intelligence in areas that include counter-terrorism, Moreton Police District, Darling Downs Police District, Ipswich Police District, South West Police District, Road Policing Command and Southern Region. These folders contain a combination of intelligence and information products produced by operational and intelligence units. A table on the right side of the page provides a summary of the most recently uploaded files so that officers are aware of the most recent operational information or intelligence uploaded onto the system.

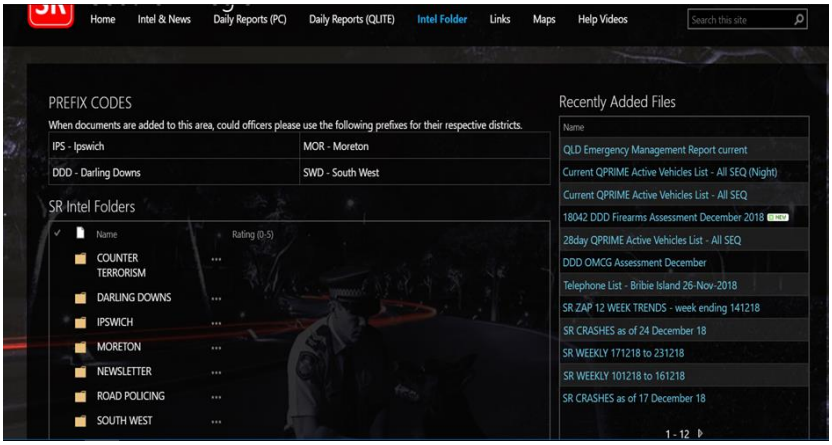

Figure 3.14 Screenshot of intel folder

Figure 3.15 highlights in a yellow circle a second top channel search bar on the SR Intelligence Home page. This search bar provides hyperlinks to several sites that can offer useful information to operational police on operation-related issues. Links have been established for Daily Reports (Intelligence), Websites, the Internet, Legislation and QPS Links. Table 3.2 provides a list of links attached to each of these sites.

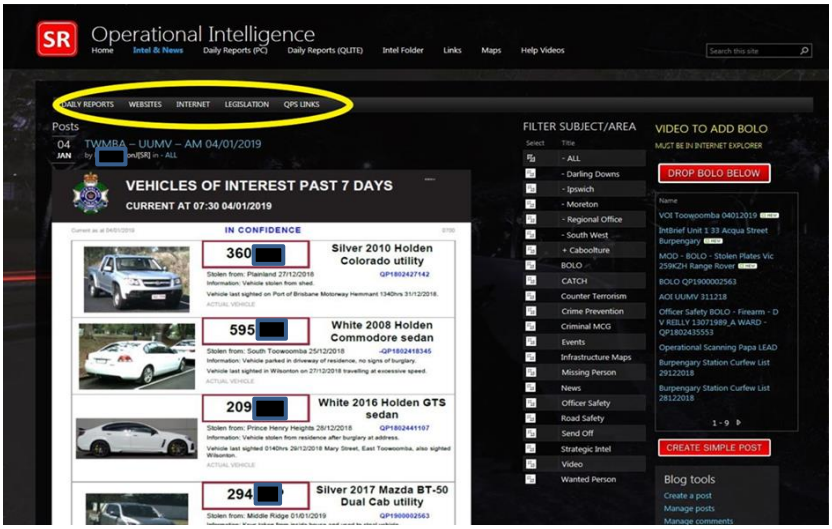

Figure 3.15 Screen shot of intel page highlighting second top channel links bar

Table 3.2 *List of website links provided in second top channel search bar*

Daily Reports	**Websites**	**Internet**	**Legislation**	**QPS Links**
Link to District Intelligence Reports	Link to Divisional and District intranet sites	ABC News	Criminal Code	Client Service System
		Australian Legal Information Institute	Domestic Violence	Departmental Vehicle Damage System
		Australian Police Journal	Drugs Misuse Act	Employee Self Service
		Bureau of Meteorology Radar	Legislation All	Evidence.com
		Google	Police Powers Responsibility Act	Handbook of Delegations and Authorities
		Queensland Police Union	Torum Act	Injury Notification
				QPrime Crime Mapping
				Police Link (online reporting)

3.3 Process design

3.3.1 Capturing and re-using information

Knowledge reuse refers to the practical re-application of captured knowledge, suggestions and collaborative assistance provided through knowledge sharing (Garfield, 2018). According to Hicks, Culley, Allen and Mullineux (2002) capturing and reusing information as knowledge is often the key to organisational competitive advantage. Similar benefits exist for public service organisations where the aim is not always to produce profit through competitive advantage but by increasing public value through improved service delivery or effective financial management (Arora, 2011). Garfield (2018) argues that reusing information from lessons that others have already learned can save time and money, minimise risk and increase effectiveness. Turner (1978) outlined that this information must be readily available, authentic for the user, applicable to the problem and accessible to those that need the information. Information reuse can include the repeat utilisation of the same information for the same or similar tasks, or the further use of information for a different purpose (Hicks et al., 2002).

The SR App was designed to enhance the ability of officers to reuse information by providing features that enabled information to be more accessible, searchable, secure and recorded more effectively. This included using codification to sort information into topics. This is done one of two ways. The first method is to post information into a blog. The post is then published and then becomes visible in a series of intelligence news feeds. An example of a post is highlighted in Figure 3.2. This function allows a document or image to be presented in a series of posts that can easily be scrolled through by the user without the necessity to open a series of folders. The most recent post then becomes the first information presented on the blog post when the user opens the SR App. In Figure 3.2 the post relates to a stolen vehicle list and is circled in yellow. The second method of adding information into the SR App involves filing the document into a relevant topic folder through a drag-and-drop function. This drag-and-drop function is highlighted with a yellow circle in Figure 3.5. When the document is successfully stored in a folder, the title of the document becomes visible in a window that displays a list of the most recent documents filed. Officers can also use the search function to access the data or document using content keywords. The search function window is highlighted in Figure 8.3. The search function allows officers to search random words or phrases that may not otherwise have been be used as the name of the file. Keywords that are included in photos or videos or within the content of pdf or word documents are searchable. After a search topic is entered, the results feature presents the documents or images according to their most recency. An example of a search result is highlighted in Figure 3.4.

During the software design process, it was important to ensure that the information was searchable by all authorised users and that they were able to also contribute to the database. However, whilst these features were important it was also necessary to ensure the integrity of the information and the entire system by ensuring that it could not be deleted by an unauthorised officer. Four site permission category groups were developed. These categories included Excel Service Viewers, Southern Region Intelligence Members, Southern Region Owners and Southern Region Guests. Excel Service Viewers were given view-only access to all excel platform documents. Southern Region Intelligence Members were given authority to contribute to all intelligence-related products that were generated from intelligence sections. These documents are generally intelligence products that have undergone a process of

analysis. Southern Region Owners were given full access to the SR App including web development tools and intelligence products. Members in this category were primarily responsible for the development or maintenance of the program. Southern Region Visitor's permission was given to all officers in the QPS. This authority included read, add and not delete access. This permission allowed all employees of the QPS to access and contribute to information and intelligence within the SR App. Importantly it does not allow officers without permission authority to modify intelligence or information products that had been previously uploaded. This feature maintains the security of all intelligence products and ensures the information is accurate at the time of posting. Figure 3.16 identifies the site's permission authorities available to each group of users.

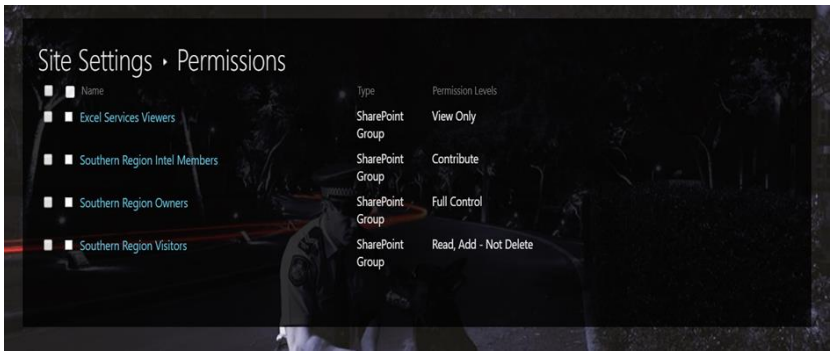

Figure 3.16 Screenshot of site permissions and authority

3.3.2 Sharing knowledge and lessons learned

Handzic (2004) argues the reason why knowledge should be managed is to achieve process and product improvement, increase decision making and make adaptation to change easier for an organisation. De Silva, Howells and Meyer (2018) describe the process of knowledge capitalisation which involves leveraging and recombining existing knowledge between employees, partners and wider networks to generate value from collaborative innovation. Nonaka and Takeuchi (1995) highlight that the ability of organisations to unlock innovation potential is based on an organisation's ability to capture and reuse knowledge. Gultekin (2009) outlines that in police work, tacit and explicit knowledge needs to be managed. Tacit knowledge includes what police officers know including their experience and skill. This knowledge is often more difficult to capture and codify. However according to Choo

(2000), explicit knowledge is more easily managed using computer databases, software programs, photographs or films.

The SR App is designed to capture and reuse both explicit and tacit forms of knowledge and information. The collection of explicit information is performed through the creation of a series of databases that allow information to be codified and stored according to their subject title. This example is demonstrated in Figure 3.2 which highlights the Filter/Subject areas in the SR App. Information can either be searched by subject title using the search function highlighted in Figure 3.3 or by directly reviewing the contents of the subject folder. As explained by Gultekin (2009) it is often more difficult to capture tacit forms of information. The SR App is designed to include a comments section that relates to each individual information or intelligence product. This feature allows users to comment on intelligence products. By recording personal experience and knowledge implicit information is also captured and a process of value-adding is created. Figure 3.17 highlights where tacit information can be recorded and remain connected with the original intelligence product, importantly this information then becomes searchable.

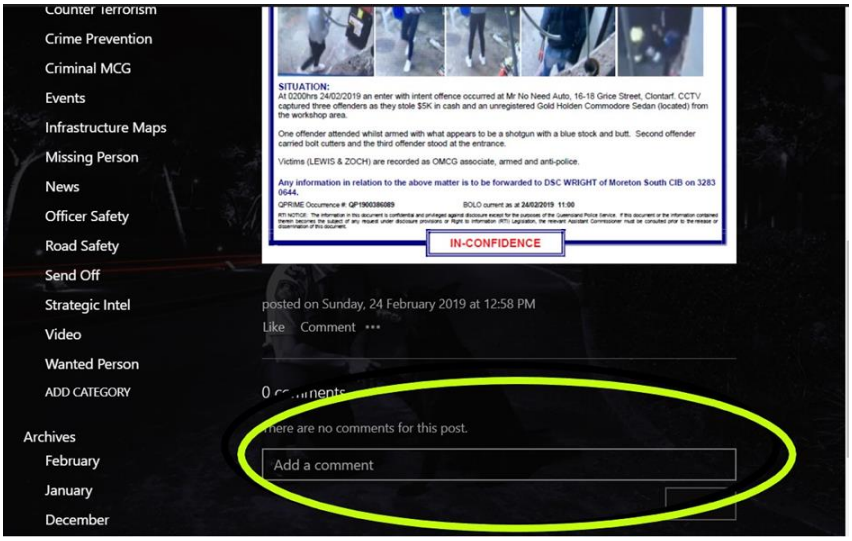

Figure 3.17 Screen shot highlighting comments feature

3.3.3 Measuring and managing the value of knowledge management

Due to the intangible nature of knowledge resources, it is difficult to develop a comprehensive method of measuring knowledge value (Hu, Wen & Yan 2015). According to Hu et al. (2015), most methods that have been developed to measure the value of knowledge have focused on the combined performance of knowledge resources. Zhang (2010) in a study applied the Kaplan and Norton Balanced Score Card (BSC) method to measure knowledge management performance with some effectiveness however highlighted that the BSC method does not include an explanation of how the evaluation process should be conducted for key areas within the BSC framework. According to Hu et al. (2015) less is known about measuring the value of separate knowledge products. The SR App was designed with analytical capability using the SharePoint Search Analytics Function (SSAF) to measure the number of times an information product was viewed in the previous two weeks and the total number of times the intelligence product was accessed in its lifetime. Whilst these results do not measure the effectiveness of the products they provide an indication of how often the product is accessed. Currently, the analytics function only gives an indication of how often the information products are being viewed and not a measurement of how effective they are to the user or the organisation. In the case where some intelligence or information products are more strategic or have greater significance to managers, these products often have fewer views. Despite results indicating some intelligence products have been accessed less than others, this is not an indication they are less useful to the organisation or the individual.

Generally, strategic products are of more interest to a limited number of managers whereas operational information products are of more interest to the operational police officer who represents a larger customer base than compared with the limited number of managers. Therefore, the number of views is not necessarily an accurate measurement of usefulness. Another exception to the analytics function is that it does not provide the name of the user nor the date it was accessed and so it remains difficult to determine what audience is accessing and reading the information and intelligence products. However, many of these limitations were addressed using qualitative research techniques in the form of surveys and group discussions during the research using the IDAM framework to determine the efficiency and effectiveness

of the management and dissemination of operational information and intelligence. These results have been reported in more detail in Chapter 5.

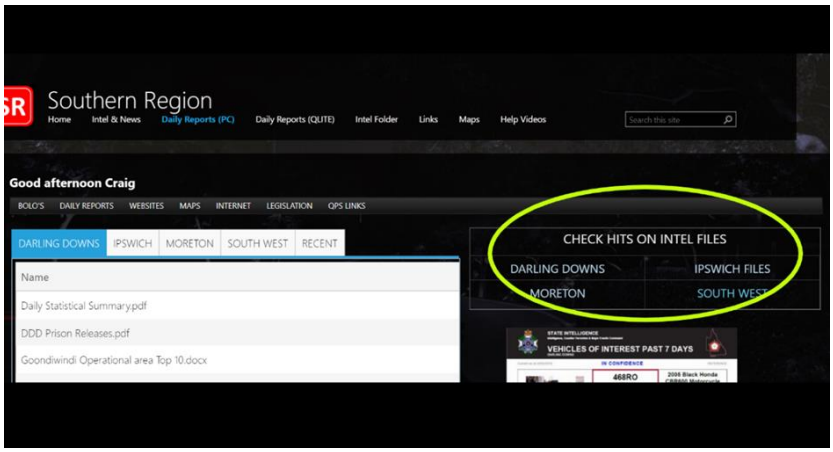

Figure 3.18 Screen shot of analytics function

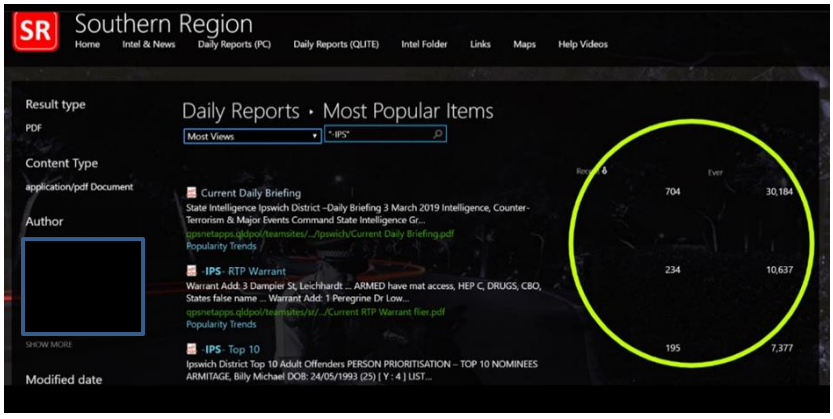

Figure 3.19 Screenshot of analytics results

3.4 People design

3.4.1 Creating knowledge and intellectual capital teams

Nonaka (1991) highlighted that creating new knowledge goes beyond managing information and extends to the process of tapping into the experience and insights of

all employees so others within the organisation can benefit from those lessons. Gogan, Artene, Sarca and Draghici (2015) outlined that organisational performance is not the result of macroeconomic policy or financial balance but the result of technical progress, innovation and intellectual capital. Intellectual capital is an intangible organisational asset that is categorised into three areas these are, human capital, structural capital and relational capital (Diaz-Fernandez, Gonzalez-Rodriguez and Simonetti, 2015). Gogan et al. (2015) argued that the quality of intellectual capital is an important concept for any organisation seeking to drive performance in the knowledge age, particularly where fixed and financial assets have less influence than intangible resources. Diaz-Fernandez et al. (2015) described the intellectual capital concepts. Human capital is described as the knowledge, professional skills, experience, expertise, education, creativity and resourcefulness of an organisation's workforce. Structural capital is described as the organisation's technology, culture, policies and networks. Relational capital is described as the organisation's networks, relationships, marketing channels and partnerships.

Kumar, Jain and Tiwary (2013) outlined that knowledge creation does not happen at any single stage within an organisation and the knowledge conversion process happens on an individual, organisational and inter-organisational level with the combined involvement of many people at all levels. Davenport and Prusak (1998) described this combined commitment of knowledge generation as a knowledge-orientated culture. According to Davenport, De Long and Beers (1998), an organisations knowledge orientated culture is demonstrated by employees who share a positive commitment to knowledge sharing. Haesli and Boxall (2005) argued that leaders should encourage recruiting, retaining and rewarding employees who are committed to the knowledge-creation process. The early recruitment of suitable staff who share a commitment to the development of a better way to create, share, manage and disseminate operational information was essential to the SR App project. Whilst some of the work during the development phase of the SR App was conducted in official work time, most of the work and research was performed in the researcher's own time. This work was supported by senior leaders who provided their influence and authority to support the provision of resources and a governance structure that supported the introduction of the SR App and its ongoing management, maintenance and continued development.

The SR App was developed through the combined and coordinated expertise of officers from a variety of sections and units within the QPS. The expertise of these areas can be summarised into five main areas that include Intelligence, Operational, Technological, Management and Training. Table 3.3 provides a list of the Intellectual Capital Teams who contributed to the SR App project.

Table 3.3 *SR App intellectual capital teams*

Functional Category	**Stakeholder**	**Expertise**	**Input**
Intelligence	Intelligence Covert Surveillance Command	Content Experts Product Knowledge Process Knowledge Network Knowledge	Application Design Content Design Data Management and Input Systems Maintenance
Operational	Districts and Divisions	Operational Knowledge Investigation Knowledge Tactical Knowledge Network Knowledge	Application Design Content Design Data Input
Technology	Public Sector Business Agency (PSBA) PSBA (Web Services) PSBA (Mobility Services)	Technology Experts Hardware Infrastructure Software Knowledge	Data Storage Technology Support Systems Maintenance
Management	Assistant Commissioner Southern Region Assistant Commissioner ICSC Director PSBA	Organisational Governance	Human and Capital Resources Analytics Committee Support Policy and Governance
Training	Southern Region People Capability Command Districts Divisions District Education and Training	SR Application knowledge Training Knowledge Content Knowledge	Training Calendar Training Facilities Trainers

3.4.2 Formation of people-orientated knowledge centres

The formation of knowledge centres emerged during the creation of intellectual capital teams representing functional categories in intelligence, operational, technology, management and training areas. According to Goh (2005), knowledge centres are the focal points for the development of knowledge skills, managing and enhancing databases and the facilitation of knowledge flows. While many stakeholders contributed specialist input, the knowledge centres also facilitated the cross-flow of

knowledge and skills from one specialist category to another. This created a greater group capacity to respond to project challenges and make recommendations based on a wide degree of knowledge and input. The functional capacities that emerged from the SR Project focused on application design (IT), content design (Intelligence), data management, systems maintenance, data input, training and policy (governance).

Application design focused on the ongoing design and functionality of the SR App and related technology. Many of the features in the application have emerged because of advances in knowledge of SharePoint design and updates. Product design focused specifically on the development of intelligence or information products that were produced, collected, managed and disseminated by the system. Intelligence product design is often determined by the needs of the consumer and the organisation's intelligence governance structure. It is also influenced by the type of information and intelligence that is being collected and other factors that may include environmental crime trends. Data management focused on the process of how the information and intelligence were managed by the system, this included the process of collecting, filing, disseminating and sharing. The information management process is done primarily by intelligence officers however is supported by operational officers through blogging and information uploads.

Systems maintenance focuses on the ongoing maintenance and development of the SR App and related technology. The SR App is primarily maintained by the original developers however because the SR App has been built on a QPS SharePoint platform, SharePoint is maintained at an organisational level by QPS IT Business Unit. Data input into the SR App can be performed by all QPS employees with a view to enhancing the information-sharing capacity of the program. Training into the use and functional capabilities of the SR App is generally performed by officers from the project team or others from functional units that have a good understanding of the program however the SR App also includes a series of how-to videos so officers can perform basic functions. The SR App project has a robust governance structure that provides policy and procedural support ensuring a consistent approach to the collection, management and dissemination of operational information and intelligence in the Southern Region.

3.4.3 Using collaborative technology for knowledge exchange between people

Goh describes collaborative technologies as organisational intranets, electronic mail and groupware for users. This KM principle is fundamental in this case study. The SR App was designed on a SharePoint platform. The functions embedded in SharePoint facilitated the application of KM principles applied during the design of the SR App. Collaborative technologies including email, intranet and other software solutions used to manage information continue to become more advanced with ongoing development in IT. This was evident during the lifetime of this research project as ongoing SharePoint software updates continued to improve functionality. However, despite advances in technology, the KM processes outlined by Goh in 2005 continue to remain relevant to KM design.

This research will be designed to determine whether the development of the SR App improved the management and dissemination of operational information and intelligence and further identify what type of operational information and intelligence police officers prefer. The research questions for this study are:

Research Question 1: Can the management and dissemination of operational information and intelligence to police be performed more efficiently and effectively in the Queensland Police Service (QPS)?

Sub-question 1: What types of operational information and intelligence do operational police officers prefer?

Sub-question 2: Can operational information and intelligence be delivered in a more effective and efficient way using SharePoint application technology (ie., the SR App).

3.5 Postscript

At the time of writing the results of this research, the QPS undertook a program of organisational restructuring. As part of this restructuring the Moreton District, formally in the Southern Police Region was separated from the Southern Region and included in the formation of the North Coast Region.

Chapter 4: METHODOLOGY

4.1 Introduction

This research is aligned with the Queensland Government Digital Strategy 2017 – 2021 to design, develop and deliver digital services that meet people's needs, the Public Service Business Agency Strategic Plan 2018 – 2022 to implement cloud-ready, integrated platforms and the Queensland Police Service Strategic Plan 2018 - 2022 to equip its workforce to meet current and future challenges through technology and to provide the facilities to support front line staff. Through a continuous process of innovation, the QPS will be better positioned to deliver upon its organisational objectives and deliver greater value for Queensland. Ultimately the technology and the information process framework subject to this research have been designed with the fundamental goal of making the community safer by maximising opportunities to prevent crime and enhance community safety (QPS 2020).

This study is designed to evaluate whether the management and dissemination of operational information and intelligence to operational police can be performed in a more effective and efficient manner than QPS Email using software application technology designed according to KM principles. This chapter describes the research methodology including a discussion of the philosophical principles and methods, research design, data collection, data analysis, participants and other research elements used to answer the research question.

The literature review established that while there was considerable research on knowledge management (KM) practice and approaches there was little consensus as to what if any systems could be described as best practice (Chapman & Macht, 2018). The QPS, like many other organisations, relies heavily on information systems to store information and email to disseminate information. According to Burgess, Jackson, and Edwards (2005), email is often ineffective because of high volume with low-quality content tendency leading to workplace inefficiencies and its potential to create a state of information overload for many workers. The design of the SR App was based on a framework proposed by Goh (2005) who synthesised nine of the most effective

knowledge-based initiatives into three main principles that he summarised as products, processes, and people. These principles were discussed in the literature review.

The effectiveness of the SR App and its impact on intelligence and knowledge management and dissemination will be determined using a Biomatrix systems theory approach to research. The Biomatrix systems theory proposes that entity systems (organisations, groups, people) are interconnected by activity systems. Each activity system represents a process where the flow of matter, energy, and information (MEI) is exchanged (Dostal, Cloete, & Jaros, 2006). By analysing the flow of MEI between the entity systems (organisation and individuals) the researcher will be able to determine whether the intelligence and information management and dissemination process was optimised using KM design principles proposed by Goh (2005). The evaluation framework created by combining Goh's KM Principles of product, process, and people with Dostal et al., Biomatrix activity system elements of matter, energy and information is called the Information Delivery Assessment Model (IDAM). The IDAM will be used to evaluate the management and dissemination of operational information and intelligence using the SR App and QPS Email system. The level of optimisation of the software application (if any) will be determined by analysing the combined results of measuring the quantitative results obtained using SharePoint Search Analytics Function (stage 1), survey questionnaire (stage 2) and time and motion study (stage 5) with the qualitative results obtained during interviews (stage 3) and focus group discussion (stage 4). These results will be used to determine whether using the SR App has optimised the management and dissemination of operational information and intelligence in the QPS.

A research paradigm represents the researcher's worldview about conducting research. Tashakkori and Teddlie (2010) argued that paradigms are belief systems that reflect and guide decisions that researchers make. This study will be based on the Pragmatist research paradigm focusing on the real-world problems associated with the management and dissemination of high flows of information and intelligence in the QPS. The research provides insight and understanding as to how operational information and intelligence can be managed and disseminated in a more effective way. Ontologically, Patel (2015) argued that pragmatists believe reality is constantly debated, interpreted, and re-negotiated and epistemologically the best method of research is one that solves the problem with change being the aim of the study.

According to Armitage (2007), Pragmatist research is applicable to social and management research as it is congruent with the mixed methods approach of a practitioner-based research program on a real-world problem. Patton (2002) argued that the focus of social science research should be on the problem and that pluralistic approaches should be adopted to understand the problem more effectively. Creswell (2011, p. 10) highlighted that the "pragmatic approach emphasises the research problem and uses all approaches to understand the problem".

This research focused specifically on providing an effective alternative to the competing interests of managing and disseminating operational information and intelligence through the QPS Email System. The research includes an analysis of efficiency gains by using SharePoint Application Technology to manage the dissemination of operational information. The research provides insight into issues associated with the effective management of information including the topic of information overload. The research aims to contribute to both theory and practice, and thereby lead to the future development of IT solutions that overcome the challenge of disseminating high flows of information. Thus, the question of whether the IT solution (SR App) would deliver organisational efficiency gains by delivering a better method to manage and disseminate operational information and intelligence. The research will also contribute to Biomatrix system theory by using activity system elements (matter, energy, and information) as a framework to evaluate the effectiveness of the dissemination of operational information and intelligence communications in a Police KM System.

4.2 Method

This study will apply a mixed methods approach by including both quantitative and qualitative data gathering and analytical techniques consistent with the Pragmatist paradigm. Mixed methods research involves the collection of both quantitative (closed-ended) data in response to research questions or hypotheses and qualitative (open-ended) data (Creswell, 2011). According to Creswell (2011), mixed methods ensure that bias and weaknesses of individual quantitative and qualitative approaches can be neutralised or minimised by triangulating data sources that support the interpretation of results. Hussein (2009, p. 43), defined triangulation as the "use of multiple methods mainly qualitative and quantitative methods in studying the same phenomenon for the purpose of increasing study credibility". Tashakkori and Teddlie

(2010) argued that mixed methods provide the ability to answer research questions that single quantitative or qualitative approaches cannot; they provide stronger inferences to answer complex social phenomena and they provide the opportunity through divergent findings for an expression of differing views. Johnson (2007) described mixed methods research as between the extremes of quantitative research and qualitative research seeking a middle solution to problems of interest.

The study adopts a mixed methods approach ensuring that both quantitative and qualitative data are integrated to provide a more comprehensive analysis of the phenomenon (Creswell, 2011). Undertaking a mixed method approach will thereby include multiple viewpoints, perspectives, and positions (Johnson, 1997). Hussein (2009) pointed out that this provides the researcher a greater capacity to understand a subject by neutralising the flaws of one method and strengthening the benefits of the other for better overall results. This research will include quantitative data analysis techniques using SharePoint search analytics to understand what intelligence products police officers use and when they use them and a time and motion study that compares the time taken by Police Officers to access operational information and intelligence disseminated by QPS Email and the SR App.

4.3 Research design

According to Creswell (2011), data collection includes setting the research design boundaries of the study. This may include collecting information through a combination of structured and semi-structured interviews and the delivery of surveys. This study will include data analysis, surveys, interviews, group discussion and a time and motion study. The researcher will use a combination of data collection methods. Data collection will be conducted in the following five stages illustrated in Figure 4.1:

Stage 1 – Collection and analysis of data using SR App SharePoint Search Analytics Function (Quantitative);

Stage 2 – Survey tool designed using Biomatrix Activity Systems and Goh's KM principles (Qualitative);

Stage 3 – Interviews (Qualitative);

Stage 4 – Focus Group Discussion (Qualitative); and

Stage 5 – Time and Motion Study (Quantitative).

Figure 4.1 Flow chart of five data collection stages

4.4 Stage 1 data analysis

Stage 1 of the research was designed to address sub-question 1 that states, 'What types of operational information and intelligence do operational police officers prefer?' The SR App includes a SharePoint Search Analytics function that provides information on the frequency of access to intelligence and information products. Software analytics are designed to enable data exploration and analysis to obtain insightful and actionable information (Zhang & Xie, 2020). Data sources can come from program logs, system events, check-in history and performance counters. Logging databases collect information from disparate services, collate the information and then report it at a site level giving administrators the capacity to determine how their site is being utilised and what people are searching for (Microsoft, 2022). The SR analytics function provides details on the number of views per site, the number of views per intelligence product and the number of unique users. The information provides an indication of usage patterns including what intelligence products are more commonly used.

The analytics function also provides information on the times of high and low connectivity to information and intelligence products. The analytics function does not however provide data that discloses the identity of officers accessing information or intelligence products. The analytics capability will be used to determine what intelligence and information products were being used and how frequently. This stage of research can be conducted with little to no risk of bias from the researcher or participants. The analytics are calculated and delivered independently through the software system that has been designed to record and measure the use of information products stored on the system. The results of these data will be further explored in the qualitative stages of the research.

4.5 Stage 2 survey

Stage 2 of the research is designed to address the research question 'Can the management and dissemination of operational information and intelligence to police be performed more efficiently and effectively in the QPS?' During this stage of research, an integrated KM Biomatrix systems research model was created to evaluate the management and dissemination of operational information and intelligence using the software solution (SR App) and QPS Email. This model, called the Information Delivery Assessment Model (IDAM), is summarised in Table 3.1 in Chapter 3. The survey will be offered to 100 police officers from a total population of 361 officers stationed in the Moreton Police District undertaking Police Operational Skills Training (POST).

Check and Schutt, (2012, p. 160) described surveys as "a collection of information from a sample of individuals through their responses to questions". Creswell (2011) argued that surveys are an effective tool for social researchers to find out the opinions and attitudes of a sample population. Population sampling refers to a process of obtaining information from a subset of participants that are representative of an entire population (Ben Shlomo, Brookes, & Hickman, 2013). "A research population refers to the total universe of units from which the sample is selected" (Ghauri & Gronhaug, 2005, p. 147). Fridah (2002) pointed out that surveys enable the researcher to gain a better understanding of a population without having to conduct a complete enumeration which would be time-consuming and costly.

The Moreton Police District was selected for the population survey because it is located within the Southern Police Region, is representative of a wide variety of policing units representing Criminal Investigation, Dog Squad, Child Protection, Scientific, Forensic Crash, First Response, Traffic and Tactical Response units as well as having a diverse geographical representation of urban and country police divisions. The Moreton Police District is also geographically close to the researcher, reducing the cost of the study and improving efficiencies associated with travel, communication, and access to participants. Preliminary analysis of software user data also reveals that the Moreton District is not the highest recorded use of the SR App and so there is less risk of biased results indicating over-positive returns during the survey.

The population sample to be used in these studies will be taken from a group of QPS Officers who are Police Operational Skills Training (POST) qualified. All

police officers must qualify annually in POST to undertake operational duties. Participants in Stage 2 of the research will be selected from police officers stationed in the Moreton Police District attending POST. POST is delivered yearly and involves a series of scenario-testing exercises. POST includes weapons re-qualification, taser requalification and review of other use of force tactics and methods. POST is delivered in a consistent format state-wide to all QPS officers with the same learning outcomes. Officers undergoing POST are required to take a period of downtime between scenario testing, creating the opportunity for the researcher to explain and deliver survey questionnaires. All participants will be asked to participate on a voluntary basis. Conducting surveys during POST ensures the delivery of policing services to the community is not impacted and police officers are not diverted from other important duties. Every officer undertaking POST will have the same opportunity to complete the survey. Creswell (2011) describes convenience sampling as one where the participants are ready and available to be studied. POST training sessions include a combination of officers from a variety of stations and units. Officers are rostered to attend POST depending upon their availability, work commitments, leave requirements and fitness for duty. The rostering of officers attending POST will be done independently to the control of the researcher and will follow no specific order or preference.

The survey will include a series of closed-ended questions followed by a series of response options numbered 1 to 10 on a Likert scale. The Likert scale is commonly adopted by social science researchers to measure participants' attitudes by asking whether they agree or disagree with a question or statement (Awang, Afthanorhan, & Mamat, 2015). According to Vongalo (2017), Likert scales measure subjective variables that are based on feelings, behaviours, and personal opinions. By adopting a larger scale there is a greater degree of variance and a better opportunity to detect differences by offering a higher level of measurement precision (Leung, 2011). The Likert scale is subject to significant debate concerning the analysis and the inclusion of points on the scale. While 5-point Likert scales are often used, based on reasons of reliability (McKelvie, 1978), in a more recent study conducted by Joshi, Kale, Chandel and Pal (2015) argued in favour of a 7-point Likert scale because the participants responses may lie between the two descriptive options provided on the 5- point Likert scale. However, Wittink and Bayer (1994) argued in favour of a 10-point Likert scale for reasons including better data diversity offering a higher degree of measurement

precision and better opportunity to detect change. They noted, however, that larger Likert scales take longer to complete and did not recommend them for long questionnaires.

A 10-point Likert scale will be adopted in this study with '1' representing (not useful or not effective) and '10' representing (extremely useful or extremely effective). The midpoint of the scale will be marked generally (somewhat useful or somewhat effective). The questions will be constructed to be relevant to the research question using familiar language, designed to cover one point at a time and easy to understand (Derrington, 2009). The questionnaire will be clearly formatted using the University of Southern Queensland questionnaire title page and introduction. Each question will be clearly labelled 1-21 The survey will be administered to up to 20 officers at one time. A pilot test of the survey will be conducted to ensure that the questionnaire covers the information required and to ensure its effectiveness in addressing the research question. This will be done by discussing the survey questions with colleagues and academic supervisors and seeking feedback. The survey tool will be developed by using the IDAM framework created by combining the elements of Dostal, Cloete, and Jaros (2006) Biomatrix activity system (matter, energy, and information) with Goh (2005) KM principles (people, process, and products). The combination of KM principles and activity system elements is summarised in Table 4.1.

The results of the Likert scores will be calculated and recorded in tables representing the SR App and QPS Email showing mean test scores and standard deviations. Pearson Product Moment Correlation Coefficient analysis will be conducted on all survey results identifying whether there is a positive or negative linear relationship between questions relating to both the SR App and QPS Email including the strength of the correlations. A Point Biserial Correlation analysis will then be conducted to determine correlations between participants' rank and questions to determine the linear relationship between variables. Cronbach Alpha analysis will be conducted to determine the internal reliability of all survey questions. Tests of difference will be conducted on survey scores to test whether a difference in means between the SR App and QPS Email. Finally, all survey scores will be graphed according to the results from each question.

Anecdotal feedback suggests that survey fatigue in the QPS is often responsible for low rates of return or inaccurate results. To overcome this issue the survey will be delivered to officers in a hard copy format. The data from the hard copy surveys will

then be recorded on a database by the researcher. The hard-copy surveys will be retained for auditing purposes. According to Machin, Campbell, Tan, and Tan (2018), an effective sample will be one where the sample is reflective of the population allowing true inferences to be made about the population. There are currently 1380 operational police officers located throughout the Southern Police Region and 361 officers based in the Moreton District (QPS, 2019).

Table 4.1

Information and Delivery Assessment Model (IDAM) using combined elements of Biomatrix activity system and KM principles

		Knowledge Management Principles		
		People	**Process**	**Product**
Biomatrix Activity System	**Matter**	People/Matter	Process/Matter	Product/Matter
	Energy	People/Energy	Process/Energy	Product/Energy
	Information	People/Information	Process/Information	Product/Information

In the survey, each question will be designed to include separately one of the Biomatrix activity system elements with one of Goh's KM principles. Table 4.2 and Table 4.3 summarise this point and demonstrate how each of the elements and principles is combined to form a specific survey question. Questions 1 to 10 of the survey will be designed to evaluate the effectiveness and efficiency of the SR App in managing and disseminating operational information and intelligence to police, these are summarised in Table 4.2.

Questions 11 – 20 of the survey will be designed to evaluate the effectiveness and efficiency of the QPS Email system in managing and disseminating operational information and intelligence to police using the same framework in questions 1-10, these are summarised in Table 4.3. Question 21 is designed to determine if officers are likely to delete QPS Email without reading because of feelings of being overwhelmed with email. The survey will provide a research tool to evaluate and compare the effectiveness and efficiency of the SR App compared with QPS Email in managing and disseminating operational information and intelligence to police. For example, Question 2 reflects the combination of elements, people (Goh's KM principle) and matter (Biomatrix activity system). The question will state 'On a scale 1-10 how do you rate the SR Apps' general usefulness in supporting your role?' Question 2 will be

formatted to focus on how matter namely the (SR App technology) impacts the general usefulness for police (people). The scale one to ten reflects the degree to which the SR App (technology or matter) assists the user (people) to perform their role. A list of questions 1-21 is provided in Table 4.4.

Table 4.2

Summary of combined elements of Biomatrix activity system and KM principles Questions 2 to 10 relating to the dissemination of information and intelligence by SR App.

		Knowledge Management Principles		
		People	**Process**	**Product**
Biomatrix	**Matter**	People/Matter Question 2	Process/Matter Question 3	Product/Matter Question 4
Activity	**Energy**	People/Energy Question 5	Process/Energy Question 6	Product/Energy Question 7
System	**Information**	People/Information Question 8	Process/Information Question 9	Product/Information Question 10

Table 4.3

Summary of combined elements of Biomatrix activity and KM principles– Questions 11 to 19 relating to the dissemination of information and intelligence by QPS email.

		Knowledge Management Principles		
		People	**Process**	**Product**
Biomatrix	**Matter**	People/Matter Question 11	Process/Matter Question 12	Product/Matter Question 13
Activity	**Energy**	People/Energy Question 14	Process/Energy Question 15	Product/Energy Question 16
System	**Information**	People/Information Question 17	Process/Information Question 18	Product/Information Question 19

Table 4.4

Summary of questions 1 -21 (Stage 2 Survey Questionnaire)

Question Number	**Survey Question**
1	Are you currently working in ICMC or other intelligence role?
2	On a scale 1-10 how do you rate the SR Apps general usefulness in supporting your role?
3	On a scale 1-10 how effective do you rate the process to disseminate and store intelligence and operational information using the SR App?
4	On a scale 1-10 how do you rate the usefulness of the intelligence and information products stored in the SR App?
5	On a scale 1-10 how do you rate your level of enthusiasm to disseminate, store and access intelligence and operational information using the SR App?
6	On a scale 1-10 how do you rate the level of effort required to capture, store and disseminate intelligence with the SR App?
7	On a scale 1-10 how effective do you rate your ability to access the intelligence and the information products on the SR App?
8	On a scale 1-10 how useful do you rate the type of information and intelligence products on the SR App?
9	On a scale 1-10 in your opinion how effective does the SR App manage information and intelligence?
10	On a scale 1-10 in your opinion do the information and intelligence products in the SR App provide you enough information to do your job effectively?
11	On a scale 1-10 how do you rate email in its general usefulness in supporting your role?
12	On a scale 1-10 how do you rate your effectiveness in disseminating intelligence and operational information via email?
13	Do you file intelligence products disseminated by email in your own folders?
14	On a scale 1-10 how do you rate your level of enthusiasm to use email to store, access, disseminate intelligence and operational information?
15	On a scale of 1-10 how do you rate the overall procedures in place to capture, store and disseminate intelligence with email?
16	On a scale of 1-10 how effective do you rate your ability to access the intelligence and the information products on email?
17	On a scale of 1-10 how useful do you rate the type of information and intelligence products disseminated by email?
18	On a scale of 1-10 how effective does disseminating information and intelligence via email allow you to find it?
19	On a scale of 1-10, in your opinion do the information and intelligence products disseminated by email provide you enough information to do your job effectively?
20	Do you delete information and intelligence related emails before reading their content?
21	Do you delete emails without reading them because you are feeling overwhelmed by the number of emails you have received?

Stage 2 will involve a quantitative analysis of survey data to determine whether the management and dissemination of operational information and intelligence were optimised using KM design principles. This will involve calculating the survey means and standard deviations for each separate question relating to both the SR App and QPS Email. The analysis will include conducting correlation tests for Questions 2 to 10 for the SR App and Questions 11 – 19 for QPS Email to determine the relationship between elements of the IDAM including inter-dependencies.

Cronbach Analysis will be used to determine the reliability of all questions and their level of internal consistency. *T*-tests for dependent means will be used to compare the means for the two related sets of scores between the SR App and QPS Email and to determine their statistical significance.

4.6 Stage 3 interviews

Stage 3 of the research is designed to address the research question, 'Can the management and dissemination of operational information and intelligence to police be performed more efficiently and effectively?', Sub Question 1 'What types of operational information do operational police prefer?' Stage 3 involves a research interview strategy using the IDAM as a framework for interview questions. 'Research interviews are designed to explore the views, experiences, beliefs and/or motivations of individuals on specific matters and provide a better understanding of social phenomena than would be obtained from purely questionnaires' (Gill, Stewart, Treasure, & Chadwick, 2008, p. 292). Gill et al. (2008) explained that researchers may utilise three types of research interview strategies. These include structured, semi-structured and unstructured interview formats. Structured interviews are a list of preformatted questions administered verbally. Unstructured interviews are performed with less organisation and often do not reflect any preconceived theories (Gill et al., 2008). Semi-structured interviews usually include several key questions that define the area explored with the flexibility to allow the researcher to ask further questions that investigate a response in more detail (Gill et al., 2008). The researcher will undertake a semi-structured interview technique to enhance the detail of information previously discovered in Stage 1 (Data Analysis) and Stage 2 (Survey Questionnaire). The researcher will interview 16 officers identified using a purposive sampling technique. These interviews will be electronically recorded and later transcribed. Prior to the interview, participants will be contacted via email and an explanation concerning

confidentiality, ethical considerations and a brief outline of the study will be provided. The interview tool is designed as a series of open-ended questions that define the area of research. The researcher has the flexibility to diverge from the preformatted questions to explore participant responses in more detail. The questions will be constructed to be relevant to the research question, follow a logical order and be succinct. The interview tool will be developed by using the IDAM framework combining the elements of Dostal, Cloete, and Jaros (2006) Biomatrix activity system (matter, energy, and information) with Goh's (2005) KM principles (people, process, and products). An additional four general questions (21 to 24) will be based specifically on the research question and not specifically on the combination of KM principles and activity system elements as will be questions 1 - 21. The combination of KM principles and activity system elements is summarised in Table 4.5.

Table 4.5

Summary of combined elements of Biomatrix activity System and KM principles

		Knowledge Management Principles		
		People	**Process**	**Product**
Biomatrix	**Matter**	People/Matter	Process/Matter	Product/Matter
Activity	**Energy**	People/Energy	Process/Energy	Product/Energy
System	**Information**	People/Information	Process/Information	Product/Information

Questions 1 to 20 will be designed to include separately one of the Biomatrix activity system elements with one of Goh's KM principles. Table 4.5 and Table 4.6 summarise this point and demonstrate how each of the elements and principles will be combined to form a specific survey question. Questions 1 to 10 of the survey will be designed to evaluate the effectiveness and efficiency of the SR App in managing and disseminating operational information and intelligence to police, these are summarised in Table 4.8.

Questions 11 – 20 will be designed to evaluate the effectiveness and efficiency of the QPS Email system in managing and disseminating operational information and intelligence to police using the same framework in questions 1-10. The framework is summarised in Table 4.7. The interview tool will be designed to evaluate and compare the effectiveness and efficiency of the SR App compared with QPS Email in managing and disseminating operational information and intelligence to police. For example, Question 2 will reflect the combination of elements, people (Goh 2005) KM principles and matter (Dostal, Cloete, and Jaros 2006) Biomatrix activity system. The question

will state ‘How do you describe the SR Apps general usefulness in supporting your role?’ Question 2 will be formatted to focus on how matter namely the (SR App technology) impacts the general usefulness for police (people). A summary of the questions is provided in Table 4.8.

Table 4.6

Summary of combined elements of Biomatrix activity system and KM principles – Questions 2 to 10 relating to the dissemination of information and intelligence by SR App.

		Knowledge Management Principles		
		People	**Process**	**Product**
Biomatrix	**Matter**	People/Matter Question 2	Process/Matter Question 3	Product/Matter Question 4
Activity	**Energy**	People/Energy Question 5	Process/Energy Question 6	Product/Energy Question 7
System	**Information**	People/Information Question 8	Process/Information Question 9	Product/Information Question 10

Table 4.7

Summary of combined elements of Biomatrix activity system and KM principles – Questions 11 to 19 relating to the dissemination of information and intelligence by QPS email

		Knowledge Management Principles		
		People	**Process**	**Product**
Biomatrix	**Matter**	People/Matter Question 11	Process/Matter Question 12	Product/Matter Question 13
Activity	**Energy**	People/Energy Question 14	Process/Energy Question 15	Product/Energy Question 16
System	**Information**	People/Information Question 17	Process/Information Question 18	Product/Information Question 19

Questions 21 – 24 will be designed to explore more about the type of information and intelligence products disseminated using the QPS Email.

Table 4.8

Table of questions 1 -24 (Stage 3 Research Interviews)

Question Number	**Research Question**
1	Please provide an outline of your professional experience and a description of your current role?
2	How do you describe the SR Apps general usefulness in supporting your role? Please explain your answer.
3	How effective do you describe the process to disseminate and store intelligence and operational information using the Sr App? Please explain your answer.
4	How useful do you describe the intelligence and information products stored in the SR App? What intelligence products do you find more useful than others?
5	How would you describe your level of enthusiasm to disseminate, store and access intelligence and operational information using the SR App? Do you think it is worth your while contributing to the intelligence and information stored on the SR App?
6	How would you describe the level of effort and time required to capture, store, and disseminate intelligence with the SR App? Does the process to disseminate intelligence or information using the SR App take you long? Is there any time savings compared to other systems i.e.: email?
7	How would you describe your ability to access the intelligence and the information products on the SR App? Do you find it easy or hard to navigate?
8	How useful would you describe the type of information and intelligence products on the SR App? Do you use an intelligence or information product more frequently than others? What is the most common intelligence product you use and why?
9	In your opinion how effective does the SR App manage information and intelligence? Do you think it could be done better? If so how?
10	In your opinion do the information and intelligence products in the SR App provide you enough information to do your job effectively? Are there some information or intelligence products that you would use more than others?
11	How useful do you describe email in supporting your role?
12	How would you describe the effectiveness of disseminating intelligence and operational information via email?
13	Do you store intelligence products disseminated by email in your own personal intelligence folders? What type of information/intel?
14	How would you describe your level of enthusiasm to use email to store, access, disseminate intelligence and operational information? Do you think using email is an effective way to store or deliver intelligence or information products?
15	How do you describe the overall procedures in place to capture, store and disseminate intelligence with email? Would you prefer to disseminate intelligence through the email system and store it yourself in your own folders as opposed to other methods?
16	How do you describe your own ability to access the intelligence and the information products on email?

Question Number	Research Question (cont)
17	How useful do you describe the type of information and intelligence products disseminated by email? Do you find the information and intelligence useful? Are there some products you prefer over others?
18	How easily can you retrieve information and intelligence products on your email after you read it? Have you ever though you had read an intelligence product on the email but not been able to find where you saw it later?
19	Does the information and intelligence products disseminated by email provide you enough information to do your job effectively?
20	Do you delete information and intelligence related emails before reading their content? If so why? Are there some emails that you are likely to delete more than others?
21	Do you ever feel overwhelmed by the number of emails you have received? Do you ever bulk delete emails without reading the title of the email? If so why? What strategies to you use to manage your email inbox?
22	Can the delivery of information and intelligence to operational police be performed more efficiently and effective?
23	What types of operational information do operational police prefer?"
24	Can information be delivered in a more effective and efficient way using software application technology?

According to McGrath, Palmgren, and Liljedahl (2019), qualitative interviews are the preferred method to understand a subject's perspective rather than being used to generate generalizable understandings of large groups of people. The researcher will adopt a purposive sampling strategy with the intention of including the views and opinions of officers stationed throughout the Southern Region. Purposive sampling is a technique commonly used to identify and select research participants that have specific knowledge or experience and can contribute to the study (Creswell & Plano, 2011). It is the researcher's intention to identify whether the results achieved in Stage 2 are consistent with the views and opinions expressed by officers stationed outside the Moreton Police District. The researcher will commence the process by interviewing the Officer in Charge of Police Intelligence sections in each of the four Police Districts in the Southern Police Region. The Officers in Charge of intelligence sections have been selected because of their expertise in intelligence and information management including their knowledge of the Southern Region and intelligence management processes that are unique to their district. The researcher will use a purposive sampling process to identify and interview additional participants. This will include an Officer in Charge of a police division representing each of the four police districts nominated by the officer in charge of intelligence. The officer in charge of the

division will then nominate operational officers representing Sergeant and Senior Constable/Constable ranks within their division. This Stage 3 of the research design is illustrated in Figure 4.2 showing the purposive sampling technique to be undertaken for the research interviews.

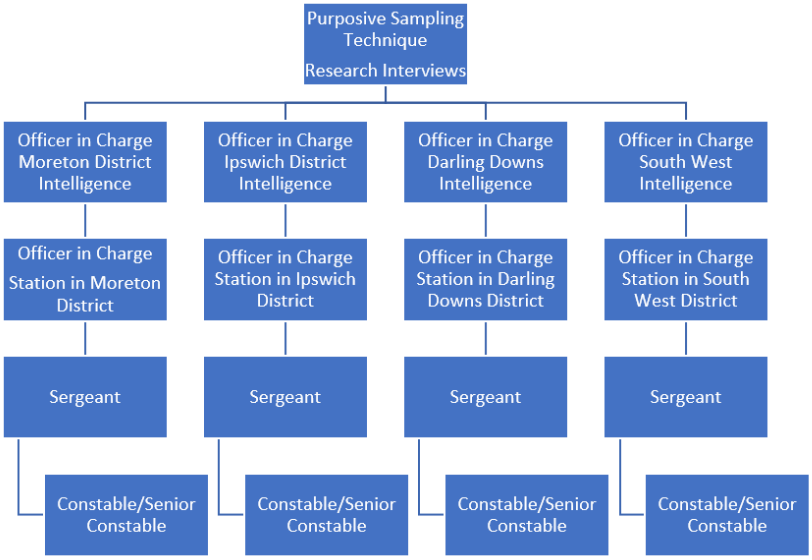

Figure 4.2 Research interviews – Purposive Sampling Technique

The transcripts of each interview will be reviewed manually through NVivo software, and the responses will be coded according to the IDAM. The qualitative results reported in Stage 3 will be reported in a series of tables structured on the IDAM. These tables will separately record the results of the thematic analysis for the SR App and QPS Email. The results of the analysis will then be compared and discussed.

4.7 Stage 4 focus group discussion

Stage 4 of the research is designed to address the research question, 'Can the management and dissemination of information and intelligence to police be performed more efficiently and effectively?' and Sub Question 1 'What types of operational information do operational police prefer'. Stage 4 will include a focus group discussion to further explore the questions and responses provided in the survey questionnaires (Stage 2). According to Nyumba, Wilson, Derrick, and Mukherjee (2018), focus group

discussion is frequently used as a qualitative approach to gain an in-depth understanding of social issues. Morgan (1998) explained that focus groups are useful in generating a greater understanding of participants' experiences and beliefs. The method aims to obtain data from a purposely selected group of individuals rather than a statistically representative sample of a broad population (Nyumba, Wilson, Derrick, & Mukherjee, 2018). Criterion sampling is an example of a purposeful sampling strategy where individuals are selected on the assumption, they possess the knowledge and experience to contribute to the area of research and can therefore provide information that is both detailed and generalisable (Palinkas et al., 2015). The researcher will conduct three separate focus group discussions with officers separately representing an investigation unit, a tactical crime unit and a first response unit. Hennink and Leavy (2014) described the significance of homogeneity in group composition as important for developing a positive group environment where participants are more likely to share opinions with others, they perceive share a similar experience. Hennink and Leavy (2014) pointed out that where participants in a group differ in terms of status or knowledge, they will often be reluctant to participate in the process. The experience and knowledge of officers from each of these three groups differ due the nature of their duties and so officers participating in the focus group will remain in their functional work units during the focus group discussion research. Focus discussion groups will be made up of between six to eight officers. Participation in the group will be voluntary.

Hennink and Leavy (2014) suggested that the optimum size for a focus group is six to eight participants explaining that smaller groups risk limited discussion while larger groups can be often harder to manage and can limit conversation. Chong et al. (2015) outlined those interactions are the most important characteristic of focus groups that differentiates them from other data collection methods. The officers will be selected on their willingness to voluntarily engage in a group discussion and to contribute to the research. A senior intelligence officer will facilitate the discussion. The researcher will be present during the group discussion to assist the facilitator. The facilitator will be briefed prior to the focus group about the study objectives, the focus group research process, and ethical issues. The facilitator will be an experienced police officer who is known in the workplace, has an established rapport with participants and is an experienced interviewer. The facilitator will use an interview schedule to facilitate discussion.

Members of the group will be encouraged to express their viewpoints at a group briefing at the beginning of the exercise and divergent viewpoints will be supported throughout the exercise by allowing enough time for those opinions to be expressed without negative or positive feedback. The group discussion will be electronically recorded, and notes of the discussion will be recorded by the researcher. The transcripts of each group discussion will later be reviewed manually through NVivo software, and the responses will be coded according to the thematic frameworks based on the IDAM. The interviewer will use a schedule of topics and open-ended questions to facilitate discussion. The themes and questions recorded in the schedule will be consistent with the research questions and Goh's (2005) KM principles of people, process, and product and Dostal, Cloete, and Jaros (2006) The Biomatrix activity systems theory (matter, energy, information). The focus group discussion themes are presented in Table 4.9. These questions may be used only as a guide for the facilitator, and it is anticipated the researcher will seek to probe and expand on issues raised during the discussion using questions that may not be included in the schedule (Gill, Stewart, Treasure, & Chadwick, 2008).

The results reported in Stage 4 will be recorded in a series of tables structured on the IDAM using thematic analysis. These tables will separately record the thematic analysis for the SR App and QPS Email. The results of the thematic analysis will then be compared and discussed.

Table 4.9

Focus group discussion schedule

Activity System KM Principles	Matter (Technology)	Energy	Information
People	**Usefulness of the SR App in supporting operational police**. • Does the SR App suit your purpose? • How would you make it better? • What advantages or disadvantages do you notice? • How does the SR App compare with other methods of disseminating intel or correspondence ie: email/online folders?	**Enthusiasm or level of interest by operational police in using the technology and information/intelligence products.** • Do you use the SR App to store intelligence or information? • Do you use the SR App to access intelligence or information? • How often do use the SR App to perform a function? • Would you prefer to use an alternative method to store or access information?	**Usefulness of information and intelligence products.** • How useful would you describe the information or intelligence products on the SR App? • Do you prefer some information or intelligence products over others, why? • What makes an information or intelligence product useful?
Process	**Effectiveness in managing and disseminating information and Intelligence.** • How effective do you feel the processes used in the SR App to manage information? • How effective do you feel the processes are to disseminate information/intel? • How do they compare with other methods ie: email/online folders? • Are there any benefits or negative impacts from either system?	**Level of effort and time required to capture, store and disseminate information and intelligence.** • Does using the SR App to store information and intelligence save time compared to other methods? • Are there any other benefits or disadvantages of using the SR App compared to other systems of storing and disseminating information/intelligence?	**Processes used in the management of Information and Intelligence.** • What advantages or disadvantages are there with the processes used to manage information with the SR App? ie: blog site, drag and drop, search function. • How do these compare with the email system?
Products	**How effective does the technology manage the information and intelligence products.** • How effective do you describe the way the technology is used to manage the information and intelligence products? • How would you suggest it could be improved? • How does it compare with the email system?	**Effort and time used to produce information and intelligence products.** • Are the methods used to create intelligence and information products effective? • Do you use the information and intelligence products? • How often do you use the intelligence and information products?	**Usefulness of intelligence and information products** • What intel or information products do you find particularly useful? • What intel or information products do you find not useful? Explain why? • What types of information and intel products do you feel would be useful? Why?
Research Questions	Can the delivery of information and intelligence to operational police be performed more efficiently and effectively?	What types of operational information do operational police prefer?	Can information be delivered in a more effective and efficient way using software application technology?

4.8 Stage 5 time and motion study

Stage 5 of the research is designed to address the research question. 'Can the management and dissemination of operational information and intelligence to police be performed more efficiently and effectively?' and Sub Question 2 'Can operational information and intelligence be delivered in a more effective and efficient way using software application technology'. This will be achieved by using a time and motion study to record the time taken to access operational information and intelligence using the SR App on a desktop computer and QLite and comparing the results with the time taken to perform the same function using the QPS Email.

According to Schonauer, Lipetski, and Schrom-Feiertag (2012), real-time motion feedback is an important aspect for measuring the effectiveness of technical systems, particularly human-computer interaction. The study will be designed to measure and then compare the average time taken to access intelligence products disseminated by the SR App compared to that of the QPS Email system. The study will be divided into four separate tasks. These tasks will be:

Desktop Computer

Task 1: Search and access Moreton District Daily Priority Offenders list (intelligence product) on SR App Moreton District Intelligence Folder using desktop computer. Table 4.10 outlines the step-by-step guide to the study in relation to Task 1.

Task 2: Search and access Moreton District Priority Offenders list (intelligence product) sent on QPS Email using desktop computer. Table 4.11 outlines the step-by-step guide to the study in relation to Task 2.

QLite

Task 3: Search and access Moreton District Daily Priority Offenders list (intelligence product) on SR App Moreton District Intelligence Folder using Q Lite. Table 4.12 outlines the step-by-step guide to the study in relation to Task 3.

Task 4: Search and access Moreton District Daily Priority Offenders list (intelligence product) via email using QLite. Table 4.13 outlines the step-by-step guide to the study in relation to Task 4.

An Apple iPhone video timer will be used to record the time and motion study (TMS) conducted on the QLite. The desktop time and motion study will be video

recorded using desktop software technology called OBS Studio. OBS Studio will also record the time of the desktop exercise. The timing will begin when the participant double-clicks on the email or SR App icon to commence the search. The timer will be stopped when the intelligence product opens on the screen. According to Lopetgui et al. (2013), workflow studies can often be oversimplified and underrepresent the complexity of the processes without accurately recording the work processes undertaken. They suggest that researchers need to have the necessary knowledge of the procedural issues under study, follow a time stamp data framework for task sequencing and ensure observers have the participant under constant observation to accurately track and account for task fragmentation and interruptions. Lopetgui et al. (2013) report that every data collection method requiring a human interface is subject to variability and error in the data capture process caused by unexpected interruptions, task fragmentation, real-world variability of workflow and complex data capturing processes. These tasks will be delivered in a clinical setting without external interruptions, with a clear set of guidelines for the participant and with pre-defined time stamp conditions. Lopetgui et al. (2013) also highlighted the importance of intra-observer and inter-observer reliability on test results. Intra-observer reliability (also known as test re-test) will be used to assess the variability of the observer's measurement over time, this will include delivering a second test to each participant using the same instructions and conditions as the first. The results of both tests will be recorded, and time variability will be determined. A copy of the test record sheet is outlined in Table 4.16. Inter-observer reliability will be addressed by ensuring the TMS is video recorded and that the same recording standards are used for all participants. These recordings will be reviewed by the academic supervisor to determine the consistency of the clinical testing and recording process and repeated if required.

The study will be conducted using 20 volunteers from the Moreton Police District. The volunteers will be selected from a group of first-response police officers issued with QLites. QLites are only issued personally to officers after they undertook a QLite user course.

The details of the study will be explained to the participants prior to the start of the test. It is noted that bandwidth affects upload and download data speeds which can often vary from one police division to another. For this reason, the TMS will be conducted at the same location over the period of the study.

Table 4.10

Desktop Computer - Task 1 Search and access Moreton District Priority Offenders list on SR App Moreton District intelligence folder using a desktop computer.

Element Number	**Element Action**	**Trigger Point**
1	Double click cursor on SR App desktop icon and open portal.	Time begins.
2	Move cursor onto and click on Daily Reports PC and open file.	
3	Move cursor onto Moreton District, click and open file.	
4	Move cursor onto Moreton District Daily Priority Offenders List and click.	
5	Moreton District Daily Priority Offenders List opens on screen.	Time ends.

Table 4.11

Task 2 Search and access Moreton District Priority Offenders list on email using desktop computer

Element Number	**Element Action**	**Trigger Point**
1	Double click cursor on email icon and open portal.	Time begins.
2	Search for Moreton District Priority Offenders tasking report email.	
3	Move cursor onto Moreton District Priority Offenders email and click.	
4	Move cursor onto Moreton District Daily Priority Offenders List attachment and click to open.	
5	Moreton District Daily Priority Offenders List opens on screen.	Time ends.

Table 4.12

QLite

Task 3: Search and access Moreton District Daily Priority Offenders list (intelligence product) list on SR App Moreton District Intelligence Folder using QLite

Element Number	**Element Action**	**Trigger Point**
1	Double click cursor on SR App desktop icon and open portal.	Time begins.
2	Move cursor onto and click on Daily Reports QLite and open file.	
3	Move cursor onto Moreton District, click and open file.	
4	Move cursor onto Moreton District Daily Priority Offenders List and click.	
5	Moreton District Daily Priority Offenders List opens on screen.	Time ends.

Table 4.13

Task 4 Search and access Moreton District Priority Offenders list on email using Q Lite

Element Number	**Element Action**	**Trigger Point**
1	Double click cursor on email icon and open portal.	Time begins.
2	Search for Moreton District Priority Offenders tasking report email.	
3	Move cursor onto Moreton District Priority Offenders email and click.	
4	Move cursor onto Moreton District Daily Priority Offenders List attachment and click to open.	
5	Moreton District Daily Priority Offenders List opens on screen.	Time ends.

Table 4.14
Time and Motion Study - test sheet record tables.
Test 1

Technology	**T1**	**T1** (Retest)	**T2**	**T2** (Retest)	**T3**	**T3** (Retest)	**T4**	**T4** (Retest)
Computer								
Q Lite								

The results reported in Stage 5 will be reported separately in tables for Desktop Computer and QLite. A multivariate analysis of variance (MANOVA) of the meantime in motion will be conducted to determine the most efficient method of accessing intelligence comparing the desktop computer with QLite results. A Tukey Post-Hoc test of difference will be conducted on the mean test results to determine the significance of results indicating whether accessing intelligence using the SR App on a desktop computer or QLite is more efficient.

4.9 Ethical considerations

Oliver (2010) highlighted the ethical considerations of conducting research in the social sciences which he describes as primarily concerned with collecting data from people. This research has been conducted with the consideration of the principles outlined by the National Health and Medical Research Council (NHMRC), National Statement on Ethical Conduct in Human Research 2018 and with the approval of the University of Southern Queensland Ethics Committee and the QPS Research Committee. The HREC approval reference number for this research is H18REA100. The NHMRC encourages an ethos of respect and concern with one's fellow creatures while undertaking research. Ethical behaviour carries a heightened level of significance within the QPS and is considered crucial in all forms of its business and operations.

The QPS Integrity Framework (2014) outlines that its reputation and the confidence that this trust inspires within the community is its greatest asset. Community confidence in the QPS in engendered through an internal culture that encourages high professional and ethical standards. The QPS re-emphasises this point in the 2017 QPS Our People Matter Strategy document that outlines the importance of

having a workplace that practices fairness, equity, and transparency through all organisational activities. Sir Robert Peel (1788-1850), the founder of the Metropolitan Police Service in the United Kingdom highlighted police only exercise their powers with the implicit consent of the community through transparency and integrity (Jackson, Hough, Bradford, Hohl, & Kuha, 2012). Ethical behaviour carries responsibility and accountability for all police officers exercising their duties. This obligation is one that the researcher acknowledges and has sought to demonstrate throughout the project.

4.10 Validity and reliability

According to Golafshani (2003), validity and reliability in qualitative and quantitative research should be examined in different ways. According to Patton (2002), quantitative researchers use standard measures that can be categorised according to pre-determined procedures. Winter (2000) argued that quantitative researchers attempt to disassociate themselves from the research process and are less inclined to involve themselves in the problem under study. Crocker and Algina (1986) outlined that validity in quantitative research involves a focus on designing and testing experiments that produce results that can be replicated and reproduced. Golafshani (2003) summarised reliability and validity in quantitative research as having two strands, the first being with reliability whether the result is replicable, and, secondly, whether the results are valid. This includes ensuring the means of measurement are accurate and that the research measures what it is intended to measure. Reliability in quantitative research is defined by Joppe (2000, p. 1) as;

> "The extent to which results are consistent over time and an accurate representation of the population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered reliable."

Hoepfl (1997) argued that while quantitative research determines a cause or makes a prediction of findings qualitative research instead focuses on understanding and the illumination of the research problem. Patton (2001) argued that during qualitative research the researcher should embrace their involvement in the research role and should be present during the changes to record an event as it unfolds.

According to Johnson (1997, p. 4) the aim of qualitative research is to "engage in research that probes for deeper understanding rather than examining surface features". Golafshani (2003) argued that to ensure reliability in qualitative research, trustworthiness must be examined. Seale (1999, p. 266) stated that "trustworthiness of a research report lies at the heart of issues conventionally discussed as validity and reliability". Johnson (1997, p. 283) explained that the validity or trustworthiness of qualitative research can be maximised by showing a credible and defensible result. Golafshani (2003) described that triangulation methods used in qualitative research can improve the validity and reliability of research or the evaluation of findings. Patton (2001, p. 353) supports this view and argues that triangulation strengthens a study by "combining several kinds of methods or data, including using both quantitative and qualitative approaches". Triangulation is defined by Creswell and Miller (2000, p. 126) as a "validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in study". Mathison (1988) argued that triangulation has become an important method to evaluate, control bias and establish valid propositions (Oliver, 2010).

The research design has been developed to enhance the reliability and validity of the results. The research employs a mixed methods approach combining the results of quantitative and qualitative methods in a triangulation approach by leveraging the results of each stage of the research to confirm the reliability and validity of the study. The researcher has used the results of each stage of the study to develop a greater understanding of the problem including the issues, themes and evidence that emerges as each stage of the research is completed.

4.11 Conclusion

This study has been based on the Pragmatist paradigm, focussing on the real-world problem associated with the management and dissemination of high flows of operational information and intelligence in the QPS. The research methodology has been designed to evaluate whether the management and dissemination of operational information and intelligence for police can be performed more effectively and efficiently. The study applies a mixed methods approach applying quantitative and qualitative data gathering in a five-stage research design that includes a combination of structured and semi-structured interviews, surveys, and time in motion study. In this

chapter, the IDAM is used as a foundation in the design of the questions for Stage 2 (Survey Questionnaire), Stage 3 (Interviews) and Stage 4 (Focus Group Discussion). The IDAM will later be again applied as a discussion framework during the results and discussion chapters to answer the research questions through the evaluation and comparison of the results. It is intended that the results of this research will answer the research questions by comparing how effectively and efficiently the SR App and QPS Email can disseminate and manage operational information and intelligence for police, ultimately determining whether it can be done better using SharePoint Application Technology.

Chapter 5: RESULTS

5.1 Introduction

This chapter presents the results of the research according to the five-stage research design described in Chapter 4. The results have been reported separately for Stage 1, Stage 2 and Stage 5. However, to avoid duplication, the results discussed in Stage 3 (Interviews) and Stage 4 (Group Discussion) have been combined because the thematic analysis conducted in both stages shared many of the same themes. The thematic analyses undertaken in Stage 3 and Stage 4 have been summarised in the relevant tables and figures presented in this chapter.

The results presented for Stage 1 are quantitative and were obtained using the SharePoint Search Analytics Function (SSAF), which allows the user to monitor and record online site and document usage patterns providing how often online operational information and intelligence products were accessed. The results in Stage 1 have been reported in a series of tables marked Table 5.1 to Table 5.4 and Figures 5.1 to 5.3. These tables separately contain the intelligence product usage for Moreton Police District, Ipswich Police District, Darling Downs Police District and South West Police District. Figure 5.1 reports the daily site usage of operational intelligence products on the SR App and Figure 5.2 reports the monthly site usage of operational intelligence products on the SR App.

The results presented for Stage 2 are also quantitative and have been obtained from the survey of 117 operational police officers. The results have been reported in a series of tables that present mean test scores and standard deviations. The results for SR App-related questions are reported in Table 5.5. Table 5.6 provides further details of the mean test scores and standard deviation results based on the IDAM for SR App-related questions. Table 5.7 provides details of the mean test scores and standard deviations for QPS Email survey questions, and Table 5.8 provides further details of the mean test scores and standard deviations for QPS Email survey results based on the IDAM.

Correlation analysis was conducted on all survey questions. The results of the survey questions relating to the SR App have been reported in Table 5.9. The results of survey questions relating to QPS Email have been reported in Table 5.10. The

results indicate a positive linear relationship between questions for both the SR App and QPS Email. Pearson Correlation Coefficient Analysis was conducted on survey results to determine the correlation between data sets for the SR App and the rank of the participants. The results of this analysis are reported in Table 5.11. The same analysis was conducted to determine the correlation between QPS Email and rank, with the results reported in Table 5.12. The results of these analyses indicated a mix of positive and negative correlations between rank and survey questions with generally higher levels of enthusiasm to use both the SR App and QPS Email reported by Senior Constables and Constables.

Cronbach's alpha reliability was conducted separately for questions relating to the SR App and questions relating to QPS Email to test the internal reliability of survey questions. The results of the analysis in both categories indicate a high level of internal consistency between survey questions.

T- tests were conducted to test the difference between the SR App and QPS Email survey questions relating to elements of the Biomatrix Activity system (matter, energy, and information). The results of these analyses were generally significant. These results are recorded in Table 5.13. *T*-tests were also conducted for both SR App and QPS Email survey questions relating to the KM principles (people, process, products). The results of these analyses were also generally significant. These results are reported in Table 5.14.

Analysis was conducted on the survey returns for the same questions relating to both the SR App and QPS Email. The results were graphed on the response rates per percentage of the total sample population. These results are recorded in Figure 5.3 to Figure 5.7. The results indicated a higher rating for the SR App in areas of the process to disseminate and store information (Figure 5.3), the usefulness of intelligence products (Figure 5.4), enthusiasm to disseminate, store and access intelligence (Figure 5.5), and ability to access intelligence and information (Figure 5.6).

The results of survey questions relating to the deletion of QPS Emails before reading the content are presented in Figure 5.8. The results of the survey question relating to the officer's ability to effectively process all information delivered through QPS Email are presented in Figure 5.9.

The qualitative results reported in Stage 3 and Stage 4 are reported in a series of tables marked Tables 5.15 to 5.17. The tables are structured according to the IDAM framework (Biomatrix Activity system elements (matter, energy, information) and the

KM principles (people, process, product) outlined in Chapter 4. These tables separately record the results of the thematic analysis for the SR App and QPS Email. Table 5.15 shows the thematic analysis of the SR App using the IDAM. Table 5.16 provides a sample of quotes relating to the SR App during focus group discussions and interviews using the IDAM. Table 5.17 shows the thematic analysis of the QPS Email using the IDAM. Table 5.18 provides a sample of quotes relating to the QPS Email during focus group discussion and interview using the IDAM. The results of the analysis of both the SR App and QPS Email are compared and discussed.

The quantitative results reported in Stage 5 outline the Time and Motion Study results for online exercises conducted using a desktop computer and QLite to access the SR App and QPS Email. The study was conducted using 20 participants. Each participant was required to complete two online tasks twice using both a desktop computer and QLite to perform the same tasks. The average time taken to complete the tasks was recorded in the results. These results are reported separately in Tables 5.19 and Table 5.20. Table 5.19 reports the Time and Motion Study results for the desktop computer, while Table 5.20 reports the Time and Motion Study results when using the QLite.

Multivariate analysis of variance (MANOVA) of the meantime in motion results was conducted. Table 5.21 summarises the meantime and motion results for each task. Table 5.23 summarises the results of the MANOVA indicating a *p*-value <.00001. The mean test results indicate that accessing intelligence via email on the QLite was the most efficient use of time while there was no difference for accessing intelligence on the SR App using a desktop computer or QLite.

Tukey's post-hoc tests of honestly significant difference (HSD) conducted on the mean test results similarly indicate that accessing intelligence via QPS Email on the QLite was the most efficient use of time while there was no difference for accessing intelligence on the SR App using a desktop computer or QLite. These results are reported in Table 5.24.

5.2 Stage 1 – sharepoint search analytics

The results of Stage 1 were obtained using the SharePoint Search Analytics Function. A detailed description of the SharePoint search analytics architecture is provided in Chapter 4 – Methodology. Table 5.1 presents the intelligence product

usage for the Moreton District as of 28 March 2020. The first column presents the number of hits in the ten days prior to 28 March 2020 and the second column presents the total number of hits of the product since their introduction. The dates each intelligence product was produced and published varies. Each of the intelligence products reported on the database has undergone several modifications and so the exact dates the products were first published in their current format is unknown. Table 5.1 indicates that on 28 March 2020, the most popular intelligence product accessed over the previous ten days in the Moreton District is Vehicles of Interest followed by the Moreton Tasking and Coordination Briefing Document. The least popular intelligence products over the same period are the Operational Summary Reports and the Moreton District Offence Report. However, good returns were also reported for the Moreton North Patrol Group Persons of Interest, Moreton South Persons of Interest, Top Ten Prison Releases and Juvenile Curfew List.

Table 5.1

Intelligence product usage- Total hits for Moreton District as of 28 March 2020

Intelligence Product	**Number of hits in the past 10-day period**	**Total number of hits**
Vehicle of Interest	350	8162
Moreton Tasking and Coordination Daily Briefing	198	493
Moreton North Patrol Group Persons of Interest	76	4251
Moreton Top 10 Prison Releases	70	2934
Moreton South Patrol Group Persons of Interest	61	2908
Moreton District Juvenile Curfew	26	2096
Moreton District Offence Hotspots	11	1056
Operational Summary Report	10	2624
Total	**802**	**24031**

Table 5.2 presents the intelligence product usage for the Darling Downs District as of 28 March 2020. The first column presents the number of hits in the ten days prior to 28 March 2020 and the second column presents the total number of hits of the product since its introduction. The dates each intelligence product was produced and published varies. Each of the intelligence products reported on the database has undergone several modifications and so the exact dates the products were first published in their current format is unknown. The ten intelligence products are

reported in the table from the highest hit rate to the lowest. Table 5.2 shows that on 28 March 2020, the most popular intelligence product accessed over the previous ten days in the Darling Downs District is Persons of Interest followed by the Return to Prison Warrants, Top Ten Offenders – Drayton and Top Five Juvenile Offenders. The least accessed intelligence products over the same period were Top Ten Offenders Stanthorpe and Top Five Offenders Goondiwindi.

Table 5.2

Intelligence product usage - Darling Downs District as of 28 March 2020

Intelligence Product	**Number of hits in past 10-day period**	**Total number of hits**
Darling Downs District Persons of Interest	135	3274
Return to Prison Warrants	106	7715
Missing Persons	72	4646
Top 10 Offenders – Drayton	48	6670
Top 5 Juveniles	38	4574
Top 10 Offenders – Country West	32	3105
Top 10 Offenders – Warwick	12	2703
Top 5 Offenders – Lockyer Valley	10	100
Top 5 Offenders – Goondiwindi	10	199
Top 10 Offenders – Stanthorpe	10	199
Total	**473**	**33185**

Table 5.3 presents the intelligence product usage for the Ipswich District as of 28 March 2020. The first column presents the number of hits in the ten days prior to 28 March 2020 and the second column presents the total number of hits of the product since their introduction. The dates each intelligence was produced and published varies. Each of the intelligence products recorded on the database has undergone several modifications and so the exact dates the products were first published in their current format is unknown. The nine intelligence products are reported in Table 5.3 from the highest hit rate to the lowest. Table 5.3 indicates that on 28 March 2020, the most accessed intelligence product over the previous ten days in the Ipswich District is the Ipswich Daily Briefing Sheet, Return to Prison Warrants, Vehicles of Interest and Top 10 Offenders. The least accessed intelligence products over the same period were the Weekly Crime Bulletin, Parolees List and Daily Summary Report.

Table 5.3

Intelligence product usage - Ipswich District as of 28 March 2020

Intelligence Product	Number of hits in the past 10-day period	Total number of hits
Ipswich Daily Briefing Sheet	644	48459
Return to Prison Warrants	208	16958
Top 10 Offenders	207	13383
Vehicles of Interest	140	10759
Ipswich Prison Releases	69	5755
Missing Persons	63	7322
Daily Summary Report	44	4543
Parolees	17	1804
Weekly Crime Bulletin	16	2978
Total	**1408**	**111961**

Table 5.4 presents the intelligence product usage for the South West District as of 28 March 2020. The first column presents the number of hits in the ten days prior to 28 March 2020 and the second column presents the total number of hits of the product since its introduction. The dates each intelligence product was produced and published varies. Each of the intelligence products presented on the database has undergone several modifications and so the exact dates the products were first published in their current format is unknown. The seven intelligence products are presented in the table from the highest hit rate in the past ten days to the lowest. Table 5.4 indicates that on 28 March 2020, the most accessed intelligence product over the previous ten days in the South West District was the Daily Summary Report. The least accessed intelligence products over the same period are the Roma Patrol Group Statistical Summary and the Charleville Patrol Group Statistical Summary.

Table 5.4

Intelligence product usage - South West District as of 28 March 2020

Intelligence Product	Number of hits in the past 10-day period	Total number of hits
Daily Summary Report	205	12152
Charleville Patrol Group Operational Summary	41	195
Dalby Burnett Patrol Group	31	1600
Dalby Burnett Patrol Group Operational Summary	25	200
South West District Statistical Summary	23	1290
Charleville Patrol Group Statistical Summary	11	721
Roma Patrol Group Statistical Summary	9	135
Total	**345**	**16293**

Figure 5.1 presents the number of daily site visits to the operational intelligence site containing all intelligence products in the Southern Region between 14 March 2020 and 27 March 2020 on the SR App. The table accompanying the graph provides a numerical record in the left column of the number of hits on the intelligence site. In the right column is the number of unique users accessing the site per day. The graph is produced from the data in the accompanying table. Figure 5.1 indicates between 14 March 2020 and 27 March 2020 the highest number of hits on the Operational Intelligence site was 227 hits on the 16 and 17 March 2020. The lowest number of hits over the same period occurred on 22 March 2020 where there were only 77 hits. Figure 5.1 indicates a zero return on 27 March 2020, this is because the search was conducted on the same date and hits on the site could not be calculated at that time. Figure 5.1 indicates that between 14 March 2020 and 27 March 2020, the highest number of unique users (n = 117) accessed the site on 16 March 2020. The lowest number of unique users (n = 49) accessed the site on 21 March 2020.

Day	Hits	Unique Users
2020-03-14	88	47
2020-03-15	138	84
2020-03-16	227	117
2020-03-17	227	107
2020-03-18	185	97
2020-03-19	169	96
2020-03-20	135	61
2020-03-21	93	49
2020-03-22	77	56
2020-03-23	203	94
2020-03-24	157	83
2020-03-25	208	93
2020-03-26	157	81
2020-03-27	0	0

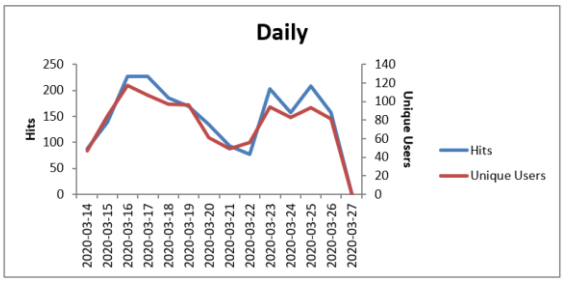

Figure 5.1 Daily site access to operational intelligence products 14 March 2020 – 27 March 2020

Figure 5.2 presents the number of daily site visits to the operational intelligence site containing all intelligence products in the Southern Region between 1 June 2018 and 27 March 2020 on the SR App. The table accompanying the graph presents the number of hits on the Intelligence site and the number of unique users accessing the site per day. Figure 5.2 indicates an overall increase in hits to the operational intelligence product site from June 2018. There have been some spikes in site hits. These occurred in August 2018 (10078 hits), October 2018 (10366 hits), March 2019 (10127 hits), July 2019 (13336 hits), August 2019 (16765 hits), September 2019 (16074 hits) and October 2019 (17371 hits). Results in Figure 5.2 indicates that in late 2019 the gap between the number of unique users and the number of site hits increased dramatically beyond what was before a consistent upward trend in both categories.

Month	Hits	Users
2018-06	1357	274
2018-07	3893	878
2018-08	10078	1281
2018-09	8903	1194
2018-10	10366	1303
2018-11	10420	1380
2018-12	8318	1138
2019-01	10608	1438
2019-02	9284	1303
2019-03	10127	1392
2019-04	7707	1142
2019-05	8794	1335
2019-06	9358	1387
2019-07	13336	1872
2019-08	16765	2344
2019-09	16074	2482
2019-10	17371	2703
2019-11	16225	2627
2019-12	7201	2327
2020-01	5194	2506
2020-02	5220	2579
2020-03	4389	2241

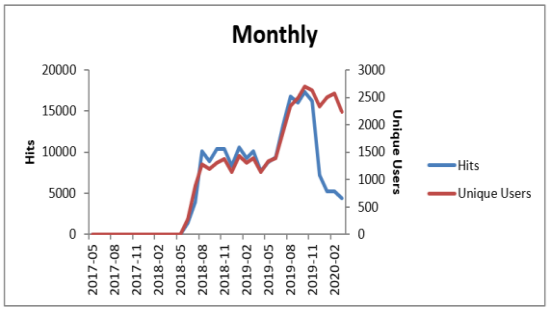

Figure 5.2 Monthly site access to operational intelligence products June 2018 – March 2020

Figure 5.3 presents the number of daily site visits and unique users to the operational intelligence site containing all intelligence products in the Southern Region between 1 July 2018 and 1 April 2021 on the SR App. Figure 5.3 demonstrates that the gap between the number of unique users and the number of site hits in late 2019 identified in Figure 5.2 has stabilised. This trend demonstrates that more users are using the SR App, however accessing fewer sites. There are two possible reasons for this trend, the first is the consolidation of intelligence and information products during this period, thereby reducing the number of separate intelligence and information products on offer. Secondly, during this same period, links to specific files in the SR App commenced being disseminated by QPS Email. Users now have the capacity to be directed to specific sites on the SR App without the requirement to navigate through a series of other sites. These factors account for fewer site hits, whilst still maintaining a high volume of unique users.

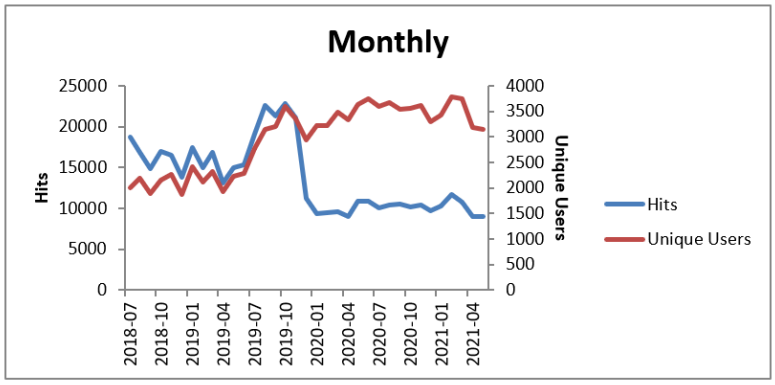

Figure 5.3 Monthly site access to operational intelligence products June 2018 – April 2021

The results obtained during Stage 1 of the research indicated that each Police District in the Southern Region has developed many similar operational and intelligence products. Analysis of the intelligence product usage data shows that each district demonstrates a unique preference for a specific information or intelligence product.

The Moreton District demonstrates a preference to access the Vehicle of Interest product, followed by the Tasking and Coordination Daily Briefing Document. The Darling Downs demonstrates a preference to access the Darling Downs District Persons of Interest and Return to Prison Warrants List. Ipswich District demonstrates a preference to access the Ipswich Daily Briefing Sheet and the Return to Prison Warrants List. South West District demonstrates a preference to access the District Daily Summary Report.

Reference to Figure 5.2, Monthly Site Access to operational intelligence products indicates that from June 2018 to March 2020 there was a significant increase in access to operational intelligence products across the Southern Police Region by more users. There was however a notable decline in reported site hits between November 2019 whilst the number of unique users has remained consistently high.

5.3 Stage 2 – survey results

5.3.1 Descriptive statistics

Stage 2 survey data were collected from a sample population of 117 operational police officers. The survey was designed as a series of close-ended questions followed by a series of response options on a ten-point Likert scale. Each question in the survey was designed on the IDAM. Questions 2 to 10 of the survey were designed to evaluate the effectiveness and efficiency of the SR App in managing and disseminating operational information and intelligence to police; questions 11-20 were designed to evaluate the effectiveness and efficiency of the QPS Email in managing and disseminating operational information and intelligence to police using the same framework as in questions 2-10.

5.3.2 Survey mean and standard deviation

The means and standard deviations were calculated from the total number of survey responses measuring between 1 and 10 for each question. Standard deviation is a measure of the spread of data relative to their means. The higher the deviation the greater the data spread is from the mean. Results of the analysis indicate that the standard deviation is relatively low and therefore the results are less volatile and more reliable. Table 5.5 shows the means and standard deviation survey results for SR App-related survey questions. Results show a mean score of 7.45 for all survey questions

with a standard deviation of 1.48. The relatively low standard deviation indicates high-reliability survey scores.

Table 5.5

Means and standard deviation survey results for SR App survey questions

Question	Mean	Standard Deviation
2	7.20	1.68
3	7.71	1.31
4	7.81	1.38
5	7.18	1.68
6	7.18	1.61
7	7.54	1.52
8	7.71	1.47
9	7.56	1.33
10	7.23	1.42
Mean	7.45	1.48

Table 5.6 shows the means and standard deviation results calculated on the IDAM framework for all SR App-related questions. Results show the lowest mean score of 7.18 was recorded for Questions 5 and 6 and the highest mean Score was 7.81 for Question 4. Skewness results indicate a generally symmetrical distribution of data. Kurtosis results were less than 3 in all areas and were thus considered normal.

Table 5.6

Means and standard deviation results calculated on KM and Biomatrix activity system framework for SR App

		Knowledge Management Principles						
		People	Process	Product	Mean	Standard Deviation	Skewness	Kurtosis
Biomatrix Activity System	Matter	Question2: M=7.2	Question 3: M=7.71	Question 4: M=7.81	M=7.19	SD=1.17	-0.51	0.91
	Energy	Question 5: M=7.18	Question 6: M=7.18	Question 7: M=7.54	M=7.15	SD=1.15	-0.51	0.37
	Information	Question 8: M=7.71	Question 9: M=7.56	Question 10 M=7.23	M=7.69	SD=1.04	-0.5	0.59
	Mean	M=7.36	M=7.38	M=7.44	n/a	n/a	n/a	n/a
	Standard Deviatiation	SD=1.36	SD=1.37	SD=1.26	n/a	n/a	n/a	n/a
	Skewness	-0.55	0.97	-0.38	n/a	n/a	n/a	n/a
	Kurtosis	0.41	2.76	-0.06	n/a	n/a	n/a	n/a

Table 5.7 shows the means and standard deviation survey results for QPS Email-related survey questions. Results show a mean score of 5.53 for all survey questions with a standard deviation of 2.06. The relatively low standard deviation indicates clustering of scores around the mean and thus high-reliability survey scores.

Table 5.7

Mean and standard deviation survey results for QPS Email survey questions

Question	Mean	Standard Deviation
11	6.64	2.04
12	5.96	2.28
14	5.42	2.27
15	5.41	2.01
16	5.53	2.24
17	5.75	2.10
18	4.51	2.25
19	5.73	1.94
Mean	5.53	2.06

Table 5.8 shows the means and standard deviation results calculated on KM and activity system framework for all QPS Email related questions. Results show the lowest mean score of 4.84 was recorded for Question 13 and the highest mean score of 6.64 for Question 11. Skewness results indicate a generally symmetrical distribution of data. Kurtosis results were less than .3 in all areas and were thus considered normal.

Table 5.8

Mean and standard deviation survey results calculated on KM and Biomatrix activity system framework for QPS Email

		Knowledge Management Principles						
		People	Process	Product	Mean	Standard Deviation	Skewness	Kurtosis
Biomatrix	Matter	Question11: M=6.64	Question 12: M=5.96	Question 13: n/a	M=n/a	SD=n/a	n/a	n/a
Activity	Energy	Question 14: M=5.42	Question 15: M=5.41	Question 16: M=5.53	M=5.39	SD=1.96	-0.24	0.52
System	Information	Question 17: M=5.75	Question 18: M=4.51	Question 19 M=5.73	M=5.30	SD=1.79	-0.3	-0.05
	Mean	M=5.89	M=5.26	n/a	n/a	n/a	n/a	n/a
	Standard Deviatiation	SD=1.83	SD=1.86	n/a	n/a	n/a	n/a	n/a
	Skewness	-0.49	-0.32	n/a	n/a	n/a	n/a	n/a
	Kurtosis	0.34	-0.16	n/a	n/a	n/a	n/a	n/a

5.3.3 Pearson product moment correlation coefficient analysis

The survey data were obtained by measuring the total responses on a scale from 1 to 10 for each of the 21 questions. Question 1, Question 13, Question 20, and Question 21 are dichotomous demographic questions and were excluded in the analysis. Pearson Correlation Coefficients were used to analyse the relationship between each of the survey questions and the relationship between officers of the rank of Sergeant/Senior Sergeant and Senior Constable/Constable. The results of the analysis are reported in Table 5.9 and Table 5.10. De Veaux, Velleman and Bock

(2016) described the strength of a linear relationship is determined by the correlation coefficient that returns a value between -1.0 and 1.0. A return of 1 indicates a perfect positive relationship, whereas -1.0 indicates a perfect negative relationship and a result of zero indicates no relationship. Under most circumstances, if the coefficient value lies between + or - .50 and + or – 1.0 then it is said to be highly correlated. If the value lies between + or - .30 and + or - .49 then it is typically said to be a 'medium' correlation. If the values lie below + or - .29 then it is typically said to be a small correlation. There is no correlation when the value is zero. Given the total number of survey respondents in this study, these general categories of correlation strength are therefore not unreasonable.

The results of correlation analysis for Questions 2 to 10 (SR Application) show that there is a positive linear relationship between all variables. The *r*-values for Questions 2 to Question 10 are recorded in Table 5.9. These values indicate that the strength of the correlations varies from medium to high. The highest recorded correlation was between Question 8 and Question 4 ($r = .78$) and the lowest recorded correlation was between Question 6 and Question 8 ($r = .35$). Table 5.5 highlights that all correlations are statistically significant at $p \leq .0001$.

The results of correlation analysis for Questions 11 to 19 (QPS Email) show that there is a positive linear relationship between all variables. The *r* values for Questions 11 to 19 are recorded in Table 5.10. These values indicate that the strength of the correlations varies from medium to high. The highest recorded correlation was between Question 17 and Question 18 ($r = .81$) and the lowest recorded correlation was between Question 18 and Question 12 ($r = .43$). Table 5.10 highlights that all correlations are statistically significant at $p \leq .0001$.

Table 5.9

Correlations based on survey results for SR Application

	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Q2								
Q3	.57							
Q4	.59	.69						
Q5	.53	.58	.60					
Q6	.52	.45	.45	.54				
Q7	.49	.48	.52	.44	.45			
Q8	.55	.57	.78	.61	.35	.54		
Q9	.55	.65	.65	.53	.51	.60	.67	
Q10	.54	.53	.59	.64	.42	.46	.58	.59

Table 5.10

Correlations based on survey results for QPS Email

	Q11	Q12	Q14	Q15	Q16	Q17	Q18
Q12	.77						
Q14	.49	.64					
Q15	.60	.69	.76				
Q16	.52	.64	.67	.74			
Q17	.56	.64	.65	.77	.81		
Q18	.32	.43	.49	.59	.64	.56	
Q19	.53	.60	.52	.61	.72	.70	.62

Point biserial correlation results for Questions 2 to 10 (SR App versus rank) are recorded in Table 5.11. The results indicate there are several negative correlations between rank and questions that are statistically significant. It is also noted that there are no positive linear relationships between variables but a point-by-point serial correlation (interval scale of questions versus the binary dichotomous scale of rank). Correlations that are statistically significant. Rank and Question 2 (r_{pb} = -.31), Rank and Question 5 (r_{pb} = -.27), Rank and Question 6 (r_{pb} = -.19) and Rank and Question 10 (r_{pb} = -.18). The negative correlation between rank and score indicates that Senior Constables and Constables are more likely to rate the SR App higher on a 10-point Likert scale compared to a Sergeant or Senior Sergeant for Question 2, Question 5, Question 6 and Question 10. A possible reason for this result is that many of the operational and information products stored on the SR App have greater application for Constables and Senior Constables than compared with Sergeants and Senior Sergeants. These results are discussed further in the discussion chapter.

Table 5.11

Correlations based on survey results for SR Application by rank

Questions	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Rank	.028	-.315	-.109	-.154	-.273	-.190	.050	-.177	-.131	-.186

Point biserial correlation results for Questions 11 to Question 20 (QPS Email v Rank) are recorded in Table 5.12. The results indicate there are several negative correlations between rank and questions that are statistically significant. It is also noted that there are no positive linear relationships between variables but a point by-serial correlation (interval scale of questions versus the binary dichotomous scale of rank). Correlations that are statistically significant include rank and Question 14 (r_{pb} = -.22), rank and Question 15 (r_{pb} = -.28), rank and Question 19 (r_{pb} = .24). The negative correlation between rank and score indicates that Senior Constables and Constables are more likely to rate Question 14, Question 15, and Question 19 higher on a 10-point Likert scale than compared to a Sergeant or Senior Sergeant.

Question 14 asked respondents how they rate their level of enthusiasm for using the QPS Email to store, access or disseminate intelligence and operational information. Results of correlation analysis indicate that Sergeants and Senior Sergeants have less enthusiasm for using the QPS Email to store, access or disseminate intelligence than compared to Constables or Senior Constables.

Question 15 asked respondents to rate the procedures in place to capture, store and disseminate intelligence using the QPS Email. Results of correlation analysis indicate that Sergeants and Senior Sergeants rate the procedures in place to use QPS Email to capture, store and disseminate intelligence lower than compared to Constables or Senior Constables.

Question 19 asked respondents to rate how the information and intelligence products disseminated by email provide the information to do the officer's job effectively. Results of correlation analysis indicate that Sergeants and Senior Sergeants rate the information and intelligence products disseminated by QPS Email to do their job lower than compared to Constables or Senior Constables.

Table 5.12

Correlations based on survey results for email by rank

Questions	11	12	14	15	16	17	18	19	20
Rank	-.167	-.144	-.224	-.289	-.123	-.094	-.152	-.242	-.123

5.3.4 Cronbach's alpha analysis

According to UCLA (2020), Cronbach's Alpha measures how closely related a set of items are consistent as a group. Cronbach's Alpha is a coefficient that indicates reliability or internal consistency for a group of items. Cronbach's Alpha can be written as a function of the number of test items and the average inter-correlation among the items (UCLA 2020). If the average inter-item correlation is low, the alpha will also be low. As the average inter-item correlation increases, Cronbach's Alpha also increases. The survey data were obtained by measuring the total responses from Questions 2 to 10 (SR App) separately with total responses for each Question from Question 11 to 19 (QPS Email), except for Question 13 which was removed from the test because it is dichotomous. Cronbach's Alpha was used to analyse the reliability of all items in the scale. The Cronbach's Alpha coefficient for Questions 2 to 10 is α = .91. This coefficient indicates a high level of internal consistency between questions. The Cronbach's Alpha coefficient for Questions 11 to 19 with exception of Q13 was α = .92**.** The coefficient indicates a high level of internal consistency between questions.

5.3.5 Tests of difference

A. Survey questions relating to matter, energy, and information

T-tests for dependent means were used to compare the means of two sets of scores that are directly related to each other. The dependent *t*-test can be used to test whether a difference in means between two related groups. Pairing data points and conducting the dependent sample *t*-test is a common approach to establishing causality in a chain of effects, signifying the difference between two means scores and direction of change without necessarily providing an explanation of the cause and effect.

A series of *t*-tests were conducted on the mean survey score for survey questions related to Biomatrix activity system elements with one of Goh's KM principles. For Q2, Q3 and Q4 (Matter for SR App) with the mean survey score for

Q11 and Q12 (Matter for Email), t = -16.52, p < .00001. The result is statistically significant at p < .05.

A series of t- tests were conducted on the mean survey score for survey questions related to Biomatrix activity system elements with one of Goh's KM principles. For Q5, Q6 and Q7 (Energy for SR App) with the mean survey score for Q14, Q15 and Q16 (Energy for QPS Email), t = 9.10,
p < .00001. The result is statistically significant at p < .05.

A *t*-test was conducted on the mean survey score for Q8, Q9 and Q10 (Information for SR App) with the mean survey score for Q17, Q18 and Q19 (Information for QPS Email), t = -11.88, p < .00001. The result is statistically significant at p < .05. The results of the t-test are summarised in Table 5.13.

Table 5.13

Summary of statistical significance for survey questions relating to matter, energy, and information for SR App vs QPS Email

SR App	**Matter**	**Energy**	**Information**
Email			
Matter	*t*=-16.53		
Energy		*t*=9.1	
Information			*t*=-11.88

B. Survey questions relating to product, process and people

A *t*-test was conducted on the mean survey score for Q4, Q7 and Q10 (Product SR App) with the mean survey score for Q13, Q16 and Q19 (Product QPS Email), t = 20.15, p < .00001. The result is statistically significant at p < .05.

A *t*-test was conducted on the mean survey score for Q3, Q6 and Q9 (Process SR App) with the mean survey score for Q12, Q15 and Q18 (Process QPS Email). t = -10.70, p <.00001. The result is statistically significant at p < .05.

A *t*-test was conducted on the mean survey score for Q2, Q5 and Q8 (People SR App) with the mean survey score for Q11, Q14 and Q17 (People QPS Email). t = -7.95, p < .00001. The result is statistically significant at p < .05. The results of the *t*-tests are summarised in Table 5.14.

Table 5.14

Summary of statistical significance for survey questions relating to people, process, and products for SR App vs Email

SR App **QPS Email**	**People**	**Process**	**Products**
People	*t*=-7.96		
Process		*t*=-10.7	
Products			*t*=20.16

5.3.6 Analysis of survey results

An analysis was conducted on the survey responses comparing the response scores for the same questions relating separately to SR App and QPS Email. These comparisons are expressed in percentages. Figure 5.4 graphically demonstrates how officers rated the effectiveness of the process to disseminate and store intelligence and operational information using the SR App and QPS Email. Results indicate that a higher percentage of officers rated the SR App higher than QPS Email with this question.

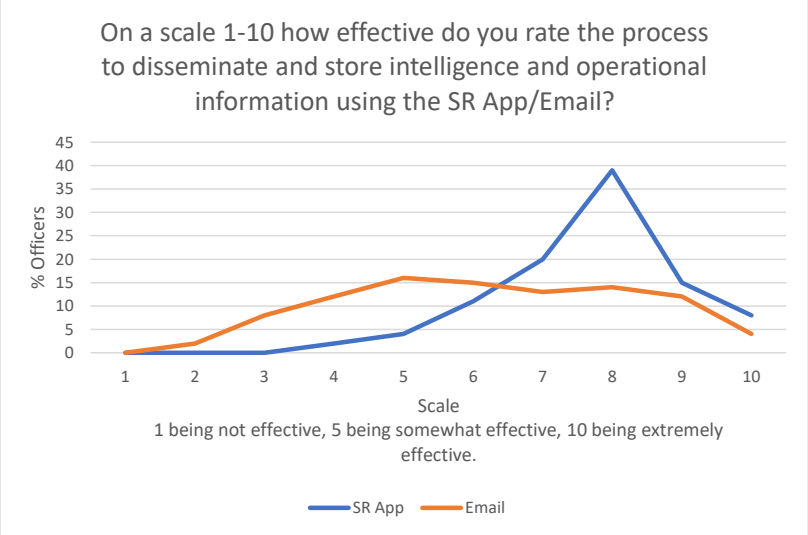

Figure 5.4 Percentage comparison of survey results SR App v QPS Email for Question 3 and Question 12

Figure 5.5 illustrates how officers rate the usefulness of the SR App and QPS Email to supporting their role. These results indicate that a higher percentage of officers rate the SR App more useful than QPS Email.

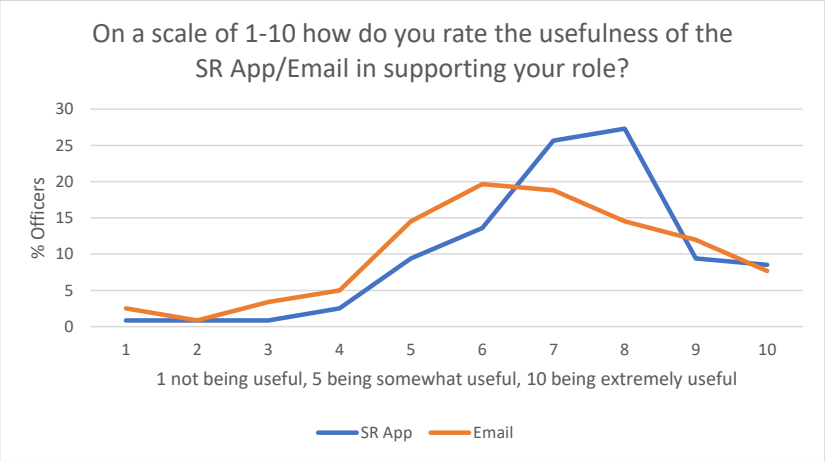

Figure 5.5 Percentage comparison of survey results SR App v QPS Email for Question 2 and Question 11

Figure 5.6 illustrates how officers rate the usefulness of the intelligence and the information products stored in the SR App compared to that with QPS Email. Survey results indicate that a higher percentage of officers rated the usefulness of the intelligence and the information products stored in the SR App higher than QPS Email.

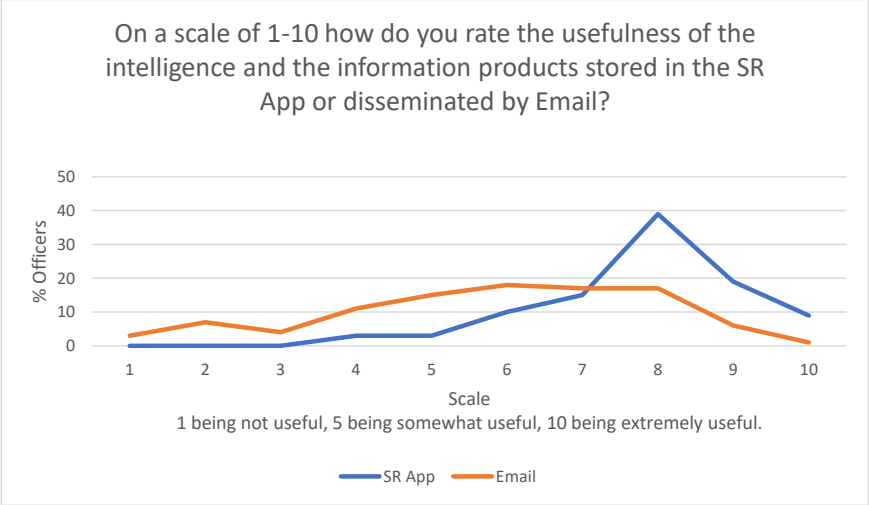

Figure 5.6 Percentage comparison of survey results SR App v QPS Email for Questions 4 and Question 17

Figure 5.7 compares how officers rated their enthusiasm to store, disseminate and access intelligence and operational information products in the SR App and QPS Email. Survey results indicate that more officers rated a higher level of enthusiasm to use the SR App than QPS Email.

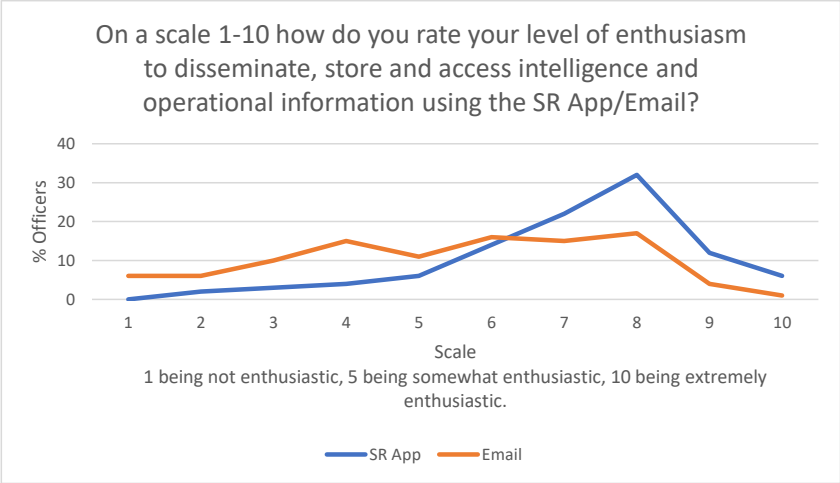

Figure 5.7 Percentage comparison of survey results SR App v QPS Email for Questions 5 and Question 14

Figure 5.8 illustrates the survey return on how officers rated their ability to access intelligence and the information on the SR App and QPS Email. Survey results indicate that a higher percentage of officers rated more ability to access intel and other information using the SR App than compared to QPS Email.

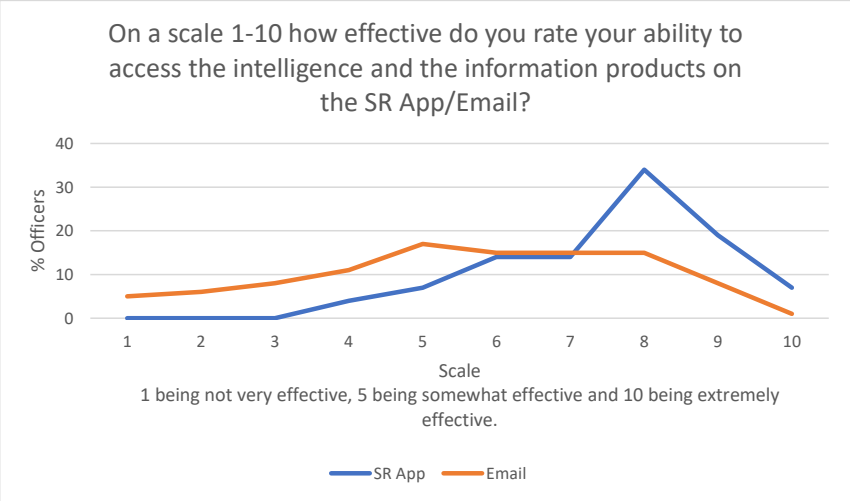

Figure 5.8 Percentage comparison of survey results SR App v QPS Email for Questions 7 and Question 16

Figure 5.9 illustrates the survey return on how officers rate the types of information and intelligence products available and or disseminated in SR App compared with QPS Email. Survey results indicate that a larger percentage of officers rated the SR App higher than QPS Email.

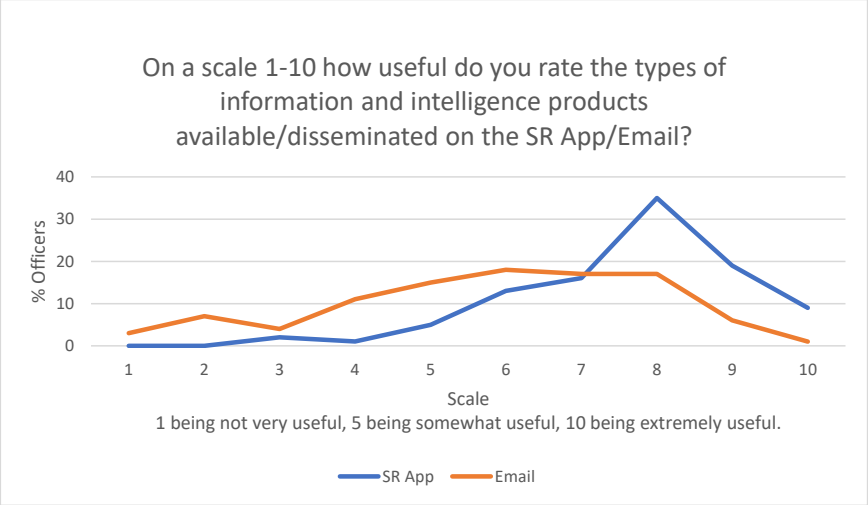

Figure 5.9 Percentage comparison of survey results SR App v QPS Email for Questions 8 and Question 17

The results from Question 13 were presented with the percentage of officers who were asked whether they filed intelligence products disseminated by email. Results show that 54% of officers indicated that they didn't file intelligence products disseminated by email, 9% of Officers said they did and 35% of officers indicated that they sometimes file intelligence products disseminated by QPS Email. These results are illustrated in Figure 5.10.

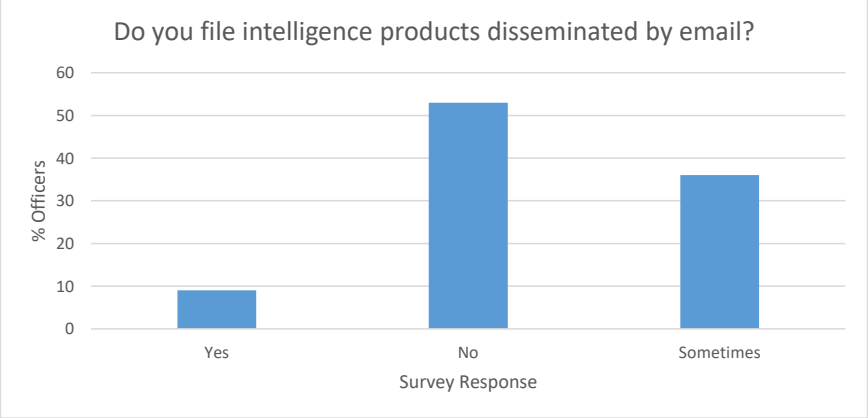

Figure 5.10 Percentage comparison of officers who file intelligence products disseminated by QPS Email (Question 13)

The results from Question 20 were presented with the percentage of officers who were asked whether they deleted information and intelligence emails before reading the content. Results show that 60% of officers sometimes deleted information and intelligence emails while approximately 9% stated they always deleted information and intelligence emails. These results are shown in Figure 5.11.

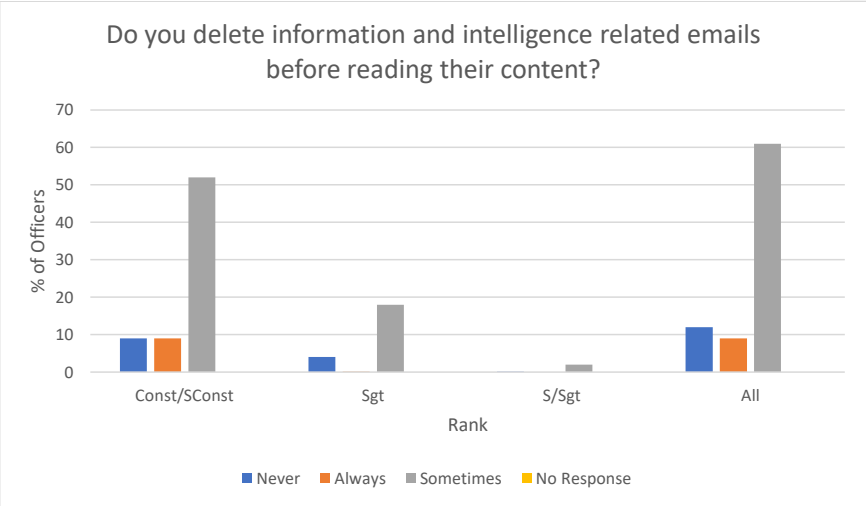

Figure 5.11 Percentage comparison of survey results by rank for Question 20

The results in Figure 5.12 show the percentage of officers who were asked whether they ever receive too much information through QPS Email to effectively process all of it in a timely manner. Results show that 78% of officers feel that they frequently receive too much information through QPS Email to effectively process.

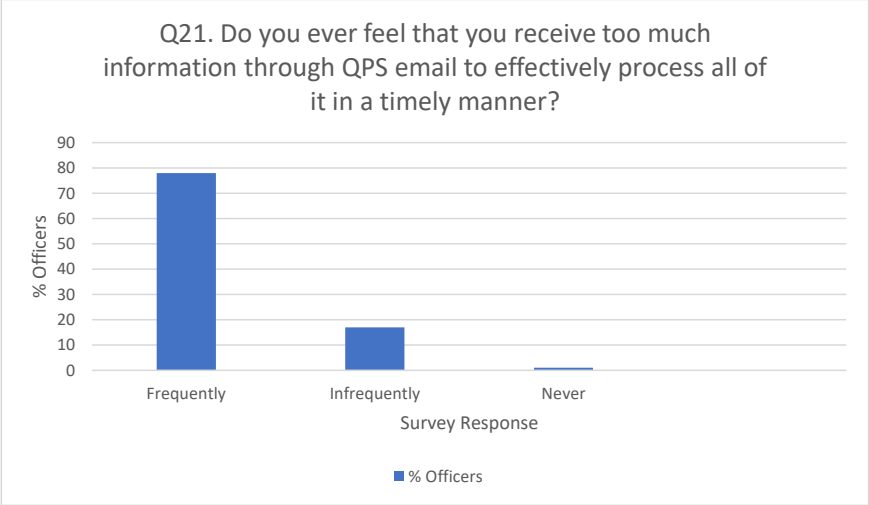

Figure 5.12 Percentage comparison of survey results for Question 21

5.3.7 Stage 2 Summary

Stage 2 of the research relied on the quantitative analysis of survey data collected from 117 participants. The survey was designed using the IDAM to determine whether the management and dissemination of intelligence and operational information was enhanced by using the SR App when compared to QPS Email.

The survey means and standard deviations results were calculated separately for questions relating to the SR App and QPS Email. Results indicate that the SR App returned higher mean scores across all questions in the survey with lower standard deviations than that compared to QPS Email. Skewness results for the SR App and QPS Email indicate a generally symmetrical distribution of data. Kurtosis results for the SR App and QPS Email remain less than 3 in all areas and were considered normal.

Results of the correlation tests for Questions 2 to 10 for the SR App show a positive linear correlation between all questions. There is also a similar result reported for questions 11 to 19 that refer to QPS Email. The correlations reported for all questions are significant at $p \leq .0001$.

Cronbach's Alpha Analysis was used to analyse the reliability of all questions. The Cronbach's Alpha coefficient calculated for Questions 2 to 10 and Questions 11 to 19 indicates high levels of internal consistency between questions. *T*-tests for

dependent means were used to compare the means for the two related sets of scores between SR App and QPS Email. The results were statistically significant across all categories with $p < .05$. Analysis of survey returns compared the responses for the same questions relating separately to the SR App and QPS Email. Results indicated that in all questions more percentage of officers rated the SR App higher than QPS Email.

Results of the survey questions relating specifically to QPS Email indicate that a high percentage of officers sometimes deleted information and intelligence-related email before reading. A high percentage of officers also frequently felt they received too much information through QPS Email to effectively process it in a timely manner.

5.4 Stage 3 and stage 4 - research interviews and focus group discussions

The results of open-ended responses to semi-structured interviews (Stage 3) and focus group discussions (Stage 4) were thematically analysed. The analysis focussed on the views expressed by the participants during the interviews and focus group discussion. The themes raised during Stages 3 and 4 were mostly consistent between the two stages and were therefore combined into the same tables. Table 5.15 provides a summary of themes using IDAM. Table 5.16 includes a sample of quotes from participants relevant to the themes and framework for the SR App. Table 5.17 provides a summary of themes using the IDAM for QPS Email. Table 5.18 includes a sample of quotes from participants relevant to the same framework for QPS Email. The results of the analysis yielded several themes. These themes are discussed using the IDAM framework and compared with the observations and comments relating to the SR App and QPS Email systems.

People and matter

A comparison of the results of the thematic analysis relating to Question 2 and 11 (People/Matter) recorded in Table 5.15 (SR App) and Table 5.17 (QPS Email) suggest that user functionality of the SR App was enhanced by the general capacity to access, store, monitor and record information. Constable 1 during interview stated: "Officer safety stuff (information) is really good. To be able to jump on the picture top ten offenders and know where they are is useful." The results from Table 5.18 (QPS Email) noted that the email system is easy to use and accessible on all QPS and

personal devices. Analysis of the email system indicates that users experience a high amount of information through email that can often contribute to the accumulation of messages and significant time spent managing information. Analysis also indicates that there is often a loss of information in the QPS Email system through poor information management practices or functionality. Senior Constable 1 during an interview stated, “Police get a lot of emails that have no bearing or significance on the day-to-day job”.

People and energy

A comparison of the results of the thematic analysis relating to Questions 5 and 14 (People/Energy) recorded in Table 5.15 (SR App) and Table 5.17 (QPS Email) indicate that improved functionality with the SR App provided time-saving benefits and assists with planning and the allocation of resources. Sergeant 1, Officer in Charge Intelligence during an interview stated: “I really like the concept, it’s saved us emailing a lot of information. We just generate the documents and drop them in (the SR App) and there they are”. The results from Table 5.18 (QPS Email) noted that users have a high acceptance of email predominantly because of its ease of use and accessibility across a wide number of personal and QPS devices. Results indicate however that there was a level of frustration and dissatisfaction due to the high flow of information and heavy email burden. Sergeant 2, Officer in Charge of Intelligence during an interview stated “My issue is we get 12 separate emails each with an intel product, it becomes email fatigue to a degree. The idea to consolidate that into a portal where you can access intel at any time you want is good”.

People and information

A comparison of the results of the thematic analysis relating to Questions 8 and 17 (People/Information) recorded in Table 5.15 (SR App) and Table 5.17 (QPS Email) indicate that information is more useful to users when it is up-to-date and caters for their intelligence needs. Access to information was at times dependent on the knowledge of the SR App technology and its features. A user with greater knowledge of the SR App would more likely access a wider range of intelligence products. Sergeant 3, Officer in Charge Intelligence during an interview outlined the wide intelligence needs of users. These included tactical intelligence for emergency incidents, operational intelligence for operational policing activities and strategic

intelligence for higher organisational needs. The results from Table 5.18 (QPS Email) noted that usefulness was enhanced by the generally high level of understanding and knowledge of the email system and the capacity to disseminate information quickly. During the interview Constable 2 however, identified that officers often get so many email messages they often don't get time to read them and often delete them without reading them.

Process and matter

A comparison of the results of the thematic analysis relating to Questions 3 and 12 (Process/Matter) recorded in Table 5.15 (SR App) and Table 5.17 (QPS Email) indicate that process effectiveness was improved through enhanced search capability and remote accessibility. These benefits were however limited by the user's knowledge of the SR App technology and internet access. During the interview, Constable 3 stated: "I don't need to go looking for an email about a BOLO (Be on the lookout intelligence document) that has come out 3 weeks ago, it's there and its accessible and in an easy place to go and find (on the SR App)". The results from Table 5.18 (QPS Email) noted that user confidence in the QPS Email system and the ability to share information quickly between users on both personal and QPS electronic devices contributed to overall process effectiveness.

Process and energy

A comparison of the results of the thematic analysis relating to Questions 6 and 12 (Process/Energy) recorded in Table 5.15 (SR App) and Table 5.17 (QPS Email) indicate that time savings and energy efficiency in the process were enhanced through the capacity to disseminate, store, and find information quickly. The level of efficiency and effectiveness obtained using the SR App was however dependent on the user's knowledge of and their ability to operate the system. By comparison, most users had a high level of understanding of the email process and were able to disseminate information quickly. Constable 4 from First Response stated: "Email has been consistent. It's been the consistent way of disseminating information traditionally". The SR App does however provide greater time savings and efficiency relating to its capacity to file information that can later be searched and found more easily. The SR App has provided an alternative to disseminating all operational information through email. Constable 5, First Response states "Intel that would normally have been sent

out through email is no longer cluttering up the email often making it difficult to find later".

Process and information

A comparison of the results of the thematic analysis relating to Question 9 and 18 (Process/Information) recorded in Table 5.15 (SR App) and Table 5.17 (QPS Email) indicate that the process management of information was affected by the capacity to store, search, filter and disseminate information. Both the QPS Email and SR App were important tools in this process. The QPS Email system was generally considered more effective to disseminate operational or tactical information in the field, while the SR App generally has more functional features to store, search, and filter information. Not all officers have access to QLite while in the field. QPS Email is accessible to all officers on their personal devices and therefore is more frequently used for this purpose. Some Investigators have not yet been issued with a QLite and therefore are dependent on their personal phones for the dissemination of intelligence by email when in the field. In comparison, first response officers are equipped with QLite and have access to the SR App both in the field and in the office, therefore having greater opportunity to access information. During the focus group discussion Investigator 1 noted; "Because once a bolo (be on the lookout for) was posted (via email) it was loaded onto QPrime, but it was never really searchable. But now I can search the description and the document (using the SR App). So that's where the advantages are. But it's not much good if you don't have a QLite."

Product and matter

A comparison of the results of the thematic analysis relating to Questions 4 and 13 (Product/Matter) recorded in Table 5.15 (SR App) and Table 5.17 (QPS Email) generally indicate that the SR App had a greater capacity to store and filter a wider range of information and intelligence type (ie: tactical, operational, strategic) than compared with QPS Email. An Intelligence Officer during a Focus Group Discussion highlighted the importance of being able to store information or intelligence so that it can later be found when required "I can make the fanciest of intelligence products and stick them somewhere but nobody's going to give a damn until they need to give a damn". It was noted that both the QPS Email system and SR App were generally considered important tools to disseminate intelligence and other operational

information to the Police. Notably, Intelligence Officers generally began to use QPS Email to send out hyperlinks to information and intelligence holdings stored in the SR App, thus directing specific information to users. Based on feedback, officers usually considered the stolen vehicle hotlist, offender curfew list, missing persons list, daily intelligence reports and top ten offenders list as high value. During focus group discussions Investigator 2 stated “Investigators don’t have QLites, and I know that’s a really sore point. From the uniform staff the feedback we got is there is probably a suite of 12 different intelligence products they like”.

Product and energy

A comparison of the results of the thematic analysis relating to Questions 7 and 16 (Product/Energy) recorded in Table 5.15 (SR App) and Table 5.17 (QPS Email) generally indicate access to intelligence and information products via SR App and QPS Email were enhanced through ease of use. The difference noted was that the ease of use for the SR App related specifically to its search capability and the capacity to store and manage information in a single location. The ease of use for QPS Email is related to the high level of user understanding of the email system and the capacity to access QPS Email on all personal devices giving mobility to more users. Factors affecting the general accessibility of intelligence and information using the SR App were user access to QLites, knowledge of the SR App and access to the internet in rural or blackspot areas. The factors affecting the overall accessibility to intelligence and information using email were the limited search functionality and capacity to manage and store large amounts of information. Email was also often affected by access to the internet. An observation made by an Intelligence Officer during the focus group discussion was the functionality of the SR App allows intelligence officers to monitor information and product usage giving them the capacity to know whether their information products are being used. “the reason why we like our SR App so much is we can see how many people are accessing these products”.

Product and information

A comparison of the results of the thematic analysis relating to Questions 10 and 19 (Product/Information) recorded in Table 5.15 (SR App) and Table 5.17 (QPS Email) generally indicate operational intelligence products are valued by police when the intelligence provides priority targets, tasked patrol areas, information is up-to-date and timely and intelligence is relevant to the tactical, operational, or strategic needs. Information and Intelligence are not widely valued when it is low-grade or no longer current. “The main thing General Duties Police want to know is who is wanted and who is right to go into the bin (custody). They just want to chase the crooks. Investigators sort of need that considerable background and work up”. (Intelligence Officer 3 – Focus Group).

Table 5.15

Thematic analysis of SR App using IDAM

	People	**Process**	**Product**
Matter (Technology)	People/Matter **Question 2** User functionality was improved through: • Search capability • Remote access to information. • Capacity to record information. • Access to up to date information. • Capacity to monitor intelligence usage.	Process/Matter **Question 3** Process effectiveness was improved through: • Enhanced search capability • Enhanced remote access to information. • Enhanced capacity to record information. • Access to multiple forms of information. • Single storage of information. Effectiveness was limited by: • Knowledge of SR App technology and access to training. • User capability. • Access to internet and bandwidth.	Product/Matter **Question 4** The Information and Intelligence products valued in the SR App were: • Curfew information. • Stolen vehicle list. • Top 10 Offender list • CCTV Mapping. • Daily Intelligence reports. • Missing Person Flyers • Offender profiles. • Information relevant to crime trends. The SR App has high level of functionality to store, search and disseminate information products that include word documents, pdf files, .mov files and .jpeg files.
Energy	People/Energy **Question 5** Improved functionality provided the following benefits for users: • Time Savings • Assists planning and allocation of resources. • Reduction in email burden and white noise.	Process/Energy **Question 6** Time savings and energy efficiency in process were enhanced through: • Capacity to disseminate information. • Capacity to store and search for information. • Greater mobility. • Capacity to share timely and relevant information. • Capacity to share information. • Provides time savings. Time savings and energy efficiency were dependant on: • Knowledge of SR App technology. • User capacity. • Level of training.	Product/Energy **Question 7** Access to intelligence and information products were enhanced through: • Ease of use. • Search capability. • Capacity to store information in single location. • Access to intelligence was limited by: • Access to internet • Access to QLites. • Knowledge of SR App. • Access to training. • User capability.

	People	Process	Products
Information	People/Information **Question 8** Usefulness of information and intelligence products for users included: • Information is regularly updated. • Product variety caters for wide audience. • Provides platform to view video files.	Process/Information **Question 9** Information process was enhanced through: • Time savings. • Capacity to store large amounts of information. • Capacity to search, filter and sort information. • Capacity to monitor information usage.	Products/Information **Question 10** Intelligence products are valued by police when: • Intelligence provides priority targets • Patrol area and times are specific. • Information is up to date and timely. • Information is reflective of crime trends.

Table 5.16

Sample of feedback relating to SR App during focus group discussion and interviews using IDAM

	People	**Process**	**Product**
Matter	People/Matter **Question 2** **Access up to date intelligence:** The Intelligence I would probably say is one of the better features of the SR App just because the Intel Sections are constantly updating it. (Interview- Constable First Response) **Search Capability:** Officer Safety stuff it's really good to be able to jump on the picture top ten offenders and know where they are is useful (Interview- Constable First Response) **Capacity to monitor intel usage:** Yeah, the reason why we like our SR App so much is as we can see how many people are accessing these products. (Focus Group – Intelligence)	Process/Matter **Question 3** **Enhanced search capability:** You know where all that information is. I don't have to go looking for an email about a BOLO that has come out 3 weeks ago it's there and its accessible and in an easy place to go and find. (Interview- Constable First Response) The great part about that is we can type in dude with red hat or red hat and you'll get anything that's ever mentioned about red hats. (Focus Group – First Responders)	Product/Matter **Question 4** **Variety of Products:** Investigators don't have Q lights and I know that's a really sore point. From the uniform staff the feedback we got is there is probably a suite of 12 different intelligence products they like. (Focus Group – Investigators) I think from a CIB perspective, what you produce is quite good. I think we have the luxury of having Intel embedded with us, so if there were any changes, that would have been brought up to Intel straight away. (Focus Group – Investigators)
Energy	People/Energy **Question 5** Time Savings: I think it is efficient. I really like the concept it's saved us emailing a lot of information. Its saved us sending out documents every day by email. I still send out the email with the link. The email goes out to between 400-500 people every morning across our District. I think it is effective. We generate the documents, drop them in the folders. I like that aspect. (Interview – Officer in Charge Intelligence)	Process/Energy **Question 6** **Capacity to store and search for information:** Intel that would normally have been sent out on email it is no longer cluttering up the email often making it difficult to find later. (Interview- Constable First Response) Because once a BOLO was posted it was loaded onto Q Prime, but it was never really searchable. But now the intel can search the description and the document. So that's where the advantages are (Focus Group – Investigators)	Process/Information **Question 9** **Time Savings:** Because once a bolo was posted (via email) it was loaded onto Q Prime, but it was never really searchable. But I now can search the description and the document (using the SR App). So that's where the advantages are, but it's not much good if you don't have a Q Lite. (Investigator – Focus Group)
Information	People/Information **Question 8** **Product variety caters for wide audience:** We've got tactical intelligence which is what we get a lot of demand supporting critical incidents and operations. We've got the operational intelligence which supports General Duties policing. Looking at overall crime trends, what's	Process/Information **Question 9** **Time Savings:** Because once a BOLO was posted (via QPS Email) it was loaded onto QPrime, but it was not searchable. But I now can search the description and the document using the SR App. So that's where the advantages are, but its not much good if you don't have a QLite (Investigator – Focus Group)	Products/Information **Question 10** **Information is up to date and timely:** The main thing General Duties Police want to know is who is wanted and who is right to go into the bin (custody). They just want to chase the crooks. Investigators sort of need that considerable background and work up. We've had a few things run through using for

Information	People	Process	Product
	going to happen this week, what offenders are active, new crime trends. We've also got the strategic space which supports higher level strategy. (Interview – Officer in Charge Intelligence)		cigarette breaks or running IPND. Background investigative work sort of looking at the phone records, financial records those sorts of things. (Interview – Officer in Charge Intelligence)

Table 5.17

Thematic analysis of QPS Email using IDAM

	People	Process	Product
Matter	People/Matter **Question 11** Email was considered useful for users because: • Ease of use. • Accessibility on QLites, desktop computers and personal devices. Organisational reliance on email communications created: • Information overload for some users. • Accumulation of email messages. • Receipt of non-relevant information. • Excessive time spent managing email messages. • Loss of information caused by bulk delete actions or inability to find old email messages.	Process/Matter **Question 12** Process effectiveness was improved through: • Enhanced remote access including ability to access on personal devices. • Information can be shared quickly between users. Effectiveness was limited by: No capacity to record information or intelligence on central data base.	Product/Matter **Question 13** The Intelligence product disseminated via an email link to the SR App and were of high value to Police were: • Offender curfew information. • Stolen vehicle list. • Expression of Interest – Special Duties. • Top 10 Offender list The Email has high level of functionality to disseminate information however less capacity to search and store. products.
Energy	People/Energy **Question 14** There is a high level of enthusiasm to use email by users because: Simple to use Wide accessible on QLites and personal devices. Enthusiasm to use email creates: • High flow of information creating heavy email burden. • Leads to high storage of	Process/Energy **Question 15** Time savings and energy efficiency were enhanced through process: • Capacity to disseminate information quickly. • Mobility and accessibility. • Capacity to provide timely and relevant information. • Enhanced capacity to share information. • User confidence	Product/Energy **Question 16** Access to intelligence and information products via email were enhanced through: • Ease of use. • Access through personal devices. Access to intelligence and information products via email was limited by: • Access to QPS Ipads (Q Lites). • Search capability. • Capacity to store and manage information.

Energy	**People** • duplicate information. • Creates risk of message loss. • Creates user frustration and dissatisfaction.	**Process** Time savings and energy efficiency were negatively impacted by: • Limited capacity to store and search for information.	**Product**
Information	People/Information **Question 17** Usefulness for users was enhanced through: • Capacity to disseminate information quickly. • Email is accessible on personal devices and QLites. • High degree of user confidence in email technology. Intel or information products receiving positive feedback: • Daily hotlist for stolen vehicles. • Top 10 wanted offenders. • Prison release notifications. • Persons wanted on warrant.	Process/Information **Question 18** The process management of information was affected by: • Capacity to search, filter and disseminate information. • No capacity to monitor information usage. • Greater access to users whilst in the field on their personal devices.	Products/Information **Question 19** Intelligence products are valued by police when: • Intelligence provides priority targets and tasked patrols. • Information is up to date and timely. • Information is reflective of crime trends. • Intel relevant to tactical, operational, or strategic environmental needs.

Table 5.18

Sample feedback relating to QPS Email during focus group discussion and interviews using IDAM

	People	**Process**	**Products**
Matter	People/Matter **Question 11** **Accumulation of email messages:** Police get a lot of emails that probably have no bearing or significance on the day-to-day job. A lot of PSBA emails that don't seem to have any relevance to what we're doing. You haven't time so you just hit control and delete everything. (Interview-S/Constable First Response)	Process/Matter **Question 12** **Enhanced remote access including ability to access on personal devices.** Anywhere, they've got mobile coverage they can access information on email. (Interview – Intelligence Officer)	Product/Matter **Question 13** **Intelligence disseminated by email:** In terms of getting intel quickly. It still works (email). Yesterday the guys attended a scene viewed the CCTV, got a still shot of the primary suspect and emailed it through to other crews that were patrolling the area. (Focus Group – Investigators)
Energy	People/Energy **Question 14** **High flow of information creating heavy email burden or white noise.** Their issue and my mine is that we get 12 separate emails each with an intel product it becomes email fatigue to a degree. So the idea was to consolidate that into a portal where you can access intel at any time you want. So if they (uniform crews) are out on the road they can access their intel. (Interview-Officer in Charge Intelligence)	Process/Energy **Question 15** **User confidence:** Email has been consistent. It's been the consistent way of disseminating information traditionally. (Interview- Constable First Response) **Mobility and access:** Email is probably more useful for me personally. I can access it on my personal device. (Focus Group – Investigators)	Product/Energy **Question 16** **Capacity to store and manage information:** Honestly, I set up multiple files on my emails and send all the bolo's there and just try to look at them there because they clog up your email. And then once a week I go through and look at the bolo flyers and to see if anything pops out to me, so I really dislike the old school email. (Interview-Constable First Response) Being operational you don't get the time to sit down and actually go through your email. So really looking for something that gives you that important stuff, so you don't have to search through your email. (Interview- Constable First Response)
Information **Information**	People/Information **Question 17** **High degree of user confidence in email technology:** There would be advantages in storing intel in the App because people probably get the email and just delete the email it. Yeah, we get that many emails that's it's just becomes a mailbox filler. (Interview – Constable First Response)	Process/Information **Question 18** **Capacity to search, filter and disseminate information.** It becomes a bit of an avalanche. I think it is easy to get lost. When people start a shift, they have 20-30 emails clicking through and deleting all the guff from whatever computer systems are back on and off and a lot of stuff that's irrelevant to the junior officer. I think that stuff (intel) can get lost in there and get easily deleted.	Products/Information **Question 19** **Intel products are valued by police when information is up to date and timely.** Now with Police Link and Crime Stoppers and things like that and particularly with the online we get much more information a greater volume but with the greater volume has been some degradation of quality. (Interview – Officer in Charge Division)

	People	Process	Product
		(Interview – Constable First Response)	We really need to refine what we send out on the intel stuff because you just get spammed. Yeah, you just get rid of it. Unless you see something that's relevant to you. (Interview – Officer in Charge)

Analysis of open-ended responses to semi–structured interviews and focus group discussions revealed many similar themes. These themes were summarised using the IDAM framework. The results of this analysis for the SR App and QPS Email were then compared.

Thematic analysis indicated that the functionality of the SR App was generally enhanced by the capacity to access, store, monitor and record information. The QPS Email was widely accepted as easy to use and more accessible using personal devices including mobile phones. Users however reported the high flow of information through QPS Email often created a significant amount of user time spent on managing email. Some users reported deleting or not reading emails because of time limitations. Comparatively, it was reported that the SR App's general functional capacity to manage and search for information created broad time-saving benefits for users. SR App users reported that this functionality also assisted with planning and the allocation of resources.

Analysis revealed that the SR App generally provided users with a wide variety of information and intelligence products that were consolidated and searchable on the one database. However, it was occasionally observed that user's ability to access this information was often dependent on their knowledge of the SR App and its features. Comparatively, it was noted that email was broadly considered to be useful for disseminating information quickly to more people, particularly in tactical or urgent operational scenarios. This is often because most users have QPS Email access on their personal devices whereas the SR App is only accessible on QPS Desktop computers and QLites. Initially, during this study, most investigators and some first response police were not issued with QLites limiting the capacity to access the SR App whilst in the field however, this situation has improved with the continued rollout of QLites to police providing better access to online information.

Analysis reveals that operational intelligence and information products are widely valued by police when the information is up to date and provides priority targets and tasked patrol areas. Information is commonly not valued when it is low grade, no longer current or not relevant. Valuable intelligence and operational information generally assist officers with planning and the allocation of resources.

5.5 Stage 5 - time and motion study

Mean and standard deviation results

The following data report the time-in-motion results for 20 participants. These include means and standard deviations for the following tasks.

Task 1: The average length of time in seconds to access intelligence on the SR App using a desktop computer. These results are recorded in Table 5.19.

Task 2: The average length of time in seconds to access intelligence on QPS Email using a desktop computer. These results are recorded in Table 5.19.

Task 3: The average length of time in seconds to access intelligence on the SR App using Q Lite. These results are recorded in Table 5.20.

Task 4: The average length of time in seconds to access intelligence on QPS Email using Q Lite. These results are recorded in Table 5.20.

Each of these Tasks was repeated and subsequently labelled as Test 2.

The mean time taken by participants to access intelligence on the SR App using a desktop computer was 19.8 seconds (*SD* = 5.3); the mean time taken by participants to access intelligence on QPS Email using a desktop computer was 20.0 seconds (*SD* = 5.4); the mean to access intelligence on the SR App using QLite was 16.6 seconds (*SD* = 3.5); and the mean time in seconds to access intelligence on QPS Email using QLite 6.2 seconds (*SD* = 1.8). A summary of mean time results per task is recorded in Table 5.21.

Table 5.19

Time and motion results Desktop Computer

Participant	Task 1- Access to SR App Test 1 (seconds)	Task 1 Access to SR App Test 2 (seconds)	Average (seconds)	Task 2 Access to Email Test 1 (seconds)	Task 2 Access to Email Test 2 (seconds)	Average (seconds)
1		13	13	16	16	16
2	17	15	16	19	17	18
3	20	11	15.5	17	17	17
4	17	28	22.5	13	15	14
5	18	18	18	13	16	14.5
6	26	15	20.5	23	18	20.5
7	29	34	31.5	30	28	29
8	21	16	18.5	30	22	26
9	14	13	13.5	15	13	14
10	37	20	28.5	49	11	30
11	19	18	18.5	11	17	14
12	30	28	29	27	16	21.5
13	16	18	17	15	18	16.5
14	29	17	23	29	25	27
15	18	19	18.5	6	16	11
16	16	13	14.5	13	13	13
17	22	17	19.5	29	17	23
18	28	21	24.5	44	24	34
19	17	20	18.5	14	33	23.5
20	17	12	14.5	14	19	16.5
Mean	**21.63**	**18.3**	**19.8**	**21.4**	**18.6**	**20**
SD	**6.3**	**5.9**	**5.3**	**11.2**	**5.4**	**6.5**

Table 5.20

Time and motion results QLite

Participant	Task 3- Access to SR App Test 1 (seconds)	Task 3 Access to SR App Test 2 (seconds)	Average (Seconds)	Task 4 Access to Email Test 1 (seconds)	Task 4 Access to Email Test 2 (seconds)	Average (Seconds)
1	21	11	16	7	5	6
2	11	14	12.5	7	5	6
3	12	14	13	6	5	5.5
4	17	11	14	6	3	4.5
5	12	11	11.5	7	3	5
6	18	14	16	4	5	4.5
7	18	16	17	4	4	4
8	11	13	12	7	4	5.5
9	20	11	15.5	6	4	5
10	16	24	20	6	3	4.5
11	21	17	19	8	6	7
12	21	10	15.5	7	6	6.5
13	22	16	19	8	7	7.5
14	17	17	17	12	6	9
15	28	17	22.5	9	6	7.5
16	12	25	18.5	15	6	10.5
17	26	21	23.5	n/a	n/a	n/a
18	n/a	n/a	n/a	n/a	n/a	n/a
19	n/a	n/a	n/a	n/a	n/a	n/a
20	n/a	n/a	n/a	n/a	n/a	n/a
Mean	**17.8**	**15.4**	**16.6**	**7.4**	**4.9**	**6.2**
SD	**5.1**	**4.5**	**3.5**	**2.8**	**1.3**	**1.8**

One-Way MANOVA

Multivariate analysis of variance (MANOVA) indicated that there was a statistically significant difference in time to access intelligence between groups (F = 31.25, $p < .00001$). The mean time in motion results for each task is recorded in Table 5.21 and a summary of data of mean time in motion results is recorded in Table 5.22 and Table 5.23. Tukey's honestly significant difference (Q) indicated that while there was no statistically significant difference in time to access intelligence between Task 1 and Task 2, between Task 1 and Task 3 and between Task 2 and Task 4, there was a difference between Task 1 and Task 4 (Q = 12.0, $p < .0001$), between Task 2 and Task 4 (Q = 12.2, $p < .00001$) and between Task 3 and Task 4 (Q = 9.2, $p < .00001$). These data are recorded in Table 5.24. From these data, the average length of time in seconds to access intelligence on QPS Email using QLite was the most efficient use of time, while no difference was observed for accessing intelligence on the SR App using a desktop computer, accessing intelligence on QPS Email using a desktop computer, or accessing intelligence on the SR App using QLite.

Table 5.21

Mean time and motion results per task

Treatment 1 (Task 1)	Treatment 2 (Task 2)	Treatment 3 (Task 3)	Treatment 4 (Task 4)
13	16	16	6
16	18	12.5	6
15.5	17	13	5.5
22.5	14	14	4.5
18	14.5	11.5	5
20.5	20.5	16	4.5
31.5	29	17	4
18.5	26	12	5.5
13.5	14	15.5	5
28.5	30	20	4.5
18.5	14	19	7
29	21.5	15.5	6.5
17	16.5	19	7.5
23	27	17	9
18.5	11	22.5	7.5
14.5	13	18.5	10.5
19.5	23	23.5	6
24.5	34		
18.5	23.5		
14.5	16.5		

Table 5.22

Summary of data for Multivariate analysis of mean time and motion results

Treatment	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Total
N	20	20	17	16	73
$\sum X$	395	399	282.5	98.5	1175
Mean	19.8	19.9	16.6	6.1	16.1
$\sum X^2$	8331.5	8767.5	4890.8	654.3	22644
SD	5.3	6.5	3.5	1.8	7.2

Table 5.23

Multivariate analysis results of time and motion study

Source	*SS*	*df*	*MS*	
Between-treatments	2149.5	3	716.5	F=31.25 p<.00001
Within-treatments	1581.82	69	22.93	
Total	3731.3288	72		

Post Hoc Tukey HSD

Table 5.24

Results of Post Hoc Tukey analysis

Pairwise Comparisons		$HSD_{.05}$ = 4.1934 $HSD_{.01}$ = 5.1455	$Q_{.05}$ = 3.7233 $Q_{.01}$ = 4.5687
T_1:T_2	M_1 = 19.75 M_2 = 19.95	0.20	Q = 0.18 (p = .99929)
T_1:T_3	M_1 = 19.75 M_3 = 16.62	3.13	Q = 2.78 (p = .21065)
T_1:T_4	M_1 = 19.75 M_4 = 6.16	13.59	Q = 12.07 (p = .00000)
T_2:T_3	M_2 = 19.95 M_3 = 16.62	3.33	Q = 2.96 (p = .16587)
T_2:T_4	M_2 = 19.95 M_4 = 6.16	13.79	Q = 12.25 (p = .00000)
T_3:T_4	M_3 = 16.62 M_4 = 6.16	10.46	Q = 9.29 (p = .00000)

5.6 Summary of results

The results were reported according to the IDAM framework outlined in Chapter 4. Stage 1 of the research utilised the SharePoint Search Analytics Function to calculate the intelligence product usage for the four police districts in the Southern Region. This analysis shows the most frequently used intelligence product for each district and the number of site visits. This included a record of all unique users to the site over the same period. Results show that each district developed intelligence and information products that were unique to their area. However, many of the intelligence and information products were similar in all districts. This included the Top Ten Offenders list, Missing Persons, and Vehicles of Interest. These results will be discussed further in Chapter 6.

Stage 2 of the research utilised survey data from a sample of 117 participants. The means and standard deviations were calculated from survey responses relating to both the SR App and QPS Email. The same was calculated for each of the responses

based on the elements of the IDAM framework. The results of the survey for the SR App across all elements of the framework returned a higher median than compared to QPS Email. Both SR App and QPS Email recorded low standard deviations across all elements of the framework indicating predictable returns for each question. Results of Pearson Correlation analysis for the survey responses indicated a positive linear relationship for all questions relating to the SR App and QPS Email. Results of a Cronbach's Alpha analysis indicate a high level of consistency for all questions relating to both the SR App and QPS Email. Results of a *t*-test relating to the IDAM framework indicate all results were statistically significant. Exploratory Factor analysis indicates that questions relating to both the SR App and QPS Email have a medium to high factor loading.

The qualitative results reported in research interviews and focus group discussions were combined into a series of tables structured on the IDAM framework for the SR App and QPS Email. Thematic analysis undertaken revealed many of the same themes. The analysis revealed that the SR App generally provided an enhanced capacity to search, store and manage intelligence and information compared to QPS Email, however, email was widely considered an effective method of delivering information on the basis that more officers had access to email on their personal devices. These results will be discussed further in Chapter 6.

The quantitative results reported in the Time and Motion Study revealed that accessing intelligence via QPS Email on the QLite was the most time efficient. Although the dissemination of intelligence products was often performed using multiple individual emails and therefore increased the overall time to disseminate more operational information and intelligence, participants however noted the time savings created using the search function in the SR App providing quicker access to historic information. There was no difference observed for accessing intelligence on the SR App using a desktop computer, accessing intelligence on QPS Email using a desktop computer or accessing intelligence on the SR App using QLite. These results will also be discussed further in Chapter 6.

Chapter 6: DISCUSSION

6.1 Introduction

Research Question 1 sought to determine whether the management and dissemination of operational information to police can be performed more efficiently and effectively in the QPS. The results of this research demonstrated that using the SR App and SharePoint technology in this work-based case study that can be.

Research sub-question 1 sought to determine what operational information and intelligence operational police officers prefer. The results of this study found that there is no preferred operational information and intelligence product over another. Instead, the research showed that officer intelligence needs are based on the criminal environment they work in, this includes their location or station where they work from, the officer's role within the organisation, for example, whether they are a first responder or investigator and the rank and responsibility they hold. This research showed that whilst there were similar types of information and intelligence disseminated across the Southern Region, there were exceptions. These were cases where crime was unique to a specific area and so this was reflected in the different operational information and intelligence disseminated. In other examples where crime trends were similar over a larger area and extended across district, divisional and regional boundaries, the information, and intelligence were often similar. This research confirms that operational information and intelligence products must remain current to the criminal environment to deliver effective strategy and to maintain officer confidence in the intelligence product and the intelligence system.

Research sub-question 2 sought to determine whether operational information and intelligence can be delivered in a more effective and efficient way using SharePoint Application Technology, i.e., SR App. The results of this study found that it can be used to build an effective KM System to manage and disseminate operational information to intelligence to police. The results of this research support the argument that operational information and intelligence can be managed and disseminated more efficiently and effectively using the SR App than compared with QPS Email.

This discussion will summarise the research results and compare them to previous research outlined in the literature review chapter. The discussion will be formatted using the IDAM. The discussion will conclude by answering the research questions using the IDAM framework in this response.

A summary of the research shows in Figure 4.5, Percentage comparison of survey results for Question 2 and Question 11 shows that a higher percentage of officers rate the SR App as more useful in supporting their role than with QPS Email System. A Cronbach's Alpha analysis indicated that there was a high level of internal consistency between questions relating specifically to the SR App and those relating specifically to the QPS Email System. The coefficient for Questions 2 to 10 (SR App) were $\alpha = .91$ and the coefficient for Questions 11 to 19 (QPS Email) were $\alpha = .92$. The test of difference scores conducted on the mean survey results relating to questions addressing the KM principles of people, process, and products for the SR App and QPS Email System were statistically significant, supporting results that indicated a higher mean response across the people, process and product categories for the SR App than compared to QPS Email. These results indicate that the SR App in the product category provided better features that enabled knowledge to be structured and mapped more efficiently and that knowledge was also more effectively embedded into new intelligence products and services. In the process category, the results show that knowledge was captured and reused more efficiently and effectively enhancing the capacity to share knowledge or benefit from lessons learnt. This included the capacity to measure and manage the value of knowledge-based assets by using the analytics function in the SR App. In the 'people' category, the SR App was better able to facilitate the creation of new knowledge by supporting the formation of what Goh describes as intellectual capital teams. Intellectual capital teams are groups of people from multiple disciplines who were able to contribute to the development of new KM practices and to the management and enhancement of knowledge databases facilitating the knowledge capital flow. These contributions represent what Goh argues to be the innovation outcomes of effective KM Strategy contributing to organisational learning through ongoing innovation.

The results of the research based on the elements of the Biomatrix activity system framework, matter, energy, and information also support the argument that operational information and intelligence can be managed and disseminated more

effectively and efficiently using the SR App than compared with QPS Email. The test of difference scores conducted on the mean survey results relating to questions addressing the Biomatrix activity system framework of matter, energy, and information for the SR App and QPS Email System were statistically significant supporting results that indicated a higher mean response across the matter, energy and information categories for the SR App than compared with QPS Email. These results indicate that in the 'matter' category, the software design features in the SR App enhanced the capacity to deliver and manage operational information and intelligence more effectively. In the 'energy' category, the mean results indicated that police officers had a higher level of enthusiasm to use the SR App to manage and disseminate operational information and intelligence. Mean survey results also indicated that officers believed that the SR App provided greater time savings when capturing, storing, and disseminating operational information. This also included the enhanced capacity to access intelligence and information products more effectively. In the information category, the results indicate that officers found the type of information and intelligence products on the SR more useful and that the management of that information and intelligence was done more effectively. The mean results also indicated that officers believed the information and intelligence products in the SR App allowed them to do their job more effectively than compared with the information and intelligence products disseminated by QPS Email.

The Information Delivery Assessment Model shown in Table 5.1 was developed on the theoretical foundations of Biomatrix Systems Theory using Dostal et al. (2012) Biomatrix activity systems approach and Goh's (2005) KM principles. The research was conducted using the elements of this framework to evaluate whether the management and dissemination of operational information and intelligence to police can be performed more efficiently and effectively in some or all areas using KM principles. This chapter will use the IDAM framework to discuss the results of this research including their relationship with the survey questions.

Table 5.1

Information and Delivery Assessment Model (IDAM) using combined elements of Biomatrix activity system and KM principles

		Knowledge Management Principles		
		People	**Process**	**Product**
Biomatrix Activity System	**Matter**	**People/Matter**	**Process/Matter**	**Product/Matter**
	Energy	**People/Energy**	**Process/Energy**	**Product/Energy**
	Information	**People/Information**	**Process/Information**	**Product/Information**

6.2 People and matter – Does the technology support police?

The People (Goh, 2005) and Matter (Dostal et al., 2006) elements of the IDAM focused on evaluating whether the SR App and QPS Email System technology (matter) supported the role of the user (people). In the Stage 2 survey, most officers rated the SR App more useful in supporting their role than compared with QPS Email. The survey results indicated that on average, officers rated the SR App a score of 7.2 on a 10-point Likert Scale where 1 indicated not very useful, 5 indicated somewhat useful and 10 indicated extremely useful. The survey results indicated that on average, officers rated the QPS Email System a score of 6.64. The standard deviation results for the SR App were 1.68 and 2.04 for QPS Email, indicating low variations, with generally consistent results across the survey. Pearson Correlation Coefficient Analysis was conducted to analyse the relationship between each survey question and the relationship between officers of the rank of Sergeant/Senior Sergeant and Senior Constable/Constable. Question 2 relating to the people/matter elements of the IDAM for the SR App stated: On a scale 1-10 how do you rate the SR Apps general usefulness in supporting your role? Results indicated a negative linear relationship between rank and response rating showing that Senior Constables and Constables were more likely to rate the SR App higher than compared with Sergeants or Senior Sergeants. The results indicate that Constables and Senior Constables are more likely to agree that the SR App support their role compared to Sergeants or Senior Sergeants.

A thematic analysis was conducted on the responses for Stage 3 (Research Interviews) and Stage 4 (Focus Group Discussion). Results indicate that the enhanced functionality of the SR App contributed to its inherent usefulness for users, supporting

the results of the survey. Functional features included the capacity to search and access information across the entire database including the capability to search for keywords within word documents and excel files as well as the title of documents including jpeg and pdf files. Participants noted the capacity to upload operational information and other intelligence documents onto the SR App including the ability to view video and jpeg files. Officers noted that they were able to use the scrolling function to review information quickly, having the capacity to swiftly recognise the most relevant information rather than having to spend more time opening individual files or messages to read their content. Other features included the capacity to comment on, forward and share intelligence products to other specific users or members of workgroups.

Intelligence Officers also noted their capacity to measure intelligence usage, using the SharePoint analytics function to determine what intelligence products were being opened more often. Intelligence officers were able to use this information to design products that were best meeting the intelligence and operational information needs of users. These observations are consistent with the results of previous studies, Razmerita et al. (2016) noted that knowledge sharing is better supported when KM processes facilitate the management and dissemination of personal and organisational knowledge through multimodal interaction. Turk (2013) pointed out that people naturally interact with the world multimodally. Multimodal interaction provides the technology user access to more information through multiple modal channels that include site, touch, sound, and vision (Turk, 2013). Less information is provided when information is communicated through a single modal form for example text on a computer screen. The SR App provides users with multiple options to disseminate and manage information for example, using video, blog comments, word docs and pictures increases the opportunity for information to be better understood and shared more effectively.

Participants noted that the ease of use of the QPS Email System contributed to its inherent usefulness. This included the capacity to access email on QLite and other personal mobile devices which were particularly important for officers who were not issued with a QLites. Users reported that they were familiar with the QPS Email System and were able to send messages to any user or group of users quickly from any device or location within mobile reception. Whittaker and Sidner (1996) noted that

email was an attractive method of disseminating information quickly and noted that email was becoming more frequently used for many different tasks that it was never originally designed or intended to perform. In a study by Vacek (2014) on email overload he noted that despite improvements in technology and greater organisational awareness, email messaging is expected to continue to increase. The QPS is likely to experience a similar trend with improvements in technology and mobility facilitating information dissemination on both personal and QPS devices. The thematic analysis noted that users were often distracted by the high flow of email and push notifications that in some cases required significant time to manage. This ultimately impacted their capacity to perform other functions including response to calls for service.

The interruption of email whilst performing other functions can affect the time it takes to perform other duties, often leading to inefficient work practices. Hemp (2006) noted that in a study undertaken by Microsoft that it takes a person on average 25 minutes to regain concentration on a task after responding to an interrupting email message. Hemp (2006) reported that knowledge workers spend an average of 20 hours a week managing email which is estimated to cost the US economy $900 billion a year. Participants noted the high volume of emails contributed to the accumulation of unread email messages. Some officers reported deleting emails they did not have time to read, or they felt were not relevant to their personal or professional interest. Hemp (2006) highlighted that this is a common trait and that for every 6 emails that are initially ignored, 5 are eventually deleted without ever being read. Respondents reported that it was likely that these practices lead to the loss of potentially relevant information.

These results are consistent with research by Burcher and Whelan (2018) that concluded that many current systems used to share and manage high amounts of intelligence inhibit ILP strategy. Officers in this study reported difficulty in finding old email messages, noting they would often forget when they read the message or whether they stored the email or if they had deleted it. Burcher and Whelan (2018) argued that the ILP strategy needs to be better supported by accurate information recording, and better software systems need to be designed to collect, manage, and analyse information.

The People (Goh, 2005) and Matter (Dostal et al., 2006) elements of the IDAM focused on evaluating whether the technology (matter) supported the role of the user (people). The results indicate that technology can have a significant impact on the KM

outcomes for police and that technology designed on KM principles can enhance user experience and access to operational information and intelligence. It is evident that both technologies (SR App and QPS Email System) contribute to knowledge sharing for different reasons. The SR App design features based on Goh's knowledge for innovation framework (2005) enhanced the technology's capacity to support police. The structuring and mapping of knowledge into specific operational topics and the capacity to post up-to-date information into an online blog facilitated information sharing and the capacity to search and find information later. Nonaka and Takeuchi (1995) explained that when organisations combine the learnings of explicit knowledge through the transfer of knowledge from tacit to explicit form new knowledge is then created.

New knowledge in the form of tacit experience then becomes explicit when it is again stored and shared. Goh (2005) pointed out that it is through this ongoing process of knowledge creation that lessons are learnt from previous experience and innovation then takes place. This cycle ultimately facilitates the improvement of organisational processes, contributing to efficiency gains. At the time of this study, the SR App could only be deployed on QLites and QPS desktops and so officers without a QLite or internet access did not have the same mobile access to information as those with the technology. It is noted however that the ongoing rollout of mobile devices including QLites and the recent SharePoint upgrade that allows SharePoint to be deployed to personal devices will enhance the organisation's capacity to manage and disseminate operational information and intelligence to police. These results are consistent with Gottschalk's (2009) assertion that intelligence and information sharing should include interoperable systems with features that include information discovery and access to knowledge-sharing capability that includes the capacity to capture and disseminate explicit and tacit knowledge.

The QPS Email System is enthusiastically used by officers to disseminate operational information and intelligence. However, the high flow of information being disseminated by email carries with it a degree of risk that not all information will be read in time to take advantage of the information or may otherwise be deleted without being read. The QPS Email System also lacks the functional capacity to effectively store information so that it can be searched or shared by multiple users, limiting the

opportunity to leverage information assets, and therefore reducing the opportunity for innovation or organisational improvement.

6.3 People and energy - enthusiasm to use the SR App or email system to manage and disseminate operational information and intelligence

The People (Goh, 2005) and Energy (Dostal et al., 2006) elements of the IDAM focused on the level of enthusiasm or interest (energy) by operational police (people) in using the technologies (SR App or QPS Email) to disseminate, store and access intelligence and operational information. In the Stage 2 survey, most officers rated a higher level of enthusiasm to use the SR App than compared with the QPS Email System. The survey results indicated that on average, officers rated the SR App a score of 7.18 on a 10-point Likert Scale where 1 indicated not enthusiastic, 5 indicated somewhat enthusiastic and 10 indicated extremely enthusiastic. The survey results indicated that on average, officers rated the QPS Email System a score of 5.42. The standard deviation results for the SR App were 1.38 and 2.27 for email, indicating a generally low variation for answers relating to the SR App with a slightly higher variation for answers relating to QPS Email.

These results however were generally consistent across the survey. Pearson Correlation Coefficient Analysis was conducted to analyse the relationship between each survey question and the relationship between officers of the rank of Sergeant/Senior Sergeant and Senior Constable/Constable. The results of the correlation tests for all questions indicated a positive linear relationship between all variables. Question 5 relating to the people/energy elements of the IDAM for the SR App stated, on a scale 1-10 how do you rate you level of enthusiasm to disseminate, store and access intelligence and operational information using the SR App? Results indicated a negative linear relationship between rank and response rating showing that Senior Constables and Constables were more likely to have rated a higher level of enthusiasm to use the SR App to disseminate operational information and intelligence than compared with Sergeants or Senior Sergeants. A similar result was shown with Question 14 relating to the people/energy elements of the IDAM for the QPS Email System that stated: On a scale 1-10 how do you rate your level of enthusiasm to disseminate, store and access intelligence and operational information using the Email System? Results indicated a negative linear relationship between rank and response rating indicating that Senior Constables and Constable were likely to rate the QPS

Email System higher than Sergeants or Senior Sergeants. The results indicate that Constables and Senior Constables also have more enthusiasm to use email to disseminate, store and access intelligence and operational information compared to Sergeants or Senior Sergeants. A similar result was noted in a historic study of QPS Technology Systems conducted by Chan, Brereton, Legousz and Doran in 2001, noting that the proportion of police officers satisfied with the ease of use of technology decreased with seniority in rank.

The study did not investigate the cause of this outcome however noted that senior officers were more likely to report they had not received formal training and often learnt to use the IT systems through informal methods such as trial and error or with the help of other colleagues. The researchers were unable to determine whether the reason for this was because the officers preferred to not make use of the training, had poor computer literacy skills, lack of motivation or were subject to time constraints. The results of this study were also consistent with findings in the Chan et al. (2001) study that found that police generally appreciated IT as a technology tool for managing information and believed they would not be able to cope with all the information without the appropriate technology to support KM.

Thematic analysis was conducted on the responses for Stage 3 (Research Interviews) and Stage 4 (Focus Group Discussion). Officers reported a high level of enthusiasm to use the SR App to disseminate, store and access intelligence and operational information. Respondents reported that the SR App provided time savings by enhancing the capacity for information to be managed and disseminated more effectively, allowing officers to find the information they were seeking without having to sort through large amounts of irrelevant information.

Respondents reported the accessibility to more information also assisted them with operational planning and decision-making, contributing to the better allocation of resources. These findings are consistent with Carter's (2011) assertion that ILP should include the process of using analysed information to inform operational decisions, identify trends, and prevent threats. Ratcliffe (2005) noted the importance of intelligence to effective crime prevention and control and argued the more effective information management is in a police organisation, the more effective the organisation is.

Respondents demonstrated a high level of acceptance of the QPS Email System because of its ease of use and accessibility on personal mobile devices. However, they reported some dissatisfaction with the high volume of emails they received. Users considered that a large portion of the QPS emails they received were irrelevant or not related to their operational needs. Respondents also reported that many intelligence and operational products were often disseminated separately, and they felt that the information could be consolidated into one email message to reduce the total number of emails they receive.

These results are consistent with a 2019 study of email usage for working-age knowledge workers conducted by Adobe. The study revealed that workers often felt dissatisfied with email when email was either not relevant to the user, too lengthy or poorly written or delivered too frequently (Adobe, 2019). The same study revealed that survey participants felt frustrated when emails contained information that was no longer current or not relevant to the user. According to Abramovich (2019), accurate and useful personalised information in an email is a must and that the sender must understand the implication of the email upon the user.

The results of this area of the study indicated that the level of enthusiasm to disseminate, store and access operational information and intelligence using the SR App and QPS Email was based upon three defining characteristics. These included the user's capacity to effectively store operational information and intelligence so that it can easily be found. Secondly, it included the capacity to search for information across multiple digital formats including content and title search capability using a keyword search function. Thirdly, it included using technology (SR App or QPS Email) that was easy to operate and had the capacity to deploy on all mobile devices including personal devices. These results are consistent with Jacks et al. (2012) argument that effective KM typically involves knowledge creation, knowledge storing, knowledge retrieving, knowledge transfer and knowledge application.

The features of the SR App supported the capacity to manage store, search and refine operational information and intelligence. Most users reported that the SR App was relatively easy to use however some participants reported they were not aware of some of the more advanced features and information products that enhanced the SR Apps' overall functionality. At the time of this study, the SR App was available on QLites but not on personal devices, limiting its mobile capacity. In comparison, the

QPS Email System is available on personal devices and therefore had greater mobile capacity than the SR App. However, the QPS Email System lacks many of the design features that facilitate the management of information. This includes the capacity to search for information via in-text keywords across multiple folders that can be accessed and shared by a wide audience on the same platform. This reduces the capacity to share information and build on the knowledge, reducing the organisational capacity to leverage knowledge assets and encourage innovation.

The level of enthusiasm to use the QPS Email System was supported by its ease of use and accessibility on personal devices. This is consistent with many articles that highlight email's ongoing popularity. Ricciuti (2015) argued that email is engrained into our culture through habit, highlighting how its reliability provides users with an ongoing degree of secure communication. This encourages users to send continued amounts of information without considering the compounding effects of multiple emails to other users. Unfortunately, much of that information, which is usually sent to a bulk list of email accounts is often irrelevant to the receiver and in some cases contributes to a state of information overload for some users.

The negative consequences of information overload have been well documented and include poor decision making leading to high-cost outcomes Peng (2011). Sheptycki (2013) pointed out that in an intelligence environment, information overload affects the quality of the information in the intelligence cycle leading to pathologies that include linkage blindness, intelligence gaps, white noise, duplication, institutional friction, information silos and intelligence hoarding. Each of these pathologies negatively impacts intelligence outcomes and ILP strategy resulting in the ineffective deployment of resources.

6.4 People and information – Type of information and intelligence products disseminated on the SR App and email system

The People (Goh 2005) and Information (Dostal et al., 2006) elements of the IDAM focused on how useful the type of information and intelligence products (information) were for operational police (people) disseminated using the technologies (SR App or Email). In Stage 2 survey, most officers rated the usefulness of information and intelligence products disseminated by the SR App higher than the QPS Email

System. The survey results indicated that on average, officers rated the SR App a score of 7.71 on a 10-point Likert Scale where 1 indicated not useful, 5 indicated somewhat useful and 10 indicated extremely useful. The survey results indicated that on average, officers rated the QPS Email System a score of 5.75. The standard deviation results for the SR App were 1.47 and 2.10 for QPS Email, indicating a generally low variation for answers relating to the SR App with a slightly higher variation for answers relating to email. These results were generally consistent across the survey. Pearson Correlation Coefficient Analysis was conducted to analyse the relationship between each survey question. The results of the correlation tests for all questions indicated a positive linear relationship between all variables

Thematic analysis was conducted on the responses for Stage 3 (Research Interviews) and Stage 4 (Focus Group Discussion). Officers reported that those with a greater knowledge of the SR Apps functionality and product offerings would be likely to access more operational information and intelligence than those officers who had less knowledge. Officers reported that the SR App catered for a wide variety of intelligence needs for most users including officers at different ranks or operational units that were likely to prefer access to different products. For example, front-line operational police were more likely to access operational information relating to offenders' modus operandi than compared to senior officers seeking strategic operational information and intelligence for higher organisational needs. The analysis also confirmed that users considered the usefulness of the operational information and intelligence also related to the capacity for officers to be able to quickly find and review up-to-date information that was relevant to their immediate intelligence needs. The SR App successfully demonstrated the application of Ratcliffe's (2003) 3-I (i.e., interpret, influence, impact), Intelligence-led policing model by highlighting that demand for intelligence products is determined by the analyst's interpretation of the criminal environment and the influence the crime analyst chooses to have on decision makers through intelligence products. The content of the intelligence product must be relevant to the criminal environment, and this explains why the results of this study identified that the content of some information and intelligence products varied across the Southern Region.

Research conducted using the SR App Search analytics to determine operational information and intelligence product usage (Stage 1) on the SR App revealed that the

intelligence needs of users often differed according to their location, their role and rank within the organisation and local crime trends. Table 4.11 shows that in the Moreton Police District, the most popular intelligence product was the Vehicle of Interest (VOI) sheet whereas Table 4.12 shows that in the Darling Downs District, the most popular Intelligence product is the Persons of Interest (POI) sheet. During group discussions and interviews, officers indicated the intelligence product usage pattern for each district was generally related to the type of crime and the modus operandi of offenders relevant to their area.

In the Moreton District, officers indicated that most offenders were using vehicles to facilitate crime and so by identifying VOI and intercepting those vehicles, officers were likely to also locate offenders. In the Darling Downs District, officers were more likely to access the persons of interest (POI) and return to prison warrant (RTP) lists to identify suspect persons. The Darling Downs District has a significantly higher number of smaller rural communities when compared to the Moreton District. An officer working in a rural division explained that offenders in smaller communities were usually already known by local Police and identified through family or association connections. Police were therefore less reliant on the identification of vehicles to identify and locate suspects.

Research also indicated that in the South West District, operational information or intelligence products were often simply crime summaries of total crimes committed in an area over a specific period. This is because in most rural communities, crime trends were generally low and it was more practical to report all crimes in one crime summary document. It was also evident during interviews that OICs in rural communities often knew who the relevant suspects were in their area and did not rely on intelligence assistance to generate the names of suspects. In general terms, however operational information and intelligence products in the Southern Police Region included prison releases, persons of interest (POI), juvenile curfew reports, high crime locations (hot spot analysis), return to prison warrants, missing persons and daily divisional or district crime summary reports.

An analysis of operational information and intelligence product usage patterns on the SR App indicated that most were accessed on Mondays and there was a general pattern of reduced usage throughout the week with the lowest consumption of information and intelligence products during the weekends, this information is shown

in Figure 4.1. Whilst the causes of this pattern of usage were not fully investigated, there is evidence that fewer officers work weekends and so, operational information and intelligence consumption is also reduced. An analysis was also conducted on the number of users compared to the total hit rate for individual information or intelligence product stored on the SR App. Table 4.3 shows that from July 2018 to October 2019 the number of site hits on the SR App was the same as the number of unique users, however, in January 2021 the number of SR App site hits reduced while the number of unique users continued to increase.

This is suspected to have occurred because hyperlinks to operational information and intelligence products began being disseminated in QPS Email messages, providing users direct access to operational and information products in the SR App site without the necessity to navigate through other information and intelligence. The increase in the number of unique users is thought to have occurred by using QPS Email to facilitate access to information stored on the SR App. According to Ratcliffe (2005), lack of clarity in intelligence use and application can have negative effects on the ability of the organisation to positively impact the criminal environment. The SR App provided greater functional capacity for intelligence used to be monitored whereas there was no capacity to monitor intelligence usage using QPS Email.

Thematic analysis was conducted for the responses for Stage 3 (Research Interviews) and Stage 4 (Focus Group Discussion) for the QPS Email System. Participants reported that the usefulness of intelligence products disseminated by QPS Email was enhanced by the capacity to disseminate and receive information quickly. Ratcliffe (2005) reported that ILP strategy requires decision-makers to employ strategies based on effective intelligence that needs to be delivered in time to have meaning and value. Ratcliffe (2005) explains while there still may be some benefits to implementing some strategy even if it is not grounded in solid intelligence, the negative consequence is that it is often difficult to accurately evaluate outcomes. Without timely operational information and intelligence, police are less likely to identify emerging crime trends and changes in the criminal environment. Participants reported that the QPS Email System facilitated information dissemination through ease of use and the capacity for users to use personal mobile devices for email access. Officers reported that the most popular operational information and intelligence products disseminated by email included the daily stolen vehicle hotlist, top ten wanted

list and outstanding warrant list. At the commencement of the study, these products were primarily pdf documents disseminated in separate emails. This contributed to a high flow of emails proving to be a source of frustration for some officers. However, hyperlinks to operational information and intelligence products stored on the SR App were eventually used as the predominant method of providing access to products. Officers reported that the QPS Email System did not have suitable functionality to store and share operational information and intelligence products.

During this study, most officers used the SR App to access historic operational and information products reducing the necessity to store the same information in private online folders or drives. According to Ratcliffe (2005), researchers must be cautious when seeking the clients' views about intelligence products as many street police officers complain they get little from strategic intelligence products when in fact these products are produced for higher-level police managers, responsible for the management of resources and overseeing the implementation of the strategy. The SR App design features overcame this issue by ensuring that information and intelligence products relevant to the tactical, operational, or strategic purpose can be more easily identified and found by officers with their own unique intelligence requirements.

The SR App supports the storage and dissemination of multiple operational information and intelligence products allowing information to be accessed and shared among multiple users. The SR App facilitated the sharing of intelligence products across divisional, district and regional boundaries. The SR App provided the analytical capability to monitor information usage, assisting intelligence officers to develop operational information and intelligence products that meet the needs of users. The QPS Email System facilitates the information dissemination process by providing mobility on personal devices however it does not have the same capacity to manage and store information thereby making access to historic information difficult to find.

6.5 Process and matter – Disseminating operational information and intelligence using the SR App or email system

The Process (Goh, 2005) and Matter (Dostal et al., 2006) elements of the IDAM focused on the effectiveness of disseminating (process) operational information and intelligence products using the SR App or QPS Email (matter). In the Stage 2 survey,

most officers rated the effectiveness of disseminating operational information and intelligence using the SR App higher than the QPS Email System. The survey results indicated that on average, officers rated the SR App a score of 7.71 on a 10-point Likert Scale where 1 indicated not effective, 5 indicated somewhat effective and 10 indicated extremely effective. The survey results indicated that on average, officers rated the QPS Email System a score of 5.96. The standard deviation results for the SR App were 1.31 and 2.28 for email, indicating a generally low variation for answers relating to the SR App with a slightly higher variation for answers relating to QPS Email. These results were generally consistent across the survey. Pearson Correlation Coefficient Analysis was conducted to analyse the relationship between each survey question. The results of the correlation tests for all questions indicated a positive linear relationship between all variables.

Thematic analysis was conducted on the responses for Stage 3 (Research Interviews) and Stage 4 (Focus Group Discussion). Officers reported process effectiveness using the SR App was perceived to be better because of enhanced search capability and remote accessibility to information. Officers also reported favourably about other operational information that is not circulated in QPS Email. This included for example access to facility maps and floor plans providing officer's greater situational awareness of jobs. These benefits however were often dependent on the user's functional knowledge of the SR App. The functional knowledge of the SR App often determined the product the user obtained from the system and consequently the inherent value they received. Whilst this theme was not explored fully in this research it is evident that users should be provided adequate training when using new KM systems, so they may receive the full benefits of the system including greater access to knowledge resources. The perception of effectiveness was impacted by issues of device mobility including internet coverage and the user's access to QLites. Users with poor internet coverage reported that this often limited their capacity to access information remotely. This was more commonly reported by officers stationed in rural communities with limited internet service coverage however also by some officers in urban centres reported similar issues.

Users reported that the capability to record and access information through a single point of truth was also of advantage and reduced the requirement to search across multiple electronic databases. Users reported that the capacity to use keywords

to search the title of documents or files including document content enhanced the SR App's overall effectiveness. These are consistent with the results of a historical study undertaken by Chan et al., (2001) who noted that police officers wanted access to more user-friendly KM Systems that provided faster access to more efficiently managed information.

Users reported that the effectiveness of the QPS Email System to disseminate operational information and intelligence was enhanced through its capacity to access information on personal devices. This facilitated the information dissemination process, providing access to information for all officers not issued with Qlites. The effectiveness of the QPS Email System was detracted by the incapacity to store and search information in a timely manner. However, officers reported that it was often quicker to open emails than it was to open operational information and intelligence products through the SR App whilst using Qlites. During stage 5 of the research, time and motion studies were conducted measuring the average time taken to access intelligence products on the SR App and QPS Email using both desktop computers and Qlites.

The mean time taken to access an intelligence product on the SR App using a desktop computer was 19.8 seconds whilst the mean time that was taken to access the same intelligence product using the QPS Email System on a desktop computer was 20 seconds. The standard deviation for the mean times taken to open the intelligence product using the SR App was 5.3 seconds while the standard deviation for the mean times taken to open the same intelligence product using the QPS Email System was 6.5 seconds. These results indicated that it was only slightly quicker to access intelligence products on the desktop computer using the SR App. The standard deviation results indicated that there was a degree of variation in the results for both the QLite and QPS email system.

A second time and motion study was conducted measuring the average time taken to access the same intelligence product on the SR App and QPS Email using a QLite. The mean time taken to access an intelligence product on the SR App using a QLite was 16.6 seconds with a standard deviation of 3.5 seconds. The average time taken to access the same intelligence product on email using a QLite was 6.2 seconds with a standard deviation of 1.8 seconds. These results indicated that it was generally faster to access intelligence products on QPS Email when using the QLite. The

negative aspects were however that many operational information and intelligence emails were being used to send one intelligence product at a time and hence access to multiple intelligence products required opening several emails creating more time to access a wider range of intelligence products. These early results were presented to Intelligence managers who participated in a review of intelligence products and as a result, decided to consolidate their multiple intelligence products into one document. Intelligence managers also commenced disseminating a daily single QPS Email message that contained links to multiple operational information and intelligence folders on the SR App.

Whilst the survey results indicated that the SR App was more effective in disseminating operational information and intelligence than compared to email, the time and motion studies showed that it was quicker to open operational information and intelligence products emailed on the QLite. These results indicated that users considered the effective dissemination of operational information and intelligence to be related to both the intelligence they receive and the speed at which they receive them. In the case of the SR App, users considered effectiveness related to the SR Apps' capacity to access information through search and recording capability. Whereas the speed at which QPS Email was able to disseminate information and intelligence whilst on QLite contributed to its considered effectiveness. The process changes made during the study to combine operational information and intelligence into one document circulated by one email including the dissemination of hyperlinks to the SR App created further efficiency gains. These results show that the effectiveness of a KM system to disseminate information is based on content, speed, and accessibility of information. This is consistent with Lauring and Zhang (2018) who argue that the effectiveness of knowledge sharing is influenced by both the characteristics of specific knowledge, properties of the sender, social factors relating to the receiver and the sociotechnical factors affecting the transmission of information.

6.6 Process and energy – Effort required to manage and disseminate operational information and intelligence using the SR App or email system

The Process (Goh, 2005) and Energy (Dostal et al., 2006) elements of the IDAM focused on the level of effort and time (energy) required to capture, store, and disseminate (process) operational information and intelligence products using the SR

App or QPS Email. In the Stage 2 survey, most officers rated greater time savings to disseminate, store and access operational information and intelligence using the SR App when compared to the QPS Email System. The survey results indicated that on average, officers rated the SR App a score of 7.18 on a 10-point Likert Scale where 1 indicated it takes too long, 5 indicated some time savings and 10 indicated significant time savings. The survey results show that on average, officers rated the QPS Email System a score of 5.41. The standard deviation results for the SR App were 1.61 and 2.01 for QPS Email, indicating a generally low variation for answers relating to the SR App with a slightly higher variation for answers relating to email. These results were generally consistent across the survey. Pearson Correlation Coefficient Analysis was conducted to analyse the relationship between each survey question. The results of the correlation tests for all questions indicated a positive linear relationship between all variables.

A thematic analysis conducted on the responses for Stage 3 (Research Interviews) and Stage 4 (Focus Group Discussion) indicated consistent results with those identified during the survey (Stage 1). Officers reported time savings and greater energy efficiency were achieved in the process to disseminate, store, and find information on the SR App. The level of efficiency was determined by the knowledge of the SR Apps functionality and the type of information officers was seeking. In comparison, users reported a high level of understanding of the QPS Email System because email had historically been used as the primary method of disseminating operational information and intelligence. Users reported that the SR App is an effective alternative reducing the volume of emails and making it easier to find historical information. Knowledge of the SR App's functionality improved the user's capability to find information in future searches. This is based on what Lonsdale and Edmonds (1997) describe as the Recall Directed Process where information is memorised accurately and the subsequent search for information is conducted using the same search criteria as previous searches. This method ultimately creates a search process where the intended information is found more quickly and accurately. The QPS Email successfully disseminates operational information and intelligence however QPS Email lacks many of the design features that facilitate the management of information, making it difficult to find and share historic information.

Time and motion studies showed that there was a similar time taken to open intelligence products disseminated by the SR App and QPS Email System on a desktop computer however there was an average 10.4 second time savings opening intelligence products on a QLite using QPS Email. The level of effort required by users to capture and store operational information and intelligence was generally less using the SR App, the level of effort by users to disseminate operational information and intelligence on QLites was less when using the QPS Email System. Because the individual QPS Email accounts of officers were not being used to store all the same operational information and intelligence products that were stored in the SR App the study did not attempt to measure the time taken to search historical data.

6.7 Process and information – Effectiveness of the SR App or email system in managing operational information and intelligence

The Process and Information elements of the IDAM focused on determining how effective the SR App and QPS Email System were considered to manage operational information and intelligence. This included the capacity to find and access information later. The survey results indicated that on average, officers rated the SR App's capacity to manage information and intelligence as a score of 7.56 on a 10-point Likert Scale where 1 indicated not useful, 5 indicated somewhat useful and 10 indicated extremely useful. The survey results show that on average, officers rated the QPS Email System a score of 4.51 for being able to find information later. The standard deviation results for the SR App were 1.33 and 2.25 for QPS Email, indicating a generally low variation for answers relating to the SR App with a slightly higher variation for answers relating to email.

Thematic analysis conducted on the responses for Stage 3 (Research Interviews) and Stage 4 (Focus Group Discussion) indicated consistent results with those identified during the survey (Stage 1). The results indicated that the management of information included the capacity to store, search, filter, disseminate and monitor information usage. The SR App was considered to have better functional capacity than QPS Email with features in the program to store, search and filter information which also provided time savings when searching for information. The SR App also had the analytical capability to monitor information usage to determine what information products were being accessed. The QPS Email System was considered more effective in

disseminating operational or tactical information in the field because of access to technology. This was because QPS Email was available on all personal devices and the SR App was not. The SR App was only deployed on desktop computers and QLites and cannot yet be loaded onto personal devices. At the time of this study, QLites were only issued to First Response Officers and were not available to all investigators. Investigators in the field were limited to intelligence disseminated by QPS Email on their personal devices.

Both the QPS Email System and the SR App are important tools for the management of operational information and intelligence. The capacity to store, search filter and monitor operational information and intelligence is performed more effectively by the SR App on both the desktop computer and QLites. These results are consistent with a study undertaken by the Nielsen Norman Group (2016) that showed that users preferred desktop computers and larger screened devices to perform more complicated computing tasks because of greater functional capacity including, larger screens and storage capacity. In circumstances where QLites were not available the capacity to disseminate operational information and intelligence in the field was performed more efficiently using the QPS Email system when it was loaded onto the user's personal device. In the same study undertaken by the Nielsen Norman Group (2016) users preferred smaller screen devices when mobile because of space, weight, and durability benefits. According to Goh (2005), the process of capturing and reusing information as knowledge is critical for organisational improvement. The QPS Email effectively facilitates the delivery of information when using small personal devices or QLites however lacks the capacity to perform higher-level KM functions involving the management and dissemination of information including the process of compiling, analysing, storing and re-distribution.

6.8 Product and matter –Operational information and intelligence stored in the SR App

The Product and Matter elements of the IDAM focused on determining how useful users considered the intelligence and information products stored in the SR App. The survey results indicated that on average, officers rated the usefulness of the intelligence and information products stored in the SR App a score of 7.81 on a 10-point Likert Scale where 1 indicated not useful, 5 indicated somewhat useful and 10

indicated extremely useful. The QPS Email System does not have the functional capacity to store operational information and intelligence products that can later be searched, accessed, and shared by a wide audience. Question 13 asked users whether they filed intelligence products disseminated by QPS Email to determine whether the information disseminated by email was ever retained and therefore reusable.

The survey results summarised in Figure 4.9 indicated that 9% of officers who receive operational information or intelligence products through email would store those products separately in their own electronic folders so they may be able to reuse that information. The survey results indicated that 54% of officers said they didn't store any operational information or intelligence products disseminated by email and that information was deleted, reducing the possibility it was ever reused. The survey results indicated that 36% of officers sometimes stored operational information and intelligence disseminated by QPS Email.

Thematic analysis was conducted on the responses for Stage 3 (Research Interviews) and Stage 4 (Focus Group Discussion). The analysis revealed that officers used the SR App to update their operational knowledge on a range of issues including the names of offenders on curfew, the type and identity of stolen vehicles, the names of the top ten offenders wanted for questioning, a review of CCTV mapping that assisted officers to investigate offences, daily intelligence reports that provided an overview of recent crime and the names of missing persons. Feedback during the interviews and group discussion indicated that the SR App was considered to have a high level of functionality that enabled information and intelligence products to be stored in many forms (ie: word docs, pdf files, mov. files and jpeg files), and then later provided the capacity for that information to be searched and shared across a wide audience. The QPS Email System was noted for the capacity to disseminate individual information products quickly however was generally not used to store information or intelligence. This limited the capacity for information to be searched and found, shared with multiple users, or re-used to assist decision-making. Participants in group discussions and interviews identified what they considered was the overuse of email to deliver multiple intelligence products. This issue was identified early in the study with intelligence managers deciding to cease the practice and instead disseminating a single email containing hyperlinks to a variety of intelligence products stored on the

SR App. This action immediately reduced the volume of intelligence-related emails and consolidated the flow of operational information and intelligence.

Gottschalk (2009) explained that the focus of intelligence and information sharing should include features of interoperable systems that facilitate information discovery and dissemination of both tacit and explicit knowledge. This innovative process enhanced the capacity for information sharing by combining the functional aspects of both email and the SR App. These innovative outcomes are what Goh (2005) would describe as products of knowledge innovation where organisations deliberately facilitating effective KM practices achieve benefits through ongoing improvement. Combining the advantages of SR App technology with QPS Email facilitated the KM process will ultimately enhance the management and dissemination of operational information and intelligence for police.

Research conducted using the SR App Search Analytics to determine operational information and intelligence product usage (Stage 1) on the SR App revealed that between June 2018 and April 2021, there were between 10,000 and 23,000 hits on individual intelligence products each month on the SR App. This included on average between 1,500 and 3,500 unique users accessing the SR Intelligence products per month. In January 2021 the number of unique users per month reduced from an average of 3,000 users per month to 1,500. This occurred at the same time Intelligence Sections began sending hyperlinks using QPS Email to intelligence products stored on the SR App, reducing the requirement for users to search through the SR App for intelligence products.

The SR App Search Analytics indicated that each police district had unique intelligence usage patterns. For example, Moreton District had the highest hit rate on the vehicles of interest (VOI) list whilst Darling Downs had a higher hit rate on persons of interest (POI). Moreton, Ipswich, and South West Districts commonly had high hit rates on daily briefing sheets. This trend was generally linked to local crime patterns and demand drivers set by operational police and managers. The content of most intelligence products was often determined by intelligence analysts whose role was to consolidate, synthesise, and analyse the inflow of information. The quality of the information and intelligence products was often dependent on a variety of factors including the skill of the analyst, the information they receive and the time limitations they had to produce the product. Chapman and Macht (2018) however point out that

KM is the responsibility of all employees, and it is essential they understand how to manage, share, and interpret the organisation's knowledge resources to facilitate effective decision-making.

6.9 Product and energy –Accessibility of the operational information and intelligence products on the SR App and email system

The Product and Energy elements of the IDAM focused on determining how effective users were able to access intelligence and information products on the SR App and QPS Email System. The survey results indicated that on average, officers rated their ability to access intelligence and information products on the SR a score of 7.15 on a 10-point Likert scale where 1 indicated not effective, 5 indicated somewhat effective and 10 indicated extremely effective. The survey results show that on average, officers rated the QPS Email System a score of 5.53. The standard deviation results for the SR App were 1.52 and 2.24 for email, indicating a generally low variation for answers relating to the SR App with a slightly higher variation for answers relating to QPS Email. These results however were generally consistent across the survey.

Thematic analysis was conducted on the responses for Stage 3 (Research Interviews) and Stage 4 (Focus Group Discussion). The analysis revealed that officers believed that access to operational information and intelligence was facilitated by the SR App's ease of use and search capability. Officers also reported the SR App provided the facility to store large amounts of information in a single location. Access to information was however limited by access to the internet and low bandwidth that ultimately affected the capacity to access online information. Officers reported that user knowledge of the SR App and its functionality impacted the type and amount of operational information and intelligence that was accessed. Access to training and QLites also impacted the user's capacity to access information. Training provided users with knowledge of where to find certain types of operational information and intelligence products and how to search for them. At the time this research was conducted, the allocation of QLites was predominantly limited to first-response officers.

Access to operational information and intelligence through the QPS Email System was enhanced by the fact that officers not issued with QLites were able to access intelligence products disseminated by email on their personal devices. Some officers reported they had set up folders within their email accounts to store operational information and intelligence products however time limitations often prevented them from reading all operational information and intelligence products sent through the QPS Email System. Officers also reported that it was often difficult to find historic information products on QPS Email because of limited search functionality. These results are consistent with previous studies that have highlighted similar issues including the difficulty in searching and finding information (Elsweiler & Baillie, 2011), the increase in lost time (Plummer, 2019), and the creation of information silos through email (Dizikes, 2022).

Time and motion studies indicated that it took a similar time to access online intelligence products using the SR App and QPS Email System using a desktop computer. The average time taken to open operational information and intelligence products using the SR App on a desktop computer was 19.8 seconds with a standard deviation of 5.3 whilst the average time that is taken to access the same information using the QPS Email System on a desktop computer was 20 seconds with a standard deviation of 6.5 seconds. The average time taken to access a selection of operational information and intelligence products using the SR App on QLite was 16.6 seconds with a standard deviation of 3.5 seconds. The average time taken to access the same information products using the QPS Email System on QLite was 6.2 seconds with a standard deviation of 1.8 seconds. There was on average 10.4 seconds in time savings for opening intelligence products on a QLite using the QPS Email System.

6.10 Product and information – operational information and intelligence in the SR App and QPS Email

The Product and Information elements of the IDAM focused on determining whether the information and intelligence products in the SR App and QPS Email System provide enough information for operational police to perform their role effectively. The survey results indicated that on average, officers rated the information and the intelligence products in the SR App to do their job effectively a score of 7.23 on a 10-point Likert scale where 1 indicated not effective, 5 indicated somewhat

effective and 10 indicated extremely effective. The survey results show that on average, officers rated the QPS Email System a score of 5.73. The standard deviation results for the SR App were 1.42 and 1.94 for email, indicating a generally low variation for answers relating to the SR App with a slightly higher variation for answers relating to email. These results however were generally consistent across the survey.

Thematic analysis was conducted on the responses for Stage 3 (Research Interviews) and Stage 4 (Focus Group Discussion). The analysis revealed that officers generally valued operational information and intelligence products that provided the names of target offenders including details such as their name, a photo, most recent known addresses, and the same details of associates. Officers also valued detailed patrol locations including specific times, days of the week and the types of offences they were likely to detect and the names of people they were looking for or likely to find. This is consistent with a New Zealand case study undertaken by Ratcliffe (2005) who identified that frontline police officers preferred intelligence that was simple to comprehend, not time-consuming to act upon, tactical in nature and arrest focussed. Officers in this current case study advised they did not value operational information or intelligence that was generalised, loosely linked to crime trends, or was simply outdated and not relevant to the current operational or tactical environment.

There are many of the same operational information and intelligence products disseminated by the QPS Email System and the SR App, these include for example, persons of interest, return to prison warrants, top 10 offenders, missing persons, vehicles of interest, crime summary and prison releases.

This research contributed to the redesign of the Moreton District Operational Briefing document that now summarises much of the information once included as several individual intelligence products into a single intelligence package. These packages are designed to provide operational information and intelligence relevant to the specific needs of users and the specific shift time they are working. For example, information concerning the details of suspects and the offences they are suspected of committing during night-time may be different from the suspects and the type of offences they are suspected of committing during the daytime. The SR App also provides users access to a suite of additional operational information and intelligence

products not disseminated by QPS Email, this includes for example facility maps and floor plans of government and critical infrastructure.

The QPS Email system does not provide the same capacity to store, search and share operational information and intelligence. It was observed that some officers created folders within their own personal email accounts to store information that they considered important. This method however tended to lead to large amounts of fragmented information that cannot be easily managed or shared. According to Goh (2005), this piecemeal approach to information management ultimately reduces the organisation's capacity to create value or enhance knowledge creation through knowledge sharing. The SR App provides the capacity for this information to be stored centrally so that it remains accessible to a wider audience. According to Ai et al. (2008) organisations that structure knowledge systems can better understand complex problems and identify gaps in knowledge and research shortfalls.

Examples of the types of information stored in the SR App include infrastructure maps, after-hours contact numbers for schools, photos and maps of critical infrastructure, legislation, and juvenile bail reporting conditions. During this study, the SR App continued to evolve as more officers contributed to program design and information and intelligence content. Whilst the SR App was initially designed to compile operational information and intelligence across the Southern Police Region there were several examples of innovative initiatives that emerged from the functional capacity to centralise operational information and intelligence using SharePoint. One example included the development of a Special Duties database that controlled the allocation and management of special duties overtime hours.

6.11 Relationship analysis of elements of the IDAM

Relationship analysis indicated a positive correlation for all survey question results relating to the SR App. All correlations were statistically significant with $p \leq .0001$. The strength of the correlations varied from medium to high.

The highest recorded correlations were for Question 8 and Question 4 with $r = .78$. This result was predictable as both questions were similar in nature however were designed to address different elements of the IDAM. Question 4 relates to the IDAM element of ‘product’ and ‘matter’ with the intent of determining whether operational

information or intelligence (products) stored specifically on the SR App (matter) were useful. Question 8 related to the IDAM element of people and information with the intent of determining whether intelligence or operational products were useful to the user. The mean response for Question 4 was 7.81 with a standard deviation of 1.38 and for Question 8, 7.71 with a standard deviation of 1.47. The result indicated that users (people) had a strong association between the SR App (matter) and their accessibility to operational information and intelligence (products). These products were considered useful to most users.

The lowest recorded correlations for the SR App were for Question 6 and Question 8 with r=.35. Question 6 relates to the process and energy elements of the IDAM. Question 6 was designed to rate the level of time savings to capture, store and disseminate operational information and intelligence using the SR App. The mean survey response for Question 6 was 7.18 with a standard deviation of 1.61 indicating a high times savings. Question 8 relates to the IDAM element of people and information. Question 8 was designed to determine how useful intelligence or operational products were for the user. The mean survey response for Question 8 was 7.71 with a standard deviation of 1.47. The result indicates that the time savings to manage information through the process of capturing, storing, and disseminating intelligence have less correlation with how useful the intelligence or operational products were to the user. Hence intelligence products may be still considered useful despite the time it takes to manage the product through capturing, storing, and disseminating the information.

Most correlations were recorded between .45 and .65 indicating a positive medium correlation between all remaining elements of the IDAM. The correlation results for Question 2 relating to the SR App's usefulness in supporting the participants' role indicated a medium correlation with (Question 3 r = .57), the process to disseminate and store intelligence, (Question 4 r = .59), the usefulness of the information stored on the SR App, (Question 5 r = .53) the enthusiasm to disseminate and access information, (Question 6 r = .52), the level of effort required to capture, store and disseminate intelligence, (Question 7 r = .49), the ability to access information stored on the SR App, (Question 8 r = .55), the usefulness of the intelligence products on the SR App, (Question 9 r = .55), the SR Apps effectiveness to manage information and intelligence and (Question 10 r = .54) the SR Apps capacity

to provide information to allow the user to do their job effectively. Similar correlations were also found for each of the questions apart from those indicating a high correlation for example: (Question 8 and Question 4 $r = .78$) and those with the lowest correlation for example: (Question 6 and Question 8 $r = .35$).

Relationship analysis indicated a positive correlation for all survey responses relating to the QPS Email System. All correlations were statistically significant with $p \leq .0001$. The strength of the correlations varied from medium to high. The highest recorded correlations were for (Question 11 and Question 12 with $r = .77$), (Question 16 and Question 17 with $r = .81$) and (Question 15 and Question 17 with $r = .77$).

Question 11 relates to the IDAM element of people and matter with the intent of determining whether the QPS Email System (matter) is useful in supporting the participants' (people) roles. The mean survey response for Question 11 was 6.64 with a standard deviation of 2.04 indicating that the QPS Email System was somewhat useful in supporting the role of police however these results when compared to the same question for the SR App were not as high as the mean response for the SR App. These results also had a higher standard deviation than compared with the responses relating to the SR App. Question 12 relates to the IDAM element of 'process' and 'matter' with the intent on determining the effectiveness of the QPS Email System (matter) in disseminating (process) operational information and intelligence to police. The mean survey response for Question 12 was 5.96 with a standard deviation of 2.28.

This result indicated that the QPS Email System was somewhat effective in disseminating intelligence and operational information to police however when compared to the same question for the SR App was not as high as the mean response for the SR App. The mean response for QPS Email also had a higher standard deviation than compared with the responses relating to the SR App. The high correlation between Question 11 and Question 12 indicates that users (people) perceptions of how well the QPS Email System (matter) disseminates (process) operational information and intelligence to them is consistent with their perception of how effectively the technology supports them to perform their role. This result is consistent with the same correlation identified with the mean results for the SR App.

Question 16 related to the IDAM element of product and energy with the intent of determining the capacity (energy) for users to access the intelligence and the information products (products) on QPS Email. The mean response for Question 16

was 5.53 with a standard deviation of 2.24 indicating that users rated their ability to access intelligence and information products via email as somewhat effective however the mean result was not as high as that for the SR App. Question 17 related to the IDAM element of people and information with the intent on determining whether intelligence or operational products (product) disseminated by QPS Email were useful to the user (people). The mean response for Question 17 was 5.75 with a standard of 2.10 indicating that users rated the type of information and intelligence products disseminated by QPS Email as somewhat useful however the mean result was not as high as that relating to the SR App. The mean result for QPS Email however had a higher standard deviation than compared with those relating to the SR App. The high correlation between Question 16 and Question 17 indicates that the user's (people) ability to access (energy) operational information and intelligence (product) is correlated to the perceived usefulness of the product (product) to the user.

Question 15 relates to the IDAM element of process and energy with the intent of determining the usefulness of the procedures (process) in place to capture store and disseminate (energy) intelligence using email. The mean response for Question 15 was 5.41 with a standard deviation of 2.01 indicating that the overall procedures in place to capture, store and disseminate intelligence using email were somewhat useful however this result was not as high as the mean result for the SR App. The mean result however had a higher standard deviation than compared with that relating to the SR App. Question 17 related to the IDAM element of people and information with the intent of determining whether intelligence or operational products (product) were useful to the user (people). The mean response for Question 17 was 5.75 with a standard deviation of 2.10 indicating that users rated the type of information and intelligence products disseminated by email as somewhat useful however the result was not as high as the mean result for the same question relating to the SR App. The mean result for QPS Email however had a higher standard deviation than compared with that relating to the SR App. The high correlation between Question 15 and Question 17 indicates that the usefulness of procedures (process) in place to capture, store and disseminate (energy) intelligence and information correlates to the users' (people) perception of how useful the operational information and intelligence (products) were for them.

The lowest recorded correlation for survey results relating to the QPS Email System were for Question 11 and Question 18 with $r = .32$. Question 11 related to the IDAM element of people and matter with the intent of determining whether the QPS Email System (matter) is useful in supporting the participants (people) role. The mean survey result for Question 11 was 6.64 with a standard deviation of 2.04 indicating that the QPS Email System was somewhat useful in supporting the role of police however this result was not as high as the mean score for the same question relating to the SR App. The mean result also had a higher standard deviation for the QPS Email than compared with the result relating to the SR App.

Question 18 related to the IDAM elements of process and Information with the intent of determining how effectively disseminating (process) information and intelligence using the QPS Email System allows users to find information (information) later. The mean result for Question 18 was 4.51 with a standard deviation of 2.25 indicating that users rated the email somewhat effective in finding information later however this result was not as high as the mean result for the same question relating to the SR App. The mean result for QPS Email however had a higher standard deviation than compared with that relating to the SR App. The low correlation between Question 11 and Question 18 indicates that the user's (people) perceptions of how effective the QPS Email System can be used to find (process) information do not strongly correlate with how well the QPS Email System (matter) is perceived by the user to support their role.

Most correlations however were between $r = .43$ and $r = .70$ indicating a positive medium-to-high correlation between all remaining elements of the IDAM. The correlation results for Question 11 relating to the QPS Email Systems usefulness in supporting the participants' role indicated a medium correlation with (Question 14 $r = .49$), the level of enthusiasm to use QPS Email, (Question 15 $r = .60$), the procedures in place to manage intelligence using QPS Email, (Question 16 $r = .52$) the ability to access intelligence and information on QPS Email, (Question 17 $r = .56$), how useful the type of information and intelligence disseminated by QPS Email, (Question 19 $r = .53$) and how well the information and intelligence disseminated by QPS Email allows you to do your job. Similar correlations were also found for each of the questions apart from those indicating a high correlation (i.e. Question 11 and Question 12 $r = .77$,

Question 17 and 16 r = .81, and Question 15 and 17 r = .77) and those with the lowest correlation (i.e. Question 11 and Question 18 r = .32).

6.12 Discussion summary

Research Question 1 sought to determine whether the management and dissemination of operational information to police can be performed more efficiently and effectively in the QPS. The results of this research using this work-based study show that it can be.

Research sub-question 1 sought to determine what operational information and intelligence products police officers prefer. The results of this study indicate that the contents of operational information and intelligence products must be relevant to the criminal environment and not be generalised, loosely linked to crime trends, or outdated. Research also indicated that the intelligence needs of operational officers can often vary according to the officer's location, role, and rank. These results contribute to previous research conducted by Ratcliffe (2005) who in a New Zealand case study found that frontline officers preferred intelligence that was simple to comprehend, not time-consuming to act on, tactical in nature and arrest focussed.

Research sub-question 2 sought to determine whether operational information and intelligence can be delivered in a more effective and efficient way using SharePoint Application Technology (i.e., SR App). The results of this study indicate that SharePoint software technology can be used to build an effective KM system to manage and disseminate operational information to intelligence to police.

An evaluation of the SR App and QPS Email System was conducted by using the IDAM (Information Delivery Assessment Model) developed by combining elements of Goh's KM principles (product, people, process) with the Biomatrix activity system elements of (matter, energy, and information). These results are summarised in the following discussion.

6.12.1 People and matter

A comparison of the results of the analysis relating to the KM principle of people with Biomatrix activity system element of matter suggests that user functionality of the SR App was enhanced by the general capacity to access, store, monitor and record

information. Police reported it was easy to know where information was being stored in the SR App. This is consistent with Goh's (2005) argument that knowledge should be systematically structured and mapped to improve the capacity to access information, enhancing the organisation's capability to address complex problems. The results noted that the QPS Email System is easy to use and accessible on all QPS and personal devices. Analysis of the email system indicates that users experience a high amount of information through email that can often contribute to the accumulation of messages and significant time spent managing information. Results also indicated that there is often a loss of information in the QPS Email system through poor information management practices or functionality. Police reported getting a lot of emails that had no bearing or significance on their job and deleting messages without reading them to reduce their email burden. These results are consistent with previous studies that have identified that the increased use of mobile technology facilitating email and other messaging systems contributed to information overload for some users (Feng & Agosto, 2017). The consequences of poor information management practice leading to loss of organisational knowledge and reduced organisational performance have been identified in previous research (Burke, 2009; Sengupta & Abdelhamid, 1993). The results of this work-based study have shown that using email alone is not the most effective method of managing operational information and intelligence for police.

6.12.2 People and energy

A comparison of the results of the analysis relating to the KM principle of people with the Biomatrix activity system element of energy indicates that improved functionality with the SR App provided time-saving benefits and assist with planning and the allocation of resources. Police Intelligence Officers reported that the SR App saved them time emailing large amounts of information in separate intelligence packages and instead provided them with the capacity to store information and intelligence products where it could be found easily by a wider audience. The results noted that users have a high acceptance of email predominantly because of its ease of use and accessibility on personal and QPS devices. This is consistent with previous research finding that email is the most prominent and preferred method of communication within organisations (Rosen et al., 2019). Results indicate however that there was a level of frustration and dissatisfaction due to the high flow of emails creating a heavy email burden for police. These results are consistent with a study

conducted by Steffensen, McAllister, Perrewe, Wang, and Brooks (2022) who identified that whilst email was a useful organisational tool it had the potential to negatively impact users. According to Jackson et al. (2008), email often disrupts employee workflow increasing time on task management and reducing workplace productivity. Email has also been found to impact work-life balance and lead to the blurring of work and private life boundaries (Butts, Becker, & Boswell, 2015). These impacts according to Reinke and Chamorro-Premuzic (2014) have created workplace dissatisfaction and decreased workplace engagement. Officers in this study reported that in addition to the many other email messages they received, they also received up to 12 separate emails a day containing a variety of intelligence or information products often causing them confusion as to what intelligence was the most recent and creating what they describe as email fatigue. Officers supported the consolidation of intelligence into a single portal where it could be accessed at any time.

6.12.3 People and information

A comparison of the results of the thematic analysis relating to KM principle people and Biomatrix activity system element of information highlights that information is more useful to users when it is regularly updated and offers a variety of choices and modes that cater for the wide intelligence and learning needs of individuals. This research identified that the capacity to search and view video files, pdf documents and word documents on the SR App gave users greater access and options to more information. These results are consistent with previous studies that highlighted multi-modal forms of communication cater for the different learning styles of individuals, creating greater interactivity and information adaption (University of Illinois, 2022). Access to information was at times however dependent on the knowledge of the SR App technology and its features. A user with greater knowledge of the SR App was more likely to access a wider range of intelligence products. Feedback during interviews highlighted that intelligence requirements for police can be summarised into tactical intelligence for emergency incidents, operational intelligence for operational policing activities and strategic intelligence for higher organisational needs. This is consistent with a recent US study conducted by Prosser (2019) that identified that police intelligence can often be defined as criminal intelligence directed towards anticipating, preventing, and monitoring criminal activity, strategic intelligence concerning trends of criminal activity over the short and

long term and tactical intelligence relating to specific criminal activity that can be immediately used in criminal investigations or tactical planning. The individual intelligence products contained within each of these categories often depended on local crime trends and the user's role within the organisation. The results of this study noted that the usefulness of QPS Email was enhanced by the generally high level of understanding and knowledge of the email system and the capacity to disseminate information quickly.

6.12.4 Process and matter

A comparison of the results of the thematic analysis relating to the KM principle of process with Biomatrix activity system element of matter indicates that process effectiveness was improved through enhanced search capability and remote accessibility. Police tended to automatically search for information on the SR App instead of QPS Email to find the operational information or intelligence they needed, reducing the time they would otherwise spend looking for specific information using QPS Email. These results are consistent with a study conducted by Mishra, White, Leong, and Horvitz (2014) revealing that people under time limitation often automatically turn to search engines to find the information they need to perform a task because they considered that the value of retrieved information diminished with time delay. In time-limited circumstances, the search functionality provided SR App users with a more effective way to find information so it could be applied to operational or tactical strategy. The results relating to QPS Email noted user confidence remains in the QPS Email system and the capacity to share information quickly contributed to process effectiveness. This is consistent with research undertaken by Mutjaba et al. (2017) who submitted that personal and business users still prefer to use email as a crucial source of communication, despite the growing number of alternative communication options. In terms of this current study, it was found that due to the limited number of QLites deployed at the time the research was undertaken, officers tended to use QPS email on their personal phones to access operational information and intelligence whilst in the field.

6.12.5 Process and energy

A comparison of the results of the analysis relating to the KM principle of process with Biomatrix activity system element of energy indicates a time saving. Energy efficiency created through process re-design enhanced the capacity to disseminate, store and find information quickly improving the user's capacity to respond and develop an operational, tactical, or strategic strategy. This is consistent with research undertaken on small and medium enterprises that show that effective KM Systems improve communication, customer service, and response times and create greater organisational efficiency (Edvardsson & Durst, 2013). According to Al Toubi and Malik (2018), the rapid acquisition and processing of information and knowledge is crucial to ensure that problems and customer requirements are addressed in a timely manner. The level of efficiency and effectiveness obtained using the SR App was however somewhat dependent on the user's knowledge of and their ability to navigate the system. This observation is consistent with research undertaken by Wang and Yang (2016) who pointed out that KM users have different functional capabilities and so KM technology should include a variety of interface system options and users should also be provided support to work within the KM system. Wang and Yang (2016) noted however that most users will eventually adopt organisational KM processes as part of their normal business. This work-based research revealed most users had a high level of understanding of QPS Email and were able to disseminate information quickly. Police expressed how easy it was to use email and they had consistently used it in the past to disseminate all types of information. The SR App however provided an effective alternative to sharing and disseminating operational information so that it could be found more efficiently.

6.12.6 Process and information

A comparison of the results of the analysis relating to the KM principle of process with Biomatrix activity system element of information indicates that the process management of information was affected by the capacity to store, search, filter and disseminate information. This is consistent with the assertion that KM is defined as the process of capturing, distributing, and effectively using knowledge to enhance learning and improve organisational performance (Shrestha, Kong, & Cater-Steel, 2018). Both the QPS Email and SR App were important tools in this process. The QPS Email system was generally considered a more effective method to disseminate

operational or tactical information in the field for users not equipped with QLites. The SR App was noted to have better functional features to store, search, and filter information. At the time of this study, not all officers had access to QLites and were dependent on their personal phones for the dissemination of intelligence by email when in the field. Generally, most first response officers were equipped with QLites and had access to the SR App both in the field and in the office, therefore having greater opportunity to access information. During the focus group discussion Investigator 1 noted; "Because once a bolo (be on the lookout for) was posted (via email) it was never searchable. But now I can search the description and the document (using the SR App). So that's where the advantages are. But it's not much good if you don't have a QLite." According to Shrestha et al. (2018), knowledge is commonly categorised as tacit or explicit. Newell et al. (2009) described tacit knowledge as being dependent on the experience and skills of the individual while explicit knowledge is objective knowledge usually contained within manuals or policies. Due to the nature of explicit knowledge, it can be easily communicated and shared whereas tacit knowledge is more difficult to communicate and share because of its subjective nature. Shrestha et al. (2018, p. 622) highlight that knowledge can "quickly become redundant and lose relevance if it is not frequently updated and refreshed". During this current research it was evident that the QPS Email could be used to effectively disseminate knowledge however lacked the overall capacity to capture the subjective knowledge of users to build upon knowledge resources. Information disseminated by email can quickly lose time relevance and consequently be of less benefit to the user and with less likelihood of being retained as an organisation knowledge asset.

6.12.7 Product and matter

A comparison of the results of the analysis relating to the KM principle of product with Biomatrix activity system element of matter generally indicate that the SR App had a greater capacity to store and filter a wider range of information and intelligence products (i.e., tactical, operational, strategic) than compared with QPS Email. An Intelligence Officer during a Focus Group Discussion highlighted the importance of being able to store intelligence products so they can be found when required. According to Shrestha et al. (2018), organisations that can effectively manage and utilise their organisation's knowledge products are more likely to coordinate and combine their resources and capabilities in more innovative ways

creating better value for their customers. It was noted that both the QPS Email system and SR App were generally considered important tools to disseminate intelligence and other operational information to police however the SR App provided better functional options that allowed operational information and intelligence products to be captured and stored more effectively. A notable observation during this study was when Intelligence Officers commenced sending hyperlinks to information and intelligence holdings stored in the SR App using QPS Email. Based on survey results, frontline officers rated a high interest in the stolen vehicle hotlist, offender curfew list, missing persons' list, daily intelligence reports and top ten offenders list. These products provided frontline officers with the information they needed to identify suspected offenders and to make arrests. These results are consistent with similar observations made during a study conducted by Ratcliffe (2005) who noted that frontline police preferred arrest focussed intelligence that was easy to consume and quick to implement. Of note, however, during this current study, is that the data analysis component of research in Stage 1 was unable to demonstrate what strategic information or intelligence products were more commonly used because of low access data. These results do not necessarily reflect a lack of interest in these products as they were developed for a smaller group of users and were less likely to be of relevance to frontline operational police who represent a larger group of users.

6.12.8 Product and energy

A comparison of the results of the analysis relating to the KM principle of product with Biomatrix activity system element of energy found access to intelligence and information products via SR App and QPS Email were enhanced through ease of use. The difference noted was that the ease of use for the SR App related specifically to its search capability and the capacity to store and manage information in a single location. The ease of use for QPS Email is related to the high level of user understanding of the email system and the capacity to access QPS Email on all personal devices giving mobility to more users. A study conducted by Obiadaze and Obijiofor (2015) on mobile phones in education found that the capacity to remotely access information including online data, email, photographs, music, and message apps as well as make phone calls, send, and receive SMS, record video, and share multi-media enhanced the learning capacity of users. Factors affecting the general accessibility of intelligence and information using the SR App were access to QLites,

knowledge of the SR App and access to the internet in rural or blackspot areas. The factors affecting the overall accessibility to intelligence and information using email were the limited search functionality and capacity to manage and store large amounts of information. Emails were also often affected by access to the internet that ultimately prevented access to operational information and intelligence. An observation made by an Intelligence Officer during the focus group discussion was the functionality of the SR App allows intelligence officers to monitor information and product usage giving them the capacity to know whether their information products were being used and how the products may be adapted to support user demand. This observation, however, does not take into consideration that many of the strategic or operational intelligence products produced for executive managers or specialist units have a smaller audience and therefore less demand.

6.12.9 Product and information

A comparison of the results of the thematic analysis relating to the KM principle of product with the Biomatrix activity system element of information indicates operational intelligence products are valued by police when the intelligence provides priority targets, tasked patrol areas, information is up-to-date and timely, and intelligence is relevant to the tactical, operational, or strategic needs. Information and intelligence are not widely valued when it is low-grade or no longer current. Intelligence Officer 3 stated; “The main thing General Duties Police want to know is who is wanted and who is right to go into the bin (custody). They just want to chase the crooks. investigators sort of need that considerable background and work up”. These results are consistent with a previous New Zealand case study conducted by Ratcliffe (2005) who noted that frontline officers preferred arrest-focused intelligence that was easy to operationalise. Ratcliffe also noted that New Zealand Police Intelligence Officers would spend significant time producing tactical intelligence because of demand from frontline officers. In this current study, the SR App provided the functional design so that all forms of strategic, operational and tactical intelligence were available to a wide audience that included frontline officers, officers from specialist units and senior officers.

Chapter 7: CONCLUSION

Reece (2011) explained that the principle of learning from experience results directly from one's own actions and according to Fergusson, Allred, and Dux (2018) is embedded in the 'practice-theory-practice' cycle of reflective practice leading to a process of self-directed learning. The 'triple dividend' outcome of the DPRS program according to Fergusson, Allred, and Dux (2018) is the achievement of benefit or contribution for the research student, the organisation, and the profession. This chapter will discuss the outcomes and dividends of this research as they apply to each of these elements of the triple dividend. These include a description of how this research has benefited the student by developing the research and analytical skills necessary to make better decisions in a complex environment and the personal sense of achievement in having the results of this research and work-based project contribute towards strategic organisational goals including that of making the community safer. The organisational dividend resulting from the design and construction of the SR App using Goh's (2005) principles of KM has improved the management and dissemination of operational information and intelligence to police. Finally, this chapter will discuss how this research has contributed to professional academic practice in KM and Biomatrix systems theory through the development of the IDAM. Uniquely this research has combined principles of KM with a Biomatrix systems theory approach to develop a framework that improves the management and dissemination of information and knowledge. The IDAM may be applied as an evaluation and design tool for police KM systems. Further research will be required to determine whether the model can have similar applications to other KM systems. This discussion will conclude by identifying some limitations to this research and recommendations for future work-based learning research.

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Fergusson, Allred, Dux and Muianga (2018) point out that work-based learning programs develop the student's problem-solving and cognitive skills so they may better conduct independent field research necessary to inform and transform rapidly changing global worlds of work. The QPS operates in a complex environment impacted by several factors that create many significant organisational challenges. According to Bayley (2016), police organisations operate in multi-dimensional

environments affected by technology, terrorism, international boundaries, public demands, accountability, politics, and special interest groups. Further, there is also the challenge of increased calls for policing services and finite resources (Fergusson, Van Der Laan, White, & Balfour, 2019). Organisations including the QPS seek to achieve the most from their limited resources by implementing a strategy that best achieves organisational goals. These influences require a profound change in management and leadership. Allen and Gerras (2009) argued that strategic thinking is a necessary skill for the 21st-century security environment and stems from a realisation that the complex, uncertain and ambiguous environment requires creative and critical thinking.

Bayley (2016) highlights that organisational reputation, and the perception of public value is achieved when managers and employees make better decisions. The DPRS program leverages benefits from a combination of the students' work experience with the process of critical reflection, self-directed study and work-based problem solving, giving the researcher the capacity to apply a process of research and critical self-reflection when analysing problems and developing solutions.

This research provided the opportunity for the researcher to consult, seek advice and mobilise resources at all organisational and community levels enhancing the student's capacity to respond to future complex challenges. The most notable dividend for the researcher is the sense of satisfaction that this research has contributed to the KM needs of the QPS, ultimately contributing to a safer community. The purpose of this research was never simply founded for the single purpose of generating new knowledge (even though this was one reason) but also included a level of emotional commitment to making society better. Fergusson, Allred and Dux (2018, p. 4) point out that work-based research is wide-reaching and extends beyond the boundary of knowledge creation pointing to the example of Teddlie and Tashakkori (2009) who observed that transformative researchers were just as concerned with social justice as they were with the creation of new knowledge.

Fergusson, Allred and Dux (2018) argue that work-based programs can provide significant dividends for the workplace or practice domain through innovation, problem-solving, data analysis, product development and strategic insight. This research has been conducted with the intention of improving the management and dissemination of operational information and intelligence to police and determining what operational information and intelligence police prefer. Information and

intelligence are critical for the delivery of tactical, operational, and strategy. All organisations are faced with macro and micro environmental challenges that create risks to their operational capability, service delivery and reputation. In a QPS context, decision-making is summarised into four guiding principles, these include decisions that should be based on sound reasons, ensure compliance with service policy and legislation, are lawful and are fair (QPS, Self Principles, 2014). Sound decision-making requires an objective assessment of all relevant information. Milkman, Chugh, and Bazerman (2008) point out that in a knowledge economy, the primary deliverable for a knowledge worker is a good decision. The identification and analysis of available and required knowledge is essential for the planning and control of actions necessary to meet organisational objectives.

The QPS relies on the principles of Intelligence-Led Policing to guide operational strategy through the capacity to research, analyse and evaluate operational information and intelligence. It is critical that officers have access to all operational information and intelligence to make the most effective decisions. The SR App enhanced the dissemination and management of operational information and intelligence thereby providing officers with a greater capacity to make better decisions, contributing to organisational strategy and improved service delivery.

Fergusson, Allred and Dux (2018) explain that the professional dividend of workplace-based projects is the contribution it has towards academic and professional practice through rigorous research design. This research contributes to practitioner-based KM research and the application of Biomatrix systems theory through the development and application of the IDAM in evaluating the efficiency and effectiveness of a police KM system. According to Asrar-ul-Haq and Anwar (2016), there is considerable academic contribution focussing on KM practices in relation to work-related outcomes however little research on organisational KM development including process mechanisms and the implementation of KM programs. They noted that the nature and methods of such processes are often unique to every organisation and so there is considerable opportunity for learnings from each organisation's experience.

Hislop et al. (2018) highlighted that the general decline of practitioner involvement in KM research and academic publication pointed to the risk that KM will simply become academic with limited practical relevance to organisations. This

program of work-based research has recorded the design and development of the software solution (SR App) using Goh's (2005) KM principles. Further, the research led to the development of the IDAM framework that has been applied as a KM evaluation tool.

A review of the literature revealed several models that have been applied to the evaluation of programs or organisational design. These models are based on a variety of theories including for example Process theory and Results theory. Ackoff (1971) for example argued that a Systems theory approach is fundamental to the study of organisations. Matook and Brown (2017) proposed a Systems Thinking framework for IT artefacts (ITA) based on seven characteristics, that included integration, connectivity, complexity, state, adaptation, self-adaptation and synchronicity of the program. The authors argued that drawing upon theory from Systems Thinking allowed greater flexible application, ensuring the model can be applied to a variety of ITAs. Matook and Brown (2017) recommended future research investigating different theoretical applications towards IT evaluation so that a broader understanding of information technology artifacts may be developed including demonstrating how an impact of one or more characteristics has on organisational outcomes.

The Biomatrix systems theory integrates many of the Systems theory concepts and has been previously applied as an organisation evaluation tool by applying a framework structured around the Biomatrix system elements of ethos, aims, process, structure, governance and substance. This research is unique in that it applies the Biomatrix systems theory, activity system elements with Goh's (2005) KM principles to develop a new evaluation model that evaluates how KM design principles affect the matter, energy and information processes in KM to deliver a more effective and efficient method of disseminating and managing information.

This research demonstrates how the combination of activity system elements impacts the state of the entity System. This research confirms that the final state of a KM system (entity system) is shaped by the MEI (activity system) and that the system may be changed when one or more elements of matter, energy or information are modified.

Nevertheless, the IDAM does provide a framework that might guide the development of KM features enabling knowledge to be structured and mapped more efficiently, embedded into new intelligence products and services, and captured and

re-used more effectively through a systems theory context. This work-based learning and research program provided a unique opportunity for KM research to be documented in both theory and practical application thereby contributing to academic and industry-based research.

REFERENCES

Abrahamson, D. (2013). The impact of organizational information culture on information use outcomes in policing: An exploratory study. *Information Research, 18*(4), 1-33.

Ackoff, R. (1967). Management misinformation systems. *Management Sciene, 14*(4), 63-71.

Ackoff, R. (1971). Towards a system of systems concepts. *Management Science, 17*(11), 661-671.

Adamovic, D., Potgieter, A., & Mearns, M. (2012). Knowledge sharing through social media: Investigating trends and technologies in a global marketing and advertising research company. *South African Journal of Information Management, 14*(1).

Adelman, S., & Moss, L. (2000). *Data warehouse project management.* Pearson.

Adobe. (2019). *Adobe email usage study.* Adobe. Retrieved October 2019, from https://www/adobe.com

Ai, H., Nobuo, M., & Akimasa, S. (2008). A mapping of global warming research based on IPCC. *Sustainability Science, 3*(2), 201-213.

Al Toubi, S., & Malik, H. (2018). Knowledge management and organisational performance with a case study from PDO. In J. Syed, P. Murray, D. Hislop, & Y. Mouzughi, *The Palgrave book of knowledge management* (pp. 437- 470). Palgrave Macmillan.

Alavi, M., & Leidner, D. (2001). Knowledge management and knowledge management systems: Conceptual foundations and research issues. *Management Information Systems (MIS) Quarterly, 25*(1), 107-136.

Alavi, M., Kayworth, T., & Leidner, D. (2006). An empirical examination of the influence of organizational culture on knowledge management practices. *Journal of Management Information, 22*(3), 191-224.

Almalki, S. (2016). Integrating quantitative and qualitative data in mixed methods research: Challenges and benefits. *Journal of Education and Learning, 5*(3), 288-296.

Alter, S. (2004). A work system view of DSS in its fourth decade. *Decision support systems, 38*(3), 319-327.

American Productivity and Quality Centre. (2020). *2020 Process and performance Management Priorities*. Retrieved February 22, 2021, from APQC: http://APQC.com

Anderson, V., & Johnson, L. (1997). *Systems thinking basics: From concepts to causal loops.* Cambridge, United Kingdom: Pegasus Publishers.

Andersson, J., & Zbirenko, A. (2014). *Effect of organisational structure, leadership and communication on efficiency and productivity.* Umea University.

Angell, I. (1990). Systems thinking about information systems and strategies. *Journal of Information Technology*, 21-36.

Ardyan, E. (2016). Market sensing capability and SME performance: The mediating role of produce innovativeness success. *International Journal of Advanced and Applied Sciences, 2*, 79-97.

Arefin, S., Hoque, R., & Bao, Y. (2015). The impact of business intelligence on organiszations effectiveness: an emperical study. *Journal of Systems and Information Technology, 17*(3), 263-285.

Argyris, C., & Schon, D. (1978). *Organisational learning: A theory of action perspective.* Addison-Wesley.

Argyris, C., & Schon, D. (1996). Organizational learning 2: Theory, method and practice. *Asia Pacific Journal of Human Resources, 36*(1), 107-109.

Armitage, A. (2007). Mutual research designs: Redefining mixed methods research design. *British Educational Research Association Annual Conference, Institute of Education 5-8th September.* University of London.

Arnold, J., Kaiser, E., Kahn, J., & Kim, L. (2013). Information structure: Linguistic, cognitive and processing approaches. *Wiley Interdisciplinary Cognitive Science, 4*(4), 403-414.

Arsawan, I., Koval, V., Rajanini, I, Rustiarini, N, Supartha, W, & Suryantini, N. (2020). Leveraging knowledge sharing and innovation culture into SME's sustainable competitive advantage. *International Journal of Productivity and Performance Management, 71*(2), xx-xx.

Asrar-ul-Haq, M., & Anwar, S. (2016). A systematic review of knowledge management and knowledge sharing: Trends, issues and challenges. *Cogent Business and Management, 3*(1), 11-17.

Australian Institute of Criminology. (2012). *National crime prevention framework.* Australian Institute of Criminology.

Awad, E., & Ghaziri, H. (2004). *Knowledge management.* Pearson Education.

Awang, Z., Afthanorhan, A., & Mamat, M. (2015). *The Likert scale analysis using parametric based structural equation modelling (SEM).* Faculty of Economics and Management Sciences, University of Sultan Zainal Abidin.

Azvine, B., Cui, Z., & Nauck, D. (2005). Towards real-time business intelligence. *BT Technology Journal, 23*, 214-225.

Bagshaw, M. (2000). Why knowledge management is here to stay. *Industrial and Commercial Training, 32*(5), 179-183.

Bailey, C., & Kandel, E. (1995). Molecular and structural mechanisms underlying long-term memory. In M. Gazzaniga, *The Cognitive Neurosciences* (pp. 19-36). Cambridge, United Kingdom: MIT Press.

Bala, H., & Venkatesh, V. (2007). Assimilation of interorganisational and business process standards. *Information Systems Research, 18*(3), 340-362.

Baldacchino, K., Armistead, D., & Parker, D. (2002). Information overload: It's time to face the problem. *Management Services, 46*(4), 18.

Balter, O. (1997). Strategies for organising email messages. *Proceedings of the conference of the British Computer Society Human Computer Interaction Specialist Group*, (pp. 31-38). Bristol.

Bandura, H. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, United States of America: Prentice Hall.

Basex. (2005). *Information overload and cost to business.* New York: Basex. Retrieved April 2, 2018

Baskarada, S., & Koronios, A. (2018). The 5S organizational agility framework: a dynamic capabilities perspective. *International Journal of Organizational Analysis, 26*(2), 331-342.

Baskarada, S., Chandran, A., Shokr, M., & Stewart, C. (2016). Facilitating organizational learning through agent-based modeling and simulation experimentation. *The Learning Organization, 23*(6), 429-443.

Bawden, D. (2001). Information and digital literacies: a review of concepts. *Journal of Documentation, 57*(2), 218-259.

Bawden, D., & Robinson, L. (2008). The dark side of information: overload, anxiety and other paradoxes and pathologies. *Journal of Information Science, 35*(2), 180-191.

Bawden, D., & Robinson, L. (2020). *Information overload: an overview*. Oxford: Oxford University Press.

Bawden, D., Holtham, C., & Courtney, N. (1999). Perspectives on information overload. *Aslib Proceedings, 51*(8), 249-255.

Beckett, A., Wainwright, C., & Bance, D. (2000). Knowledge management: strategy or software. *Management Decision, 38*(9), 601-606.

Beer, S. (1985). *Diagnosing the system for organizations.* Brisbane, Australia: John Wiley and Sons.

Bellotti, V., Ducheneaut, N., Howard, M., & Smith, I. (2005). Quality vs Quantity: Email centric task management and its relationship with overload. *Human computer interaction*, 89-138.

Ben Shlomo, Y., Brookes, S., & Hickman, M. (2013). *Lecture Notes: Epidemiology, evidence based medicine and public health.* (6th, Ed.) Oxford, United Kingdom: Wiley-Blackwell.

Berkeley University of California Graduate Division. (2016, August 12). *Berkeley Graduate Division.* Retrieved from Learning: theory and research: http://www.gsi.berkeley.edu

Bettis-Outland, H. (2012). Decision-makings impact on organisational learning and information overload. *Journal of Business Research, 65*, 814-820.

Bettis-Outland, H. (2012). Decision-makings impact on organisational learning and information overload. *Journal of Business Research, 65*, 814-820.

Betts, R. (1978). Analysis, war and decision: Why intelligence failures are inevitable. *World Politics, 31*(1), 61-89.

Bhatt, G. (2001). Knowledge management in organisations: examining the interaction between technologies, techniques and people. *Journal of Knowledge Management, 5*(1), 68-75.

Bhunia, C. (2015). Knowledge Management: why and how. *IETE Technical Review, 21*(1), 25-37.

Birasnav, M., Goel, A, & Rastogi, R. (2012, January). Leadership behaviours, organisational culture and knowledge management practices: an empirical investigation. *Global Business and Economic Review*, 9-15.

Birkinshaw, J., & Mol, M. (2006). How management innovation happen. *MIT Sloan Management Review, 47*(4).

Bitkowska, A. (2017). Knowledge management in polish enterprises. *The IUP Journal of Knowledge Management, 25*(3), 7-22.

Bjarnason, E. (2013). Distances between requirements engineering and later software development activities: a systematic map. *Requirements engineering: foundation for software quality, 7830*, pp. 292-307.

Bjorklund, D., & Pellegrini, A. (2002). *The Origins of human nature: evolutionary developmental psychology*. Washington DC, United States of America: American Psychological Association.

Boersma, J., & Stegwee, R. (1996). Exploring the issues in knowledge management. *1996 Information Resources Management Association International Conference.*

Bosancic, B. (2016). Information in the knowledge acquisition process. *Journal of documentation, 72*(5), 930-960.

Bowen, T., Evans, M., & Dalkir, K. (2015). What does knowledge look like? Drawing as a means of knowledge representation and knowledge construction. *Education for Information, 31*(1), 53-72.

Brahan, J., Lam, K., Chan, H., & Leung, W. (1998). AICAMS: Artificial intelligence crime analysis and management system. *Knowledge Based Systems, 11*, 355-361.

Braman, S. (2011). Defining information policy. *Journal of Information Policy, 1*, 1-5.

Bridgen, S. (2017). Using systems theory to understand the identity of academic advising: A case study. *NACADA Journal, 37*(2), 9-20.

Brown, J. (2001). Knowledge and organisation: a social practice perspective. *Organisation and Science, 12*(2), 198-213.

Brown, J., & Duguid, P. (2001). Knowledge and organisation: A social-practice perspective. *Organization Science, 12*(2), 215-232.

Brown, S. (2007). The meaning of criminal intelligence. *International Journal of Police Science and Management, 9*(4), 336-340. doi:10.1350

Brunell, J., Yli-Renko, H., & Clarysse, B. (2010). Learning from experience and learning from others: How congenital and interorganisational learning subsitute for experiential learning in young firm internationalisation. *Strategic Entrepreneurship Journal*, 164-182.

Buckland, M. (1991). Information as a thing. *Journal of the American Society for Information Science, 42*(5), 351-360.

Buckland, M. (2012). What kind of science can information science be. *Journal of the American Society for Information Science and Technology, 63*(1), 1-7.

Burcher, M., & Whelan, C. (2018). Intelligence-Led Policing in Practice: Reflections from Intelligence Analysts. *Police Quarterly*, 1-22. doi:10.1177/10986111187906890

Burgess, A., Jackson, T., & Edwards, J. (2005). Email training significantly reduces email defects. *International Journal of Information Management, 25*(1), 71-83. doi:10.1016/j.iijnformgt.2004.10.004

Burke, M. (2009). The exploration of relationships between information fulfillment and organisational design. *Journal of Documentation, 65*(4).

Burks, A. (1958). *The collected papers of Charles Sanders Peirce* (Vols. 7-8). (A. Burks, Ed.) Cambridge: Harvard University Press.

Burton, L., Westen, D., & Kowalski, R. (2015). *Psychology* (4, Australian and New Zealand Edition ed.). Brisbane, Australia: John Wiley and Sons.

Butler, R., Chilcot, J., Inge, T., Mates, M., & Taylor, A. (2004). *Review of intelligence on weapons of mass destruction - Report of a Committee of Privy Counsellors.* House of Commons. London: Her Magesty's Stationary Office. Retrieved April 1, 2018, from http://www.butlerreview.org.uk

Butterfield, A., & Ngondi, G. (2016). *A dictionary of computer science.* London, UK: Nile.

Butts, M., Becker, W., & Boswell, W. (2015). Hot buttons and time sinks: The effects of electronic communications during nonwork time on emotions and work-nonwork conflict. *Academy of Management Journal, 58*, 763-788.

Byrne, K., Silasi-Mansat, C., & Worthy, D. (2017). *National Library of Medicine.* doi:10.1016/j.paid.2014.10.009

Cambridge Dictionary. (2019). *Cambridge International Dictionary of English.* Cambridge, UK: Cambridge University Press. Retrieved September 12, 2017, from https://dictionary.cambridge.org

Caniels, M., Chiocchio, F., & Van Loon, N. (2019). Collaboration in project teams: The role of mastery and performance climates. *International Journal of Project Management, 37*(1), 1-13.

Capra, F. (1997). *The web of life.* New York, United States of America: Double Day.

Capurro, R., Hjorland, B., & Cronin, B. (2003). The concept of information. *Annual review of Information Science and Technology, 37*, 343-411.

Carter, D. (2004). Law enforcement intelligence: A guide for state, local and tribal law enforcement agencies. Retrieved February 12, 2021, from http://www.intellprogram.msu.edu/Carter_Intelligence_Guide.pdf

Carter, J, & Phillips, S. (2015). Intelligence-Led Policing and forces of organisational change in the USA. *Policing and Society, 25*(4), 333-357.

Carter, J. (2011). *Policing Innovation: Exploring the adoption of Intelligence-Led Policing.* Michigan State University, Criminology. Michigan: Michigan State University.

Carter, J. (2016). Institutional pressures and Isomorphism: The impact on Intelligence-Led Policing. *Police Quarterly, 19*(4), 435-460.

Carter, J., & Fox, B. (2018). Community policing and Intelligence-Led Policing: An examination of convergent or discriminant validity. *Policing: An International Journal, 42*(1), 43-58.

Chae, J., Lee, C., & Jensen, J. (2016). Correlates of cancer information overload: Focusing on individual ability and motivation. *Health Communication, 31*(5), 626-634.

Chan, J. (1997). *Changing Police Culture.* Sydney, Australia: Cambridge University Press.

Chan, J., Brereton, D., Legousz, M., & Doran, S. (2001). *E Policing: The impact of information technology on police practices.* Brisbane, Qld: Queensland Criminal Justice Commission.

Chapman, G., & Macht, S. (2018). Best practices in knowledge management: A review of contemporary approaches in a globalised world. In G. Chapman, & S. Macht, *The Palgrave Handbook of Knowledge Management* (pp. 643-666). Palgrave MacMillan, Cham.

Chase, R. (1997). The knowledge-based organisation: An international survey. *Journal of Knowledge Management, 1*(1), 38-49.

Chatterjee, D., Grewal, R., & Sambamurthy, V. (2002). Shaping up for e-commerce: Institutional enablers of organisational assimilation of web technologies. *MIS Quarterly, 26*(2), 65-89.

Check, J., & Schutt, R. (2012). *Research methods in education.* California: Thousand Oaks.

Chen, H., Schroeder, J., Hauck, R., Ridgeway, L., Atabakhsh, H., & Gupta, H. (2002). COPLINK connect: Information and knowledge management for law enforcement. *Decision Support Systems, 34*(3), 271-285.

Chen, H., Schroeder, J., Hauck, R., Ridgeway, L., Gupta, H., & Atabakhsh, H. (2003). COPLINK connect: information and knowledge management for law enforcement. *Decision Support Systems, 34*(3), 271-285. doi:10.1016/SO167-9236(02)00121-5

Chen, M. (2018). Improving website structure through reducing information overload. *Decision Support Systems, 110*, 84-94.

Chen, M., & Chen, A. (2005). Integrating option model and knowledge management performance measures: an empirical study. *Journal of Information Science, 31*(5), 381-393.

Cheng, P., Ouyang, Z., & Liu, Y. (2019). The effects of information overload on the intention of consumers to adopt electric vehicles. *Transportation*, 29.

Chevallier, C., Laaraf, Z., Lacam, J., Miloudi, A., & Salvetat, D. (2016). Competitive intelligence, knowledge management and competition: The case of european high-technology firms. *Business Process Management Journal, 22*(6), 1192-1211.

Choudhary, A., Harding, J., Camarinha-Matos, L., Lenny-Koh, S., & Tiwari, M. (2013). Knowledge management and supporting tools for collaborative networks. *International Journal of Production Research, 51*(7), 15-25.

Chow, W., & Chan, L. (2008). Social network, social trust and shared goals in organisational knowledge sharing. *Information and Management, 45*(7), 458-465.

Chun, M., Sohn, K., Arling, P., & Granados, N. (2008). Systems theory and knowlege management systems: The Case of Pratt-Whitney Rocktdyne. *Proceedings of the 41st Hawaii International Conference on Systems Sciences*, (pp. 1-10). Honolulu.

Chung, W., Chen, H., & Nunamaker, J. (2005). A visual framework for knowledge discovery on the Web: An emperical study of business intelligence exploration. *Journal of Management Information Systems, 21*(4), 57-84.

Cody, W., Kreulen, J., Krishna, V., & Spangler, W. (2002). The integration of business intelligence and knowledge management. *IBM Systems Journal, 4*(4), 697 - 680.

Cohan, W., & Levinthal, D. (1990). Absorptive capacity: A new perspective on learning and innovation. *Journal of Administrative Science Quarterly, 35*, 128-152.

Collier, P., Edwards, J., & Shaw, D. (2004). Communicating knowledge about police performance. *International Journal of Productivity and Performance Management, 53*(5), 458-467.

Commission, O. o. (2023). Retrieved January 12th, 2023, from Queensland Government Office of the Information Commission : https://wwww.oic.qld.gov.au

Cook, G. (1993). An empirical investigation of information search strategies with implications for decision support system design. *Decision Sciences, 24*(3), 683-698.

Cope, N. (2004). Intelligence-Led Policing or policing led intelligence? *The British Journal of Criminology, 44*(2), 188-203.

Cope, N., Fielding, N., & Innes, M. (2005). The appliance of science. *British Journal of Criminology, 45*(1), 39-57.

Council, N. H. (2018). *National statement on ethical conduct in human research.* Retrieved August 12, 2019, from http://www.nhmrc.gov.au

Crank, K. (2014). *Understanding police culture.* New York, United States of America: Routledge.

Creswell, J. (2011). *Research design: Qualitative, quantitative and mixed methods approach.* New Delhi, India: Sage Publications.

Creswell, J., & Miller, D. (2000). Determining validity in qualitative inquiry. *Theory into Practice, 39*(3), 124-131.

Creswell, J., & Plano, C. (2011). *Designing and conducting mixed method research.* California, United States of America: Sage, Thousand oaks.

Crocker, L., & Algina, J. (1986). *Introduction to classical and modern test theory.* New York: Harcourt.

Damanpour, F., & Aravind, D. (2015). *Managerial Innovation: Conceptions, processes and antecedents.* Cambridge University Press.

Damart, S. (2010). A cognitive mapping approach to organising the participation of multiple actors in a problem struture process. *Group decision and negotations, 19*(5), 505-526.

Datta, M. (2007). Communicating about culture and health: Theorizing culture-centred and cultural sensitivity approaches. *Communication Theory, 17*(3), 304-328.

Davenport, T. (1998). *Working knowledge.* Boston, United States of America: Harvard Business School Press.

Davenport, T., & Beers, M. (1995). Managing information about processes. *Journal of Management Information Systems, 12*(1), 57-80.

Davenport, T., & Prussak, L. (1998). *Working knowledge: How organisations manage what they know.* Boston, MA, United States of America: Harvard Business School Press.

Davenport, T., De Long, D., & Beers, M. (1998). Successful knowledge management projects. *Sloan Management Review, 39*(2), 43-57.

Davis, G., & Olson, M. (1985). *Management information systems: Conceptual foundations, structure and development.* New York: McGraw-Hill.

Derrington, M. (2009, March). A three-step guide to developing effective surveys. *Principal*, 46-47.

Dewah, P., & Mutula, S. (2014). Knowledge retention strategies in public sector organisations: Current status in sub-Saharan Africa. *Information Development, 32*(3), 1-15.

Dewah, P., & Mutula, S. (2018). Knowledge retention strategies in public sector organisations: current status in sub-Saharan Africa. *Information Development, 32*(3), 362-376.

Diefenbach, T. (2004). Different meanings of intangible assets and knowledge and their implications for management and innovation. *The International Journal of Knowledge Culture and Change, Management Annual Review, 4*(1), 553-562.

Dostal, E., Cloete, A., & Jaros, G. (2006). *Biomatrix a systems approach to organisational and societal change.* Middletown, United States of America: BiomatrixWeb.

Drugowitsch, J., De Angelis, G., Klier, E., & Angelaki, D. (2014). *Optimal multisensory decision making in a reaction time task.* doi:10.7554/elife.03005

Eckerson, W. (2005). The dawn of the BI director. *Information Management, 15*(3).

Edmunds, A., & Morris, A. (2000). Problem of information overload in business organizations: A review of the literature. *International Journal of Information Management, 20*(1), 17-28.

Effron, M. (2004). Knowledge management involves neither knowledge nor management. In M. Goldsmith, Morgan, H, & A. Ogg, *Leading Organisational Learning: Harnessing the Power of Knowledge* (pp. 39-49). San Francisco, United States of America: Jossey-Bass.

Elsweiler, D., & Baillie, M. (2011). What makes refinding information difficult. A study of email refinding. *Advances in information retrieval.*

Eltigani, A., Gardiner, P., Kirkham, R., Williams, T., & Ou, L. (2019). Learning in and from projects: The learning modes and a learning capability model. *Production Planning and Control*.

Enoch, L. (2017, August 18). *Queensland Cabinet*. Retrieved August 15, 2018, from https://cabinet.qld.gov.au/documents/2017/Jul/Digital/DIGITAL1ST%20aDVANCING%20fUTURE%

Eppler, M. (2008). *Managing information quality*. Heidelberg, Germany: Springer Science and Business Media.

Eppler, M., & Mengis, J. (2004). The concept of information overload: A review of literature from organisation science, accounting, marketing, MIS and related disciplines. *The Information Society, 20*, 325-344.

Ericson, R., & Haggerty, K. (1997). *Policing the risk society*. Toronto, Canada: University of Toronto Press.

Etikan, I. (2016). Comparison of covenience sampling and purposive sampling. Retrieved September 1, 2019, from https://www.researchgate.net/publication/304339244

Evaluating interprofesional education. (2015). *Interprofessional education and practice Guide No.3: 29*(4), 305-312.

Farkas, D., & Williams, T. (1990). John Carrolls The Nurnberg Funnel and minimalist documentation. *Transactions on Professional Communication, 33*(4). Retrieved February 1, 2022

Feng, Y., & Agosto, D. (2017). The experience of mobile information overload: Struggling between needs and constraints. *Information Research, 22*(2), 1-18.

Fergusson, L., Allred, T., & Dux, T. (2018). Work based learning and research for mid career professionals: Professional studies in Australia. *Interdisciplinary Journal of E-Skills and Lifelong Learning, 14*, 19-40.

Fergusson, L., Van der Laan, L., & Baker, S. (2019). Reflective practice and work-based research: a description of micro-and macro-reflective cycles. *Reflective Practice International and Multidisciplinary Perspectives, 20*(2), 289-303.

Fergusson, L., Van der Laan, L., Ormsby, G., & Azmy, W. (2020). Applied micro- and macro-reflective cycles in work-based learning and research: two advanced practice contexts. *Reflective Practice - International and Multidisciplinary Perspectives*, 1470-1103.

Fergusson, L., Van der Laan, L., White, C., & Balfour, J. (2019). The ethos and transformational nature of professional studies. A study of student experience in Australia. *Higher Education, Skills and Work-Based Learning*, 2042-3896.

Fergusson, L., Shallies, B., & Meijer, G. (2019). The scientific nature of work-based learning and research. An introduction to first principles. *Higher Education, Skills and Work-Based Learning*, 2042-3986.

Fiol, C. (1994). Consensus, diversity and learning in organisations. *Organisation Science, 5*(3), 403-420.

Fisher, D., Brush, A., Gleave, E., & Smith, M. (2006). Revisiting Whittakers and Sidners email overload ten years later. *Proceedings of the ACM CSCW Conference*, (pp. 309-312). New York.

Flamholtz, E., & Randle, Y. (2011). *Corporate culture: The ultimate strategic asset.* Stanford, United States of America: Stanford University Press.

Frantiska, J. (2019). Theory and Practice: Interface Development for Learning Environments. In *SpringerBriefs in Educational Communications and Technology* (pp. 13-25). Springer.

Freeze, R., & Kulkarni, U. (2005). Knowledge management capability assessment: Validating a knowledge assets measurement instrument. *38th Annual Hawaii Internation Conference on IEEE*. Retrieved January 2, 2022, from http://ieeexplore.ieee.org

Fridah, W. (2002). *Semanticscholar*. Retrieved September 12, 2019, from https://pdfs.sematicscholar.org

Furner, J. (2017). Philosophy of data; Why? *Education for Information, 33*(1), 55-70.

Galbraith, J. (1974). Organization design: An information processing view. *Computer Science, 4*(3), 28.

Genovese, M., Mazur, W., & Collins, J. (2022). Information overload: How Cov 19 has amplified operational stress among first responders. US. Retrieved January 2023, from http://www.ntoa.org

Ghauri, P., & Gronhaug, K. (2005). *Research methods in business studies.* Dorset, United Kingdom: Prentice Hall.

Giesecke, J., & McNeil, B. (2004). The state of KM. *Knowledge Management, 3*(70), 33-38.

Giguere, G., & Love, B. (2013). Limits in decision making arise from limits in memory retrieval. *Psychological and Cognitive Science, 110*(19), 7613 - 7618.

Gill, P., & Phythian, M. (2012). *Intelligence in an insecure world.* Cambridge, United Kingdom: Polity Press.

Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Methods of data collection in qualitative research: interviews and focus groups. *British Dental Journal, 204*(6).

Glancy, F., & Yadav, S. (2011). Business intelligence conceptual model. *International Journal of Business Intelligence Research, 2*(2), 48-66.

Goh, A. (2005). Harnessing knowledge for innovation: an integrated management framework. *Journal of Knowledge Management, 9*(4), 6-18.

Goh, S. (2002). Managing effective knowledge transfer: an integrative framework and some practice implications. *Journal of Knowledge Management, 6*(1), 23-30.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report, 8*(4).

Gonzalez-Valiente, C., Leon-Santos, M., & Arencibia-Jorge, R. (2019). Evoluation of the socio-cognitive structure of knowledge management (1986-2015): an author co-citation analysis. *Journal of Data and Information Science (Quarterly), 4*(1), 36-55.

Gordon, K. (2013). *Principles of data management: Facilitating information sharing.* The Chartered Institute for IT. Retrieved January 2, 2022

Goswami, S. (2015). Analysing effects of information overload on decision quality in an online environment. *Journal of Management Research, 15*(4), 231-245.

Gottschalk, P. (2009). *Policing the Police: Knowledge Management in Law Enforcement.* London, UK: Nova Science Pub Inc.

Grieve, J. (2004). Developments in UK Criminal Intelligence. In J. Ratcliffe, *Strategic Thinking in Criminal Intelligence* (pp. 25-36). Sydney, Australia: Federation Press.

Grise, M., & Gallup, B. (1999). Information overload: Addressing the productivity paradox in face to face electronic meetings. *Journal of Management Information Systems, 16*(3), 157-185.

Grovenor, T., & Davenport, V. (2001). General perspectives on knowledge management: Fostering a research agenda. *Journal of Management Information Systems, 18*, 5-23.

Guerid, F. (2021). Applied standards for effective writing in english for academic purposes. *English for specific purposes world, 23*(62).

Gultekin, K. (2009). *Knowledge management and law enforcement. An examination of knowledge management strategies of the police information system (POLENET) in the Turkish National Police.* University of North Texas. Texas: University of North Texas.

Gupta, A., & Govindarajan, V. (2000). Knowledge flows within multinational Corporations. *Strategic Management Journal, 21*, 473-496.

Gwizdka, J. (2004). *Cognitive abilities, interfaces and tasks: affects on prospective information handling in email.* Thesis, University of Toronto, Mechanical and Industrial Engineering, Toronto.

Hajibayova, L. (2019). Exploring individuals patterns of personal information management practices: factors influencing the representation, organisation and credibility assessment of information. *Information Research, 24*(3).

Handa, P., Pagani, J., & Bedford, D. (2019). *Knowledge Assets and Knowledge Audits.* Bradford, United Kingdom: Emerald Publishing Limited.

Hannan, M., & Freeman, J. (1977). The population ecology of organizations. *American Journal of Sociology*, *82*(5), 929-964.

Hansens, H. (2005). Choosing evaluation models: A discussion on evaluation design. *Evaluation, 11*(4), 474-462.

Hartshorne, C., & Weis. (1931). *Collected papers of Charles Sanders Peirce* (Vols. 1-6). Cambridge: Harvard University Press.

Hassan, I., Obaid, F., Ahmed, R., Abdelrahman, L., Adam, S., Adam, O., Kashif, T. (2020). A Systems Thinking approach for responding to the Covid 19 pandemic. *Eastern Mediterranean Health Journal, 26*(8), 872-876.

Hassell, L. (2007). Continental philosophy perspective on knowledge management. *Information Systems Journal, 17*(2), 185-195.

Hawkins, D. (2013). *Communications interoperability: A guide of interagency communications projects.* Washington, D.C: U.S. Department of Justice, Office of Community Oriented Policing Services.

Heaton, R. (2000). The prospects for Intelligence-Led policing: Some historical and quantitative considerations. *Policing and Society, 9*(4), 337-356.

Heisig, P., Suraj, O., Kianto, A., Kemboi, C., Arrau, G., & Easa, N. (2016). Knowledge management and business performance: Global experts views on future research needs. *Journal of Knowledge Management, 20*(6), 1169-1198.

Hemp, P. (2009). Death by information overload. *Harvard Business Review, 87*(9), 82-89.

Hennink, M., & Leavy, P. (2014). *Understanding focus group discussions.* Oxford, United Kingdom: Oxford University Press.

Herbig, P., & Kramer, H. (1994). The effect of information overload on the innovation choice process. *Journal of Consumer Marketing, 11*(2), 1-10.

Hicks, B., Culley, S., Allen, R., & Mullineux, G. (2002). A framework for the requirements of capturing, storing and reusing information and knowledge in engineering design. *International Journal of Information Management, 22*, 263-280.

Hill, C., Jones, G., & Galvin, P. (2004). *Strategic management an integrated approach.* Sydney, Australia: John Wiley and Sons.

Hiltz, S., & Turoff, M. (1985). Structuring computer-mediated communication systems to avoid information overload. *Communications of the ACM, 28*(7), 680-689.

Hirschheim, R. (1983). Systems in O.R: reflections analysis. *Journal of the Operational Research Society, 34*, 813-818.

Hislop, D., Murray, Shrestha, A., Syed, J., & Mouzughi, Y. (2018). Knowledge management: Potential future research directions. In J. Syed, P. Murray, & D. a. Hislop (Eds.), *The Palgrave Handbook of Knowledge Management* (pp. 691-700). Cham, Switzerland: Palgrave Macmillan.

Hjorland, B. (2014). Classical databases and knowledge organisation: A case for boolean retrieval and human decision-making during searches. *Journal of the Association for Information Science and Technology, 66*(8), 1559-1575.

Hoepfl, M. (1997). Choosing qualitative research: A primer for technology education resources. *Journal of Technology Education, 9*(1), 47-63.

Hong, H., & Kim, H. (2020). Antecedents and consequences of information overload in the Covid 19 Pandemic. *International Journal of Environmental Research Public Health, 17*(24), 9305.

Hoof, B., Vijvers, J., & Ridder, J. (2002). Knowing what to manage: the development and application of a knowledge management scan. *3rd European Copnference on Organisational Knowledge, Learning and Capabilities.* Athens, Greece.

Howell, K. (2013). *An introduction to the philosophy of methodology*. Sage Publishing.

Hubbard, D. (2007). *How to measure anything: finding the value of intangibles in business.* Hoboken, New Jersey: John Wiley & Sons.

Huber, C. (1991). Organisational learning: The contributing processes and the literatures. *Organisational Science, 2*(1), 88-115.

Hunt, R., & Newman, R. (1997). Medical knowledge overload: A disturbing trend for physicians. *Health Care Management Review, 22*, 70-75.

Huser, V., Sincan, M., & Cimino, J. (2014). Developing genomic knowledge bases and data bases to support clinical management current perspectives. *Pharmacogenomics and Personalised Medicine*.

Hussein, S. (2009). The use of triangulation in social science research: Can qualitative and quantitative methods be combined? *Journal of Comparative Social Work, 1*, 1-10.

Hwang, J., & Lin, J. (1999). Information dimension, information overload and decision quality. *Journal of Information Science, 25*(3), 213-218.

Hyland, K. (2006). *English for academic purpose.* Routledge.

I, E., & Durst, S. (2013). Does knowledge management deliver the goods in SME's. *Business and Management Research, 2*(2), 52-60.

Ikehara, H. (1999). Implications of Gestalt Theory and practice for the learning organisation. *The Learning Organisation, 6*(2), 63-69.

Illinois, U. o. (n.d.). Multimodal communication. Retrieved December 2022, from https:www.uis.edu

Information Overload Research Group. (2017). *Information overload and cost to economy*. New York: Information Overload Research Group. Retrieved April 2, 2017

Innes, M. (2006). Policing uncertainty: Countering terror through community intelligence and democratic policing. *American Academy of Political and Social Science, 605*(1), 222-241.

International Organisation for Standardisation ISO 5127:2017. (2017). *Definition of Information.* International Organisation for Standardisation. Geneva: ISO. Retrieved September 25, 2017, from http://www.iso.org

Jacks, T., Wallace, S., & Nemati, H. (2012). Impact of culture on knowledge management: A meta-analysis and framework. *Journal of Global Information Technology Management, 15*(4), 8-42.

Jackson, J., Hough, J., Bradford, B., Hohl, K., & Kuha, J. (2012). Policing by consent: Understanding the dynamics of police power and legitimacy. *European Social Survey*, 16.

Jackson, S. (1996). *Handbook of work group psychology - The consequences of diversity in multidisciplinary work teams.* John Wiley and Sons: Chichester, United Kingdom.

Jackson, T., Dawson, R, & Wilson, D. (2003). Reducing the effect of email interuptions on employees. *International Journal of Information Management, 23*, 55-65.

Jacob, J. (1984). Perspectives on information overload. *Journal of Consumer Research, 10*(4), 432-435.

Jacoby, J. (1977). Information load and decision quality: Some contested issues. *Journal of Marketing Research, 14*(4), 569-573.

Jacoby, J. (1984). Perspectives on information overload. *Journal of Consumer Research, 10*(4), 432-435.

Jajibayova, L. (2019). Exploring individuals patterns of personal information management practices: factors influencing the representation, organisation and credibility assessment of information. *Information Research, 24*(3).

John, T., & Maguire, M. (2016). *The National Intelligence Model: early implementation experience in three police force areas.* Cardiff University, Health and Social Science. Cardiff: Cardiff University.

Johnson, B. (1997). Examining the validity structure of qualitative research. *Education, 118*(3), 282-292.

Johnson, G., Scholes, K., & Whittington, R. (2006). *Exploring corporate strategy*. Harlow: Prentice-Hall.

Johnson, S., & White, G. (1971). Self-observation as an agent of behavioural change. *Behaviour Therapy, 2*(4), 488-497.

Jones, K., & Willett, P. (1997). *Readings in information retrieval.* London, United Kingdom: Morgan Kaufman.

Joppe, M. (2000). *The research process.* Retrieved September 12, 2019, from Scientific Research Publishing: http://www.scirp.org

Joshi, A., Kale, S., Chandel, S., & Pal, D. (2015). Likert scale: Explored and explained. *British Journal of Applied Science and Tec hnology, 7*(4), 396-403.

Kandel, E., Schwartz, J., Jessell, T., Siegelbaum, S., & Hudspeth, A. (1981). *Principles of Neural Science* (6 ed.). Elsevier.

Karimi, J., Somers, T., & Bhattackerjee, A. (2007). The impact of ERP implementation on business process outcomes: A factor based study. *Journal of Management Information Systems, 24*(1), 101-134.

Kast, F., & Rosenzweig, J. (1972). General Systems Theory: Applications for organization and management. *Academy of Management Journal*, 447-466.

Katz, D., & Kahn, R. (1978). *The social psychology of organizations.* New York, United States of America: Wiley and Sons.

Kay, J. (1995). *Why firms succeed.* Oxford, United Kingdom: Oxford University Press.

Keller, K., & Staelin, R. (1987). Effects of quality and quantity of information on decision effectiveness. *Journal of Consumer Research, 14*, 200-213.

Kelly-Rainer, R., & Prince, B. (2021). *Introduction to Information Systems (9th edn).* New York: Wiley.

Khosravi, P., Newton, C., & Tezvani, A. (2019). A management innovation: A systematic review and meta analysis of past decades of research. *European Management Journal, 37*, 694-707.

Kimble, G. (1961). *Hilgard and Marquis conditioning and learning (2nd edn).* Englewood Cliffes, United States of America: Prentice Hall.

King, R. (2011). Online communication technologies as vehicles for sexual violence: a challenge for police. *Australiasian Policing: A Journal of professional practice and research, 3*(1), 35-45.

Kirk, J. (1999). Information in organisations: directions for information management. *Information Research, 4*(3).

Kleiven, M. (2007). Where's the intelligence in the National Intelligence Model. *International Journal of Police Science and Management, 9*(3), 257-262.

Kline, P. (1994). *An easy guide to factor analysis.* London: Routledge.

Klir, G. (1991). *Facets of Systems Science.* London: Plenum Press.

Kock, N. (2000). Information overload and worker performance: a process-centred view. *Knowledge and Process Management, 7*(4), 256-264.

Kogut, B. (2000). The network as knowledge: generative rules and the emergence of structure. *Strategic Management Journal, 21*(3), 405-425.

Kolb, D. (1984). *Experiential learning: Experience as a source of learning and development.* New Jersey: Prentice-Hall.

Komiyama, H., & Takeuchi, K. (2006). Sustainability Science: Building a New Discipline. *Sustainability Science, 1*, 1-6.

Koniger, P., & Janowitz, K. (1995). Drowning in information, but thirsty for knowledge. *International Journal of Information Management, 15*(1), 5-16.

Kraus, S., Pohjola, M., & Koponen, A. (2012). Innovation in family firms: an emperical analysis linking organisational and managerial innovation to corporate success. *Review of Managerial Science*.

Lansdale, M., & Edmonds, E. (1992). Using memory for events in the design of personal filing systems. *International Journal of Man-Made Machine Studies*.

Laperche, B. (2016). Large firms knowledge capital and innovation networks. *Journal of the Knowledge Economcuy, 12*, 183-200.

Lauring, J., & Zhang, L. (2018). Knowledge sharing across national cultural boundaries and multinational corporations. In J. Syed, P. Murray, D. Hislop, & Y. Mouzughi, *The Palgrave Handbook of Knowledge Management* (p. 381). Palgrave Macmillan.

Laursen, K., & Mahnke, V. (2001). Knowledge strategies, firm types and complementarity in human resource practices. *Journal of Management and Governance, 5*, 1-27.

Lee, H., & Choi, B. (2003). Knowledge management enablers, processes, and organisational performance: An integrative view and empirical examination. *Journal of Management Information Systems, 20*, 179-288.

Lee, M., & Chen, T. (2012). Revealing research themes and trends in knowledge management from 1995-2010. *Knowledge Based Systems, 28*, 47-58.

Lester, S., & Costley, C. (2010). Work-based learning at higher education level: Value, practice and critique. *Studies in Higher Education, 35*(5), 561-575.

Leung, S. (2011). A comparison of psychometric properties and normality in 4,5,6 and 11 point Likert Scales. *Journal of Social Service Research, 37*(4).

Levitas, J. (2021). *Introduction to psychology*. Retrieved February 22, 2022, from www.study.com: http://www.study.com

Lewandowski, C., Carter, J., & Campbell, W. (2018). The utility of fusion centres to enhance intelligence-led policing: an exploration of end users. *Policing: A Journal of Policy and Practice, 12*(2), 177-193.

Libowski, Z. (1975). Sensory and information inputs overload: Behavioural effects. *Comprehensive Psychiatry, 16*, 199-221.

Liebel, G., Tichy, M., Knauss, E., Ljungkrantz, O., & Stieglbauer, G. (2018). Organisation and communication problems in automotive requirements engineering. *Requirements Engineering, 23*, 145-167.

Likoum, S., Shamout, M., & Abubakar, S. (2018). Market sensing capability, innovativeness, brand management systems, market dynanism, competitive intensity and performance: An integrative review. *Journal of the Knowledge Economy*, 1-21.

Loftus, B. (2010). Police occupational culture: classic themes, altered times:. *Policing and Society, 20*(1), 1-20.

Lombardi, O. (2004). What is information? *Foundations of Science, 9*(2), 105-134.

Long, S., Perumal, P., & Ajagbe, M. (2012). The impact of human resource management practices on employees turnover intention: A conceptual model. *Interdisciplinary Journal of Contemporary Research in Business, 4*(2), 629-641.

Lopetgui, M., Shasha, B., Phillip, R., Embi, P., Yen, P., Lai, A., Payne, P. (2013). Inter-observer reliability assessments in time motion studies: The foundation for meaningful clinical workflow analysis. *AMIA Annual Symposium Proceedings*, (pp. 889-896).

Lopez - Robles, J., Otegi - Olaso, J., Porto - Gomez, I., & Cobo, M. (2019). 30 years of intelligence models in management and business: A bibliometric review. *International Journal of Information Management, 48*, 22-38.

Lopez, S., Peon, J., & Ordas, C. (2006). Human resource management as a determining factor in organisational learning. *Management Learning, 37*(2), 215-339.

Love, P., Smith, J., Ackermann, F., Irani, Z., & Teo, P. (2018). The costs of rework: insights from construction and opportunities for learning. *Production Planning and Control, 29*(13), 1082-1095.

Luhmann, N. (1990). Technology, environment and social risk: a systems perspective. *Industrial Crisis Quarterly, 4*, 223-231.

Luo, L., He, Q., Xie, J., Yang, D., & Guangdong, W. (2017). Investigating the relationship between project complexity and success in complex construction projects. *Journal of Management in Engineering, 33*(2).

MacEntee, M. (2019). A typology of systematic reviews for synthesising evidence on health care. *Gerodontology, 36*(4), 303-312.

Machin, D., Campbell, M., Tan, S., & Tan, S. (2018). Sample Sizes for clinical, laboratory and epidemiology studies. Retrieved September 22, 2019, from www.onlinelibrary.wiley.com

Macintosh, A. (1996). *Position paper on knowledge assett management.* University of Edinburgh, Artificial Intelligence Applications Institute, Edinburgh.

Mackenzie, N., & Knipe, S. (2006). Research dilemmas: Paradigms, methods and methodology. *Issues in Educational Research, 16*.

Maes, P. (1994). Agents that reduce work and information overload. *Communications of the Association for Computing Machinery, 37*(7), 30-40.

Mainga, W. (2017). Examining project learning, Project management competencies and project efficiency in project based firms. *International Journal of Managing Projects in Business, 10*(3), 454-504.

Majchrzak, A., Faraj, S., Kane, G., & Azad, B. (2013). The contradictory influence of social media affordances on online communal knowledge sharing. *Journal of Computer-Mediated Communication, 19*, 38-55.

Malhotra, N. (1982). Information load and consumer decision making. *Journal of Consumer Research, 8*(4), 419-430.

Manning, P. (2001). Theorizing policing: The drama and myth of crime control in NYPD. *Theoretical Criminology, 5*(3), 315-344.

Mark, G., Iqbal, S., Czerwinski, M., Johns, P., & Sano, A. (2018). *Email Duration, batching and self-interuption: Patterns of email use on productivity and stress.* Microsoft.

Marshall, M. (1996). Sampling for qualitative research. *Family Practice, 13*(6), 522-525.

Martensson, M. (2000). A critical review of knowledge management as a management Tool. *Journal of Knowledge Management, 4*(3), 204-216.

Martin, L., & Root, D. (2010). Emerging contractors in South Africa: Interactions and learning. *Journal of Engineering, Design and Technology, 8*(1), 64-79.

Martin, P. (2017). *QPS Regional Operations.* Queensland Police Service. Brisbane: Queensland Police Service. Retrieved April 21, 2017, from https://www.police.qld.gov.au/net.qldpol/operations

Massingham, P. (2014). An evaluation of knowledge management tools: Part 2 - managing knowledge flows and enablers. *Journal of Knowledge Management, 18*(6), 1053-1074.

Matei, M., & Nitu, L. (2012). Intelligence analysis in Romania's SRI: The Critical "Ps" - people, processes, products. *International Journal of Intelligence and CounterIntelligence, 25*(4), 700-726.

Mathison, S. (1988). Why triangulate? *Education Researcher, 17*(2), 13-17.

Matook, S., & Brown, S. (2017). Characteristics of IT artifacts: a systems thinking-based framework for delineating and theorizing IT artifacts. *Information Systems Journal, 27*, 309-346.

Matoskova, J. (2016). Measuring knowledge. *Journal of Competitiveness, 8*(4), 5-29.

Maturana, H. (1975). The organization of the living: A theory of the living organization. *International Journal of Man-Machine Studies, 7*(3), 313-332.

McGrath, C., Palmgren, P., & Liljedahl, M. (2019). Twelve tips for conducting qualitative research interviews. *Medical Teacher, 41*(9), 1002-1006.

McKelvie, S. (1978). Graphic rating scales - How many categories. *British Journal of Psychology, 69*(2), 185-202.

Meglio, C., & Kleiner, B. (1990). Managing information overload. *Industrial Management and Data Systems, 90*(1), 23-26.

Meier, R. (1963). Communications overload: Proposals from the study of a university library. *Administrative Science Quarterly, 7*, 521-544.

Mele, C., Pells, J., & Polese, F. (2010). A brief review of Systems Theories and their managerial applications. *Service Science, 51*, 38-43.

Meyer, C. (2008). An introduction to complexity and business. *Wiley Online Library - Complexity, 3*(4), 21-22. Retrieved from Wiley Online Library.

Microsoft. (2022). *Microsoft analytics*. Retrieved January 12, 2023, from http://www.microsoft.com: www.microsoft.com

Miller, F. (2002). Information has no intrinsic meaning. *Information Research, 8*(1).

Miller, G. (1962). *Psychology: The Science of Mental Life.* New York, United States of America: Harper and Row.

Miller, W., & Seligman, M. (1975). Depression and learned helplessness in man. *Journal of Abnormal Psychology, 84*(3), 228-238.

Mintzberg, H. (2009). *Tracking strategies: Toward a general theory of strategy formation.* New York: Oxford University Press.

Mintzberg, H., Ahistrand, B., & Lampel, J. (1988). *The Strategy Safari.* New York, United States of America: Free Press.

Mishra, N., White, R., Leong, S., & Horvitz, E. (2014). Time critical search. *Proceedings of the 37th international ACM SIGIR conference on Research & development in information retrieval.* Microsoft Research.

Montgomery, A., & Mingis, K. (2021). The evolution of Apple's iphone. *Computerworld*. Retrieved February 22, 2022, from http://www.computerworld.com

Moore, J. (2011). Behaviorism. *The Psychological record, 61*(3), 449-463.

Morgan, D. (1998). *The focus group guide book.* London, United Kingdom: Sage Publications.

Muller, T. (1984). Buyer response to variations in product information load. *Journal of Applied Psychology, 69*(2), 300-306.

Mutjaba, G., Shuib, L., Raj, R., Majeed, N., & Al-Garadi, M. (2017). Email classification research trends: Review and open issues. *IEEE access, 5*, 9044-9064.

Mvungi, J., & Tossy, T. (2015). Usability evaluation methods and principles for the web. *International Journal of Computer Science and Information Security, 13*(7).

National Audit Office. (2012). *Mobile technology in policing.* London: National Audit Office. Retrieved January 12, 2019, from https://www.nao.org.uk.mobiletechnology

Nehls, N. (1995). Narrative pedagogy: rethinking nursing education. *Nursing Education, 34*(5), 204-210.

Nemati, H. (2002). Global knowledge management: Exploring a framework. *Journal of Global Information Technology Management, 5*(3), 1-11.

Newell, S., Robertson, M., Scarbrough, H., & Swan, K. (2009). *Managing Knowledge Work and Innovation.* Hampshire, United Kingdom: Palgrave-Macmillan.

Ng, I., Maull, R, & Yip, N. (2009). Outcome based contract as a driver for Systems Thinking and service dominant logic in service science: Evidence from Defence Industry. *European Management Journal, 4*(3), 377-387.

Nielsen Norman Group. (2016). Larger devices. Retrieved December 2022, from https://www.nngroup.com

Nonaka, I., & Konno, N. (2009). The concept of Ba: building a foundation for knowledge creation. *Californian Management Review, 4*(3), 377-387.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation.* Oxford, United Kingdom: Oxford University Press.

Nonaka, I., Takeuchi, H., & Umemoto, K. (1996). A theory of organizational knowledge creation. *International Journal of Technology Management, 11*(7-8), 833-845.

Norman, D. (1993). *Things that make us smart.* Reading, MA: Addison-Wesley.

Nunally, J. (1978). *Psychometric theory*. New York: McGraw-Hill.

Nutting, J., & White, G. (1994). *The Business of Communicating.* Sydney: McGraw-Hill.

Nyumba, T., Wilson, K., Derrick, C., & Mukherjee, N. (2018). *Qualitative Methods for eliciting judgements for decision making - The use of focus group discussion methodology: Insights from two decades of application in conservation, Methods in Ecology and Evolution.* British Ecological Society.

Oatley, G., & Ewart, B. (2003). Crimes analysis software: 'pins in maps', clustering and Bayes net prediction. *Expert Systems with Applications, 25*(4), 569-588.

Obiadaze, R., & Obijiofor, V. (2015). Use of mobile phone technology in education for easy accessability of information: Challenges and prospects. *AFRREV IJAH: An international journal of arts and humanities, 4*(2), 66-86.

O'Brien, J., & Marakas, G. (2006). *Management Information Systems.* Tata McGraw.

O'Dell, C., & Grayson, C. (1998). If only we knew what we know: Identification and transfer of internal best practices. *California Management Review, 40*, 154-174.

OLeary, Z., & Hunt, J. (2016). *Workplace research: Conducting small-scale research in organisations.* London: Sage Publications.

Oliver, P. (2010). *A students guide to research ethics.* United Kingdom: McGraw Hill.

Olson, M., & Hergenhahn, B. (2012). *Introduction to theories of learning: Ninth Edition.* Taylor and Francis Group.

Olszak, C. (2016). Toward better understanding and use of business intelligence in organisations. *Information Systems Management, 33*(2), 105-123.

O'Reilly, C., & Chatman, J. (1996). Culture as social control: corporations, cults and commitment. (B. Staw, & L. Cummings, Eds.) *Research in Organisational Behaviour, 18*, 157-200.

Owen, R. (1992). Clarifying the simple assumption of the information load paradigm. *Advances in Consumer Research, 19*, 70-776.

Oxford Dictionary. (2019). *The Oxford English Dictionary.* Oxford, United Kingdom: Oxford University Press.

P, R., & Fehnren Bacher, D. (2019). On the role of information overload in information systems success: emperical evidnce from decision support system. *International conference on Information Syustems.* Munich.

Palinkas, L., Horwitz, S., Green, C., Wisdom, J., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration Policy Mental Health, 42*(5), 533-544.

Parkay, F., & Hass, G. (2000). *Curriculum Planning (7th ed.).* Needham Heights, United States of America: Allyn and Bacon.

Parnby, J. (2002). Factory 2000 plus. *International Journal of Manufacturing Technology and Management, 4*(1-2), 158-169.

Patel, S. (2015). *The research paradigm-methodology, epistemology and ontology explained in simple language.* Retrieved October 2, 2019, from http://salmapatel.co.uk

Patton, M. (2002). *Qualitative evaluation and research methods (3rd edn).* California, United States of America: Sage Publications.

Pedler, M., Burgoyne, J., & Boydell, T. (1991). *The Learning Company: A strategy for sustainable development.* London, United Kingdom: Mc Graw-Hill.

Pemberton, J., & Stonehouse, G. (2000). Organisational learning and knowledge assetts - an essential partnership. *The Learning Organisation, 7*(4), 184-194.

Perez-Araos, A., Barber, K., Eldridge, S., & Munive-Hernandez, E. (2007). Designing a knowledge management tool to support knowledge sharing networks. *Journal of Manufacturing Technology, 18*(2), 153-168.

Personality, punishment and procedural learning: A test of J.A Grays anxiety theory. (1997). *Journal of Personality and Society Psychology, 73*(2), 337-344.

Phillips-Wren, G., & Adya, M. (2020). Decision making under stress: the role of information overload, time pressure, complexity and uncertainty. *Journal of Decision Systems, 29*, 213-225.

Pisano, G., & Teece, D. (2007). How to capture value from innovation: Shaping intellectual property and industry architecture. *California Management Review, 50*(1), 278-296.

Plahkin, A., Semenets, I., Ogorodnikova, E., & Mironov, D. (2018). Improvement of tools for decision support DSS in corporate information systems of industrial enterprises. *MATEL web of conferences*, (p. 178).

Plummer, M. (2019). How to spend way less time on email every day. *Harvard Business Review*.

Plummer, M. (2022). Building bridges, not silos. *Harvard Business Review*.

Poell, R., & Van der Krogt, F. (2003). Learning strategies of workers in the knowledge-creating company. *Human resource development international, 6*(3), 387-403.

Prasad, D. (2016). Stratified random sampling. Retrieved September 12, 2019, from https:www.statualberta.ca

Pratt, M., & Fruhlinger, J. (2019, October 16). What is business Intelligence? Transforming data into business insights. *CIO Australia*, pp. 12-15.

Preece, D. (1995). *Organiszations and technical change: strategy, objectives and involvement.* London: Routledge.

Prokopidou, G., Patheodoou, C., & Moschopoulos, G. (2004). Information overload. *Government Information Quarterly, 21*(2), 170-198.

Prosser, C. (2019). Intelligence-Led Policing: Linking local and state policies to establish a comdefinition. *Dissertation - University of Mississipi*. US.

Purvis, R., Sambamurthy, V., & Zmud, R. (2001). The assimilation of knowledge platforms in organisations: An empirical investigation. *Organisational Science, 12*(2), 117-135.

Pythian, M. (2013). *Understanding the Intelligence Cycle.* London, United Kingdom: Routledge Taylor and Francis Group, Ebsco Publishing.

QPS. (2014). Self Principles. *Decision Making in QPS*. Qld.

QPS. (2018, September 3rd). *Queensland Police Service Strategic Plan 2018-2022*. Retrieved September 3rd, 2018, from https://www.police.qld.gov.au/sites//default/files/2018-09/2018_QPS_Strategic_Plan.pdf

QPS. (2019). Southern Police Region. Retrieved August 1, 2019, from https://www.police.qld.gov.au/southernregion

Quamby, N., & Young, L. (2010). *Managing Intelligence: The Art of Influence.* Sydney, Australia: Federation Press.

Queensland Police Service. (2016). *2016 Working for Queensland survey results.* Brisbane: Queensland Police Service. Retrieved January 21, 2017, from https://www.police.qld.gov.au/workingforqueensland

Queensland Police Service. (2016). *Intelligence cycles and systems.* Queensland Police Service. Brisbane: Queensland Police Service. Retrieved April 25, 2017, from https://www.police.qld.gov.au/intelligenceprocess

Queensland Police Service. (2018). *Intelligence doctrine.* Queensland Police Service. Brisbane: Queensland Police Service. Retrieved April 1, 2018, from https://www.police.qld.gov.au/intelligencedoctrine

Queensland Police Service. (2019). *Queensland Police Service Operational Procedures Manual*. Queensland Police Service. Brisbane: Queensland Police Service. Retrieved January 19, 2019, from https://www.police.qld.gov.au/operationsproceduresmanual

Queensland Police Service. (2020). *Innovation.* Queensland Police Service. Brisbane: Queensland Police Service. Retrieved June 5, 2021, from https://www.police.qld.gov.au/mobile/innovation

Ragab, M., & Arisha, A. (2013). Knowledge management and measurement: a critical review. *Journal of Knowledge Management, 17*(6), 873-901.

Ramamurthy, K., & Sinha, A. (2008). An empirical investigation of the key determinants of data warehouse adoption. *Decision Support Systems, 44*(4), 817-841.

Rankine, M. (2019). The 'thinking aloud' process: A way forward in social work supervision. *Reflective Practice, 20*(1), 97-110.

Rashid, A., Hassan, Z., & Al-Oqaily, A. (2015). Investigation of tacit knowledge meausrement methods. *Journal of Theoretical and Applied Information Technology, 76*(2).

Rashman, L., Withers, E., & Hartley, J. (2009). Organisational learning and knowledge management in public service organisations: A systematic review of literature. *International Journal of Management Review, 11*(4), 463-494.

Ratcliffe, J. (2003). Intelligence-Led Policing. *Trends and issues in crime and criminal justice*(248).

Ratcliffe, J. (2005, December). The effectiveness of police intelligence management: A New Zealand Case Study. *Police practice and research, 6*(5), 435 - 451.

Ratcliffe, J. (2008). *Intelligence-Led Policing.* Devon, United Kingdom: Willan Publishing.

Ratcliffe, J. (2016). *Intelligence-led policing.* New York, United States of America: Routledge.

Razmerita, L., Kirchner, K., & Nielsen, P. (2016). What factors influence knowledge sharing in organizations? A social dilemma perspective of social media communication. *Journal of Knowledge Management, 20*(6), 1225-1246.

Redmond, M., & Baveja, A. (2002). A data driven software tool for enabling cooperative information sharing among police departments. *European Journal of Operational Research, 141*(3), 660-678.

Reinke, K., & Chamorro-Premuzic, T. (2014). When email use gets out of control: Understanding the relationship between personality and email overload and their impact on burnout and work engagement. *Computers in Human Behaviour, 36*, 502-509.

Reynolds, J., Caley, L., & Mason, R. (2004). *How do people learn.* Cambridge Program for Industry. London: Chartered Institute of Personal Development.

Ricciuti, L. (2015, November). *Why is email still popular?* Retrieved from Association for Information and Image Management: https://community.aiim.org

Richards, J. (2013). *Pedalling hard- further questions about the intelligence cycle in the contemporary era.* London: Routledge Taylor and Francis Group, Ebsco Publishing.

Roberts, D. (2009). Friendship fosters learning: The importance of friendships in clinical practice. *Nurse Education Practice, 9*(6), 367-371.

Roberts, N., Gerow, J., Jeyaraj, A., & Roberts, S. (2010). A meta-analysis of organisational learning and IT assimilation. *ACM SIGMIS, 48*(4), 51-68.

Rosen, C., Simon, L., Gajendran, R., Johnson, R., Lee, H., & Lin, S. (2019). Boxed in by your inbox: Implications of daily e-mail demands for managers leadership behaviours. *Journal of Applied Psychology, 104 (1)*, 19-33.

Rowley, J. (1999). What is knowledge management. *Journal of Library Management, 20*(8), 416-420.

Rymarczuk, R. (2016). Same old story: On non-use and resistance to the telphone and social media. *Technology in Society, 45*, 40-47.

Samuel, A., & Rosen, L. (2015). Managing yourself - Conquering digital distraction. *Harvard Business Review, 93*(6), 110-113.

SAP Business Objects. (2015). *sap.com*. Retrieved August 15, 2020, from SAP Business Objects Business Intelligence: https://www.sap.com

Sarantakos, S. (2005). *Social Research* (3rd Edition ed.). New York, United States of America: Palgrave Mac-Millan.

Saunders, C., Wiener, M., Klett, S., & Sprenger, S. (2017). The impact of mental representations on ICT-related overload in the use of mobile phones. *Journal of Management Information Systems, 34*(3), 803-825.

Sbaffi, L., Walton, J., Blenkinsopp, J., & Walton, G. (2020). Information overload in emergency medicine physicians: A multisite case study exploring the causes, impact and solutions in four North England National Health Service Trusts. *Journal of Medical Internet Research, 22*(7).

Scammon, D. (1977). Information load and consumers. *Journal of Consumer Research, 4*(3), 148-155.

Schafer, J. (2010). The ineffective police leader: Acts of commission and omission. *Journal of Criminal Justice, 38*(4), 737-746.

Schein, E. (2010). *Organisational culture and leadership.* Trenton, New Jersey, United States of America: Jossey-Bass.

Schick, A., Gorden, L., & Haka, S. (1990). Information overload: A temporal approach. *Accounting Organisations and Society, 15*, 199-230.

Schiuma, G. (2012). Managing knowledge for business performance improvement. *Journal of Knowledge Management, 16*(4), 515-522.

Schneider, B. (1987). The people make the place. *Personnel psychology, 40*(3), 437-453.

Schniederjans, D., Curado, C., & Khalajhedayati, M. (2020). Supply chain digitisation trends: an integration of knowledge management. *International Journal of Production Economics, 220*, 23-45.

Schonauer, R., Lipetski, Y., & Schrom-Feiertag, H. (2012). Vehicle tracking data for calibrating microscopic traffic simulation models. *SPIE 8301, Intelligent Robots and Computer Vision XXIX: Algorithms and Techniques.* SPIE International Society for optics and photonics.

Schrader, E. (1983). Questions without clear-cut answers. *AORN Journal, 38*(1), 13.

Schultz, U., & Vandenbosch, B. (1998). Information overload in a groupware environment: Now you see it, now you dont. *Journal of Organizational Computing and Electronic Commerce, 8*(2), 127-148.

Schwartz, D., Divitini, M., & Brasethvik, T. (2000). *Internet-based Organisational Memory and Knowledge Management.* London, United Kingdom: Idea Group Publishing.

Seale, C. (1999). Quality in qualitative research. *Qualitative Enquiry, 5*(4).

Segelod, E. (2001). Learning through grafting in ventures in new areas. *Scandinavian Journal of Management, 17*(3), 305-328.

Senge, P. (1992). *The Fifth Discipline, The Art and Practice of the Learning Organisation.* United States of America: Doubleday & Co.

Sengupta, K., & Abdelhamid, T. (1993). Alternative conceptions of feedback in dynamic decision environments - an experimental investigation. *Management Science, 39*(4), 411-428.

Service, N. C. (2000). The National Intelligence Model. London, Britain.

Shannon, C. (1963). *The Mathematical Theory of Communication.* Chicago, Illinois, United States of America: University of Illinois Press.

Sharma, R., & Djiaw, V. (2011). Realising the strategic impact of business intelligence tools. *VINE, 41*(2), 113-131.

Sharp, H., Rogers, H., & Preece, J. (2007). *Interaction Design: Beyond Human Computer Interaction.* New Jersey: John Wiley and Sons.

Sharp, J. (2007). Development, extension and application: A review of the Technology Acceptance Model. *Information Systems Education Journal, 5*(9).

Sharp, P. (2006). Make first steps: A collaborative approach to defining knowledge in organisations. *The Electronic Journal of Knowledge Management, 4*(2), 189-196.

Sheptycki, J. (2004). Organizational pathologies in police intelligence systems: Some contributions to the lexicon of Intelligence-Led Policing. *European Journal of Criminology, 10*, 1177-1187.

Sheptycki, J. (2004). Organizational pathologies in police intelligence systems: Some contributions to the lexicon of Intelligence-Led policing. *Eurpoean Journal of Criminology, 1*(3), 307-332.

Sheptycki, J. (2013). *Understanding the Intelligence Cycle.* London, United Kingdom: Routledge.

Sheptycki, J., & Innes, M. (2004). From detection to disruption: Intelligence and the changing logic of police crime control in the United Kingdom. *International Criminal Justice Review, 14*, 1-24.

Shollo, A., & Galliers, R. (2016). Towards an understanding of the role of business intelligence systems in organisational knowing. *Information Systems Journal, 26*(4), 339-367.

Shrestha, A., Kong, E., & Cater-Steel, A. (2018). Managing knowledge and learning for process improvement: A software mediated process assessment approach for IT service management. In J. Syed, P. Murray, D. Hislop, & Y. Mouzughi, *The Palgrave handbook of knowledge management* (pp. 621-642). Palgrave Macmillan.

Shrivastava, P. (1983). A typology of organisational learning systems. *Journal of Management Studies, 20*(1), 7-28.

Simon, H. (1991). Bounded rationality and organizational learning. *Organization Science, 2*(1), 739-751.

Simpson, C., & Prusak, L. (1995). Troubles with information overload-moving from quantity to quality in information provision. *International Journal of Information Management, 15*(6), 413-425.

Skyme, D. (2022). *www.skye.com*. Retrieved February 13, 2022, from http://www.skye.com

Skyrius, R., Katin, I., Kazimianec, M., Nemitko, S., Rumsas, G., & Zilinskas, R. (2016). Factors driving business intelligence culture. *Issues in Informing Science and Information Technology, 13*, 171-186.

Sleegers, P., & Leithwood, K. (2018). Organisational Learning. *International Encyclopedia of Education*. Retrieved August 18, 2018, from http://www.sciencedirect.com

Slotnik, G., & Vansintjan, A. (2019). *Memory: An extended defintion: frontiers in Psychology Cognition.* University of London, London. Retrieved February 1, 2022, from http:www.frontiers.org

Spang-Hanssen, H. (2001). How to teach about information as related to the documentation? *Journal for Information Technology Studies as a Human Science, 5*(1).

Sparrow, M. (2016). Handcuffed: What holds policing back, and the keys to reform. *Policing: A Journal of Policy and Practice, 13*(4), 539-541.

Sparrow, P. (1999). Strategy and cognition: Understanding the role of management knowledge structures, organizational memory and information overload. *Creativity and Innovation Management, 8*(2), 140-148.

Speier C, Valacich, J., & Vessey, I. (2007). The influence of task interuption on individual decision making: An information overload perspective. *Decision Sciences, 30*(2), 337-360.

Squire, L. (2009). Memory and brain systems: 1969-2009. *Journal of Neuroscience, 29*(41), 12711-12716.

Steffensen, D., McAllister, C., Perrewe, P., Wang, G., & Brooks, D. (2022). "You've got mail": a daily investigation of email demands on job tension and work-family conflict. *Journal of Business and Psychology, 37*, 325-338.

Steup, M. (2005). Epistemology. *Stanford Encyclopedia of Philosophy*. Retrieved July 8, 2019, from http://plato.stanford.edu/entries/epistemology/

Stewart, I. (2013). *Summary of structural changes to QPS.* Queensland Police Service. Brisbane: Queensland Police Service. Retrieved June 19, 2017, from https://www.police.qld.gov.au/structuralchange

Stufflebeam, D. (2000). *Foundation Models for 21st Century Program Evaluation.* Michigan, United States of America: Springer Publishing.

Sveiby, K. (2010). *Methods for measuring intangible assets.* Retrieved January 2, 2022, from Sveiby Articles: http://www.sveiby.com/articles/intangible methods.htm

Swain, M., & Haka, S. (2008). Effects of information load on capital budgeting decisions. *Behavioural Research in Accounting, 12*, 171-199.

Swan, J., Scarborough, H., & Preston, J. (1998). Knowledge management - the next fad to forget people? *Proceedings of the 7th European Conference on Information Systems*, (pp. 1-12).

Tabachnick, B., & Fidell, L. (2001). *Using multivariate statistics*. Boston: Allyn and Bacon.

Tafkov, I., Towry, K., & Zhour, F. (2021). The impact of knowledge transfer on investment in knowledge creation in firms. *Contemporary Accounting Research*.

Tan, H., Carillo, P., Anumba, C., Bouchlaghem, N., Kamara, J., & Udeaja, C. (2007). Development of a methodology for live capture and reuse of project knowledge in construction. *Journal of Management in Engineering, 23*, 18-26.

Tarafdar, M., D'Arcy, J., Turel, O., & Gupta, A. (2015). The dark side of information technology. *MIT Sloan Management Review, 56*(2), 61-70.

Tashakkori, A., & Teddlie, C. (Eds.). (2010). *SAGE Handbook of Mixed Methods in Social and Behavioural Research* (2nd ed.).

Tate, S. (2017). Set up for success: 7 practical steps to get your organisational culture right. *Governance Directions, 69*(3), 155.

Teerajetgul, W., & Chareonngam, C. (2008). Tacit knowledge utilisation in Thai construction projects. *Journal of Knowledge Management, 12*(1), 164-174.

Tiago, M., Couto, J., Tiago, F., & Vieira, A. (2007). Knowledge management: An overview of European reality. *Management Research News, 30*(2), 100-114.

Toor, S., & Ogunlana, S. (2008). Problems causing delays in major construction projects in Thailand. *Construction Management and Economics, 26*(4), 395-408.

Treverton, G. (2003). *Reshaping National Intelligence in an age of information.* Cambridge, United Kingdom: Cambridge University Press.

Tushman, M., & Nadler, D. (1978). Information processing as an integrating concept in organizational design. *The Academy of Management Review, 3*(3), 613-622.

Urbanek, T., Denglerova, D., & Sirucek, J. (2011). *Psychometrics: Measurement in Psychology.* Prague.

Valamis.com. (2021, August 11). *Valamis.com*. Retrieved January 28, 2022, from Knowledge Management: http://www.valamis.com

Van Zandt, T. (2001). Information overload in a network of targeted communication. *INSEAD - Economics and Political Science*, 32.

Vandenbosch, B. (1998). Information overload in a groupware environment: Now you see it, now you dont. *Journal of Organizational Computing, 8*(2), 127-148.

Vollman, T. (1991). Cutting the Gordian know of misguided performance measurement. *Industrial management and data systems, 1*, 24-26.

Von Bertalanffy, L. (1968). *General Systems Theory*. New York, United States of America: George Braziller.

Vongalo, P. (2017). Application of fuzzy logic to improve the Likert Scale to measure latent variables. *Kasetsart Journal of Social Sciences, 38*, 337-344.

Voorberg, S., Eshuis, R., van Jaarsveld, W., & van Houtum, G. (2021). Decisions for information or information for decisions? Optimising information gathering in decision-intensive processes. *Decision Support Systems, 151*.

Vygotsky, L. (1978). *Mind in Society: The development of Higher Pscychological Processes.* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.) London, United Kingdom: Harvard University Press.

Waltz, E. (2003). *Knowledge Management in the Intelligence Enterprise*. London, United Kingdom: Artech House.

Wang, C., & Ahmed, P. (2003). Organisational Learning: a critical review. *The Learning Organisation, 10*(1), 8-17.

Wang, L., & Zhao, J. (2016). Contemporary police strategies of crime control in U.S and China: a comparative study. *Crime Law Social Change, 66*, 525-537.

Wang, M., & Yang, T. (2016). Investigating the success of knowledge management: An emperical study of small and medium suzed enterprises. *Asia Pacific Management Review, 21*, 79-91.

Wark, W. (2003). Introduction: Learning to live with intelligence. *Intelligence and National Security, 18*(4), 3-4.

Warner, M. (2002). Wanted: A Definition of Intelligence. *Studies in Intelligence, 46*(3). Retrieved April 28, 2018, from https://www.cia.gov/studies/vol46/no3/article0

Wasserman, E., & Miller, R. (1997). Whats elementary about associative learning. *Annual Review, 48*, 573-607.

West, G., Meyer, G., & Zhang, Z. (1997). Organisational culture and knowledge sharing: design of incentives and business processes. *The International Journal of Organisational Analysis, 5*(1), 25-58.

Whelan, C. (2016). Organisational culture and cultural Change: A network perspective. *Australian and Nw Zealand Journal of Criminology, 49*(4), 583-599.

Whittaker, S. (2011). Personal information management: from information consumption to curation. *Annual Review of Information Science and Technology, 45*, 3-62.

Wigger, A. (2008). Managing organizational change: Application of the Biomatrix Theory to the transformation of a non-profit organization. *Workshop for organizations and personnel research. 17*, pp. 1-99. Berlin: Leibniz Economic Information Centre . Retrieved September 12, 2019, from https://www.econstor.eu.

Willmer, M. (1970). *Crime and Information Theory.* Edinburgh, Scotland: Edinburgh University Press.

Wilson, P. (1996). Interdisciplinary research and information overload. *Library Trends, 45*, 192-203.

Winter, G. (2000). A comparative discussion of the notion of validity in qualitative and quantitative research. *The Qualitative Report, 4*(3).

Wittink, D., & Bayer, L. (1994). The measurement imperative. *Marketing Research, 6*(4), 14-22.

Wixom, B., & Watson, H. (2010). The BI-based organization. *International Journal of Business Intelligence Research, 1*(1), 13-28.

Wohlstetter, R. (1962). *Pearl Harbour, Warning and Decision.* Stanford, United States of America: Stanford University Press.

Wong, K. (2005). Critical success factors for implementing knowledge management in small and medium enterprises. *Industrial Management and Data Systems, 105*(3), 261-279.

Wurman, R. (2001). *Information anxiety.* New York, United States of America: Bantam Doubleday Dell.

Yam, R., Lo, W., Tang, E., & Lau, A. (2011). *Analysis of sources of innovation, technological innovation capabilities and performance: An empirical study of Hong Kong manufacturing industries.* Research Policy 40 (3).

Yap, J., Boon, H., Shavarebi, K., & Skitmore, M. (2021). Capturing and reusing knowledge: analysing the what, how and why for construction planning and control. *Production Planning and control, 32*(11), 875-888.

Yi, J. (2009). A measure of knowledge sharing behaviour: scale development and validation. *Knowledge Management Research and Practice*, 65-81.

Yin, C., Sung, H., Hwang, G., Hirokawa, S., Chu, H., Flanagan, B., & Tabata, Y. (2013). Learning by searching: A learning environment that provides searching and analysis facilities for supporting trend analysis activities. *Journal of Educational Technology and Society, 16*(3), 286-300.

Zang, D., & Xie, T. (2020). Software analytics in practice. *Microsoft Research Journal*.

Zhang, D., & Zhao, L. (2006). Knowledge management in organisations. *Journal of Database Management, 17*(1), 1-8.

Zhou, M., & Brown, D. (2017). *Educational Learning Theories* (2nd ed.). Berkeley, United States of America: Galileo Learning Materials. Retrieved September 12, 2017, from https://oer.galileo.usg.edu

Zhuang, L., Qiu, Y., & Peng, L. (2011). Is it the more the merrier? An exploratory study into the growing problem of information overload. *Journal of Technology Management, 6*(1), 69-83.

Zins, C. (2007). Conceptual Approaches for defining data, Information and knowledge. *Journal of the American Society for Information Science and Technology*, 480-495. doi:10.1002/asi

Zins, C., Debons, A., Beghtoi, C., Buckland, M., Davis, C., & Dodig-Crnkovic, G. (2007). Knowledge map of information science; Implications for the future of the field. *Brazilian Journal of Information Science; reseach trends, 1*(1), 3-32.