



**SELINUS UNIVERSITY**  
OF SCIENCES AND LITERATURE

**Modernising your business to perform  
beter in today's markets**

By  
Moloko Patricia Mahapa

Supervised by  
Prof. Salvatore Fava Ph.D

## **A DISSERTATION**

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## **Acknowledgements**

I would like to give thanks to God Almighty and my Lord and Saviour Jesus Christ. To everyone who supported me, thank you from the bottom of my heart.

## **Dedication**

This study is dedicated to my family and my late father who will always be my inspiration.

## **Abstract**

### **Description of the Context**

Many businesses are running on IT platforms and systems that are old, the majority of these systems are suffering from constant patching; scarce documentation; and reliance on old programming languages that drain resources. Yet many businesses wonder why they are not performing better in today's markets. Cutting-edge technology can create high benefits for businesses that are willing to be early adopters or modernise. Businesses must be positioned and willing to transform old ways of doing business and also modernise legacy systems or let go of old technologies or systems that are themselves dropped by their parent companies.

According to Morris (2018:21) the complexity is so rampant that it is difficult to tell how data really flows through the legacy applications. Documentation on the changes made in the legacy application is virtually non-existent, and changes are based on reading program code and embedded notes. Everything is out of context and generally out of date. There is no real source of truth for the systems and data, meaning no change can be effected fast. Even when an organisation wants to implement new technologies, they are handled as separate tools with little integration to the legacy systems (Morris 2018:21).

Modernising the way you do business and taking advantage of new technology trends enables efficiency, improves service quality and boost organisation's performance. Modernised technology enables organisations to work SMART, by taking advantage of new capabilities of modern technology, therefore avoiding business workflow issues and enabling modern strategies that enable business to be more flexible, efficient and deliver quality service to customers.

## **Reasons for Choosing the Topic**

The reason for choosing this research topic is to highlight the benefits of modernising old business systems by first identifying the challenges organisations normally face due to legacy systems, therefore recommending modernisation as a solution.

Many of today's IT operations are 60 years old with a cobbled together mix of old and new technologies that have been made to work together. Applications written in the 1970s are still running as legacy batch systems. Some companies still use green systems that have been changed to the point where little of the original code remains in use. Some of these applications and their operating environments are no longer supported by the vendors; and change is up to specialist programmers who still deal with these technologies.

According to (Morris, 2018:21) to succeed in a technology-enabled customer-centric business environment, these constraints must be overcome. Speed, flexibility, cost efficiency, reduced risk and operational simplification are characteristics that define the IT and business operating platforms organisations need to build. So the challenge in a digital transformation initiative is not to keep up with changes in technology because it is difficult to do so. Technologies such as robotics, Artificial Intelligence (IA), holographic phones and quantum computing are already coming too fast for anyone to keep up with.

The challenge is to create a type of business and IT operating environment where the old and new systems can work together harmoniously or integrate seamlessly. This is easier to recommend, but difficult to accomplish especially if you don't have a clear modernisation strategy. This thesis discusses and recommends various modernisation methods and strategies that businesses can adopt to achieve a successful digital transformation.

Companies often think of technology transformation as an expensive exercise that if they have to modernise their business systems, the focus is on costs rather than the benefits. Search CIO (2018:22) is of the view that companies should focus on what it will take to gain market share. In today's rapidly evolving market

place, the ability for an organisation to remain relevant in the eyes of its customers is vital. Building the flexibility to adopt and integrate new technology as business adapt to evolving customer demands support this ability; a focus on cost reduction or on a particular system upgrade does not.

### **Research Expectations**

The research's expectations is that organisations can realise the value of modernising their technology. The research does this by reviewing various literature about this topic and also highlighting success stories from various companies. The research also uses a case study methodology to show how City of Johannesburg (CoJ) modernisation initiative was carried out. The aim is to use this case study to show how modernisation is addressing its current legacy challenges. CoJ like many organisations interact with customers that want to consume services on a daily basis. The organisation in return collects revenue from consumers of these services in order to keep its operations running and to make profit. It is important therefore for CoJ to modernise its legacy systems to increase its efficiency, and also make its services easily accessible online via e-Services platform, through modern technology. The findings proves that so far the modernisation initiative is showing positive results and indeed addressing CoJ legacy challenges, and more value has been realised on the investment already made. CoJ has transformed its old platform to a new agile one and modernised its old Lotus Domino WebSphere to a new Microsoft SharePoint platform to improve its online services.

Through the modernisation model, the research aims to show how technology can transform businesses, increase market share, improve efficiency and also boost revenue. The objective is for other companies to realise that innovating your technology or implementing new systems is not a waste of money but can be used to optimise their business processes. The expectation is to encourage businesses to invest in good systems that drives business efficiency and performance, this by looking into suitable transformation or digitalisation strategies that bring value.

### **The hypothesized path**

This thesis assesses the primary factors that drives the organisation's need to transform its business systems. It also discusses modernisation approaches and the business benefits of modernisation in organisations. The research also evaluate implemented, tried and tested models and approaches that organisations can use to modernise their businesses. It also maps out a digital transformation path an organisation can adopt, using the current CoJ situation as a case study.

The reason for using a case study methodology is its relevancy to this thesis and its application. The goal of using a case study research was to be able to conduct an in-depth analysis of the topic, within its context with a view to understand its benefits from the perspective of participants. Methods used in this case study research to collect data included observations, focus group, documents and artifacts analysis, customer experience. Results were analysed and interpreted, conclusions and recommendations were then made. The results and recommendations of this research study will be of benefit to every organisation that wants to transform its legacy systems in order to perform better in today's markets.

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## **List of Abbreviations**

AI:	Artificial Intelligence
App:	Application
BPMS:	Business Process Management Results
BPR:	Business Process Re-engineering
BPM	Business Process Management
BRS	Business Requirements Specification
CIO:	Chief Information Officer
CEO:	Chief Executive Officer
CoJ:	City of Johannesburg
ICT:	Information and Communication Technology
IT:	Information Technology
KPIs:	Key Performance Indicators
PaaS:	Platform as a Service
ROI:	Return on Investment
RPA:	Robotic Process Automation
SLA:	Service Level Agreement
SaaS:	Software as a Service
SDS:	Software-defined Storage
SOA:	Service-Oriented Architecture
OS:	Operating System

## **Glossary of Terms/Concepts**

**Business:** An organisation or economic system where goods and services are exchanged for one another or for money. Every business requires some form of investment and enough customers to whom its output can be sold on a consistent basis in order to make a profit. Businesses can be privately owned, not-for-profit or state-owned (Business dictionary)

**Business Model:** A business model embodies nothing less than the organisational and financial 'architecture of a business. It is not a spread sheet or computer model, although a business model might well become embedded in a business plan and in income statements and cash flow projections. But, clearly, the notion refers in the first instance to a conceptual, rather than a financial, model of a business (Teece, 2010:173).

**Business Process Re-engineering:** Business process re-engineering (BPR) is the analysis and redesign of workflows within and between enterprises in order to optimize end-to-end processes and automate non-value-added tasks (Imperial, 2015:4).

**Business Transformation:** Business transformation often demands not only technological change but also a re-organizing of roles, skills and culture (IBM, 2018:2).

**Digital Transformation:** Digital transformation is a move to fundamentally change the whole approach to IT automation. It demands a total rethinking of what can and should be done with rapidly evolving technology and with the new customers and competition that new technology creates.

**Innovation:** Innovation is usually concerned with creation and development of new ideas and solutions and it also has some well-known techniques that help the organisation and people for thinking better (Abdi; Zarei ; Vaisy ; Parvin, 2011:2)

**Legacy:** In computing terms, the word legacy is used to describe outdated or obsolete technology and equipment that is still being used by an individual or organisation. Legacy implies that the system is out of date or in need of replacement.

**Modernisation:** Modernisation can mean bridging an organisation's past, present, and future. Modernisation can also be used as a club for one vendor to beat up another's products (e.g., mainframe versus distributed), or for one faction within IT to clobber another over whose systems and staff are "legacy" and should therefore be replaced or eliminated (Fowler, 2009:1).

**Reference Model:** A reference model is an abstract framework for understanding significant relationships among the entities of some environment (Oasis, 2006:4).

**Software Architecture:** A set of artifacts (that is: principles, guidelines, policies, models, standards, and processes) and the relationships between these artifacts, that guide the selection, creation, and implementation of solutions aligned with business goals.

**ICT:** An umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as video conferencing and distance learning (Rouse, 2015:1).

**ICT strategy:** A document or group of documents which define the principles of ICT and the rules which are followed within any ICT activity of the company (Mraz, 2012:1).

**Software:** Software, in its most general sense, is a set of instructions or programs instructing a computer to do specific tasks. Software is a generic term used to describe computer programs. Scripts, applications, programs and a set of instructions are all terms often used to describe software.

**Application:** An application is any program, or group of programs, that is designed for the end user. Applications software (also called end-user programs) include such things as database programs, word processors, Web browsers and spreadsheets.

**Market:** A market is the sum total of all the buyers and sellers in the area or region under consideration. The area may be the earth, or countries, regions, states, or cities. The value, cost and price of items traded are as per forces of supply and demand in a market.



# Chapter 1: Introductory Chapter

## 1.1 Overview

This research focuses on modernisation of technology in organisations, unpacking how this can be done to bring value and improve business performance. The research explored ways and models that can be used to enable business transformation in organisation. Though every business may be unique, in terms of products and services, the objective of this research is to show that modernising your technology can add value to your business. Transforming legacy systems is a necessity if you want to improve the way you do business. Modernisation for modernisation sake is not useful. Instead, Chief Information Officers (CIOs) and business executives must have the business acumen to “resolve business challenges and make things forward looking from an industry perspective.

The case study used is based on the project carried out by City of Johannesburg (CoJ) in South Africa. Reasons for choosing CoJ is that it is in the process of modernising its legacy systems, and wants to assess the investment already spend in some areas. Massive investment has been spend to transform some legacy systems, so some executives can learn from it to learn how to address similar challenges in their of organisations. Also CIOs can use the results to motivate for more funding of modernisation projects to transform legacy systems in their organisations or departments.

Group ICT department was used as a pilot for modernisation in CoJ because applications run and support valuable business processes of any business. Business applications must be delivered at high levels of quality, performance and availability for an organisation to be able to conduct its business efficiently and service customers successfully. Business requirements can change literally overnight, and applications must be designed and developed with the resiliency necessary to accommodate a constantly changing business climate.

Through a modernisation initiative, an architecture that allows digital transformation to evolve as the business needs change gets established. According to Morris

(2018:22) if companies build a very flexible IT operation, capable of quickly incorporating whatever emerging technology, that will help them compete and be able to keep up with customer expectations and evolve as customers evolve. The modernisation strategy involves creating new business value from existing systems, incrementally transforming legacy systems into new reusable business components, or leveraging existing enterprise skills and improving productivity.

In a modernisation initiative, there is an investment to modernise legacy systems in order to address its challenges. Executives, Business or end-users of the systems often wonder if there will be value realised from it. This research is to show that any organisation can realise value from modernising their legacy systems. In the case study, the old IBM Domino platform and Domino WebSphere were first to be modernised and replaced by the New Microsoft CityNext Platform and SharePoint e-Services portal. The research assessed this modernisation initiative and within a year of going live and reported on the results and also gave recommendations.

## **1.2 Background**

Developments in the global economy have changed the traditional balance between customer and supplier. New communications and computing technology, and the establishment of reasonably open global trading regimes, mean that customers have more choices, variegated customer needs can find expression, and supply alternatives are more transparent. Organisations therefore need to be more customer-centric, evolve with technology and adopt business solutions that can enable them to meet customer needs and compete in modern global markets. This research looked at business modernisation which involve digital transformation, to improve business performance.

Setting your organisation up for success in today's digital economy is no mean feat, irrespective of what your services or products are. Besides igniting the innovative spirit, organisations also need to grapple with the difficult task of managing change on all fronts, from getting IT aligned with business goals to securing buy-in from the board for new digital initiatives (Tan, 2018:2). Often directors in some organisations view modernising their systems as a costly exercise with intangible results, so they

end up not doing or giving other projects preference. It becomes the Chief Information Officer (CIO) responsibility to sell these benefits to the board, especially where there is little knowledge of what the benefits are.

According to Tan (2018:3) Digital transformation enables organisations to better engage customers, run their core business more efficiently and enter new markets through new processes and products. Australian organisations such as Citic Pacific Mining have done well in that regard, by demonstrating clear outcomes of digital projects, and starting small to get board-level buy-in from the onset. Today, key drivers of change are transforming the business landscape, and the enterprise must respond.

According to Search CIO (2018:22) many companies are at a crossroads and time is running out for choosing the right path forward. Change has become the new norm in almost every industry and as technology evolves new ways of doing business emerge. This compels organisations to remain relevant to their customers by implementing new ways of doing business, including accelerating the pace of their organisations' digital transformation to efficiently service customers and also maximize their market share.

Legacy modernisation often demands not only technological change or transformation, but also change a re-imagination of roles, skills and culture. Organisations have to ready themselves for change because it requires going beyond simply introducing new technologies. This thesis examines the issue of legacy modernisation from both private and public business sectors standpoint.

According to The Economist (2018: 2) a successful business modernisation is about accelerating both innovation and strategic enablement across the entire enterprise. So this research's objective is to assess how to use technology to transform every aspect of business, including services and products, processes, customers and end-user experiences. CEOs and CIOs can learn how to define digital transformation for their companies; execute modernisation strategies with high agility; and innovate business models for today's evolving demands and market changes.

### 1.3 Problem Statement

As the City of Johannesburg (CoJ) grows, its business requirements and needs also grows. CoJ strives to become a Smart City, by providing services that are easy to access and use, while being efficient, responsive – in open and transparent way - and ensuring sustainability and the inclusion of environmental considerations. The CoJ needs to transform its legacy systems to position it as a Smart City and a world class City. CoJ also wants to improve its revenue collection methods and customer engagement by exploiting new technology, that will enable easy of pay and encourage more citizens and businesses in the City of Johannesburg to pay for their municipal services.

Many systems in various business units of COJ are running on outdated technology, this includes, infrastructure, platforms and application that are old. Their problems include, systems that are out of support and maintenance; constant patching; lack of scalability and flexibility; old programming languages that drain resources and constant outages.

There is also a high cost of maintaining the 'status quo' as a large percent of IT funds is spend on maintenance, support and operations. Licensing costs go up every year; and as employees move up or retire, the cost to hire people with obsolete skills goes up too. Eventually, these increasing costs crowd out any opportunity to invest in business projects and innovation. These systems automate and govern the core business operations, so they must be well-aligned with the needs of business in order to yield value. All these problems and challenges hampers CoJ to render services efficiently to its customers. CoJ is also running at a loss due to constant billing crisis, bearing the consequences of not meeting its obligation of not collecting the required revenue.

The Star Newspaper dated July, 22 (2014:1) reported that its Metro watch received more than 1 000 e-mails over the past three years from residents complaining of unexpected, inflated bills. Residents claim their consumption has not changed, that they paid regularly and then were suddenly faced with exaggerated and unexplained bills and threatened with disconnection. Metrowatch has also received complaints

from people that their properties, without explanation, have had their zonings changed from residential to business. Despite requests over the past three years for an explanation from CoJ as to why this is happening, Metrowatch has received only standard replies stating CoJ is addressing the problem of meter readings, but giving no real explanation for why this has happened.

The modernisation of the CoJ business systems is eminent to address all these problems, and can no longer be viewed as a merely costly exercise. Modernisation however, should not be simply innovating for today, but enabling sustaining cycles of innovation, opportunity and progress for years to come.

## **1.4 Research Questions**

- How does modernisation enables businesses to perform better in today's market?

In order to answer this research question, different elements in the modernisation process were analysed. Underlying the main question, several working questions exist which were also addressed by this research, such as:

- ✓ What challenges are experienced by organisations operating on old or legacy systems?
- ✓ What are fears of modernising, or why would some companies opt not to transform?
- ✓ What benefits can be realized by modernising old technology/systems and adopting new technologies?

This study is part of an international research project as it examines challenges businesses experience due to legacy systems and benefits that can be realized from modernisation initiatives. It will also recommend modernisation strategies that organisations can reference from or adopt when carrying out modernisation initiatives.

## **1.5 Literature Review**

This research contains two sections/parts of literature reviews: first one which is this one, must be read in conjunction with chapter 2, gives a detailed background to the

topic, including case studies where modernisation was used to bring business performance. It also assess the type of infrastructure and network required for modernisation initiatives to yield results. The second part in (chapter 2) of literature review is to answer the research questions, reviewing literature about topics such as – Legacy business systems challenges facing businesses, the concept of modernisation, why should a business modernise, approaches, strategies, steps and benefits.

### **1.5.1 ICT Revolution in Business**

According to Foulds (2018:4) the ICT revolution in business and governments was initially all about gaining efficiencies and reducing cost and working smarter. He further states that ICT provided the means by which businesses and governments did what they did better. In the last few years, though, a new concept has been emerging: using ICT systems, particularly the data they contain to change quite radically the way business is done, and even what business has done.

All organisations, regardless of size, industry or location, face the constant challenge of maximising the contribution of their information technology (IT) infrastructure and applications to achieving their business goals. To do so, organisations must often figure out how to use existing systems more effectively, or modernise them to better perform the tasks at hand. At times, this requires replacing legacy systems that no longer meet the needs of evolving business practices and expanding markets.

It is a little over 40 years since IBM introduced the first mainframe designed for business use. In such a long period, surprisingly little of the mainframe ecosystem has changed. Of course, the platform has changed. Today's mainframe systems have improved performance, larger memory, and multiple processors, and the early operating systems have evolved. However, at the application level, the mainframe is fundamentally the same—and that's the way many of IBM's customers like it. But plenty of customers are not so happy. (Microsoft, 2007:1)

A recent survey of 1400 CIOs by Gartner Executive Programs (EXP) indicates that CIOs' priorities are to improve business processes, control costs, find new customers, improve workforce effectiveness, and increase revenue. Although there

are no real surprises here, the disappointing aspect of this survey is that the challenges have stayed much the same for so long. (Gartner EXP Survey, February 2007.)

Perhaps the single most important fact to note is that most organisations with mainframe-based systems are spending about 75 percent of their development resources simply to maintain existing applications, which leaves only 25 percent of their development resources for innovation. Effecting a 25-percent reduction in maintenance costs means that investment in innovation can be almost doubled.

The key choices in legacy modernisation are application extension, migration, redevelopment, and replacement. These choices can be used individually or in combination. It is also important for an organisation to have a suitable legacy modernisation strategy framework to as this will help find an appropriate solution for the organisation. According to Microsoft (2007:1) the legacy modernisation ecosystem is growing and many hardware, software, and service providers see an opportunity to provide value in this market, however one should recognize the complexity of legacy modernisation and that selecting the right technology platform and solution are crucial. In the next section few success stories and views expressed by CIOs and business people have been discussed showing that organisations are seeing value in modernising, and are starting to take modernisation of legacy systems very seriously.

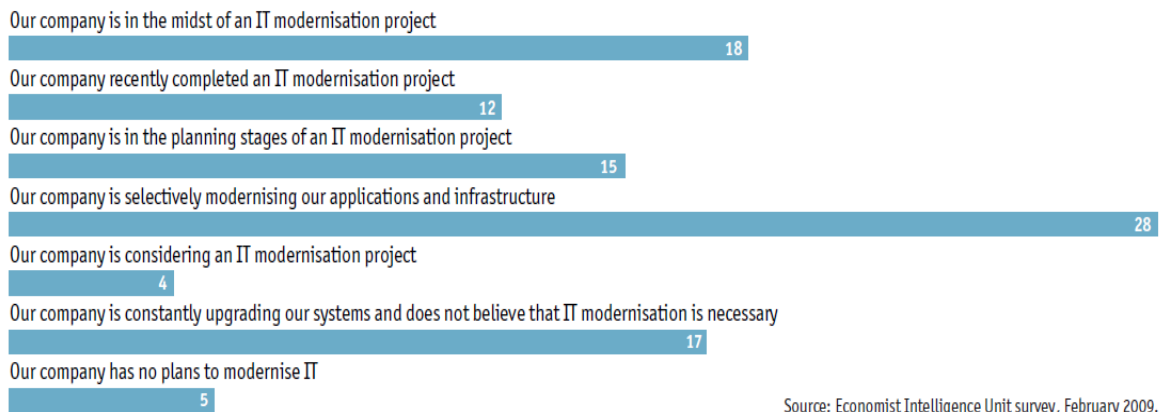
### **1.5.2 How Modernisation improves Business Operations**

Various organisations are modernising their technology to optimise their business, and it is an approach that is proven to be driving their business into the right direction, irrespective of the type of industry they are in. The current global economic crisis forces organisations around the world to make the most of their daily operations (IMF, 2012). Recent studies in different industries show that a rise in long-term organisational efficiency can be expected when adopting new information systems to support the daily operations as well as administration.

- **Survey by Economist Intelligent Unit**

Economist Intelligence Unit survey (2009:4) took a survey where the results showed that companies that have implemented IT modernisation projects, improved quality of service and revenue-generating capabilities are top reasons for satisfaction. Economic Intelligence Unit survey reported that of the respondents whose companies have recently completed an IT modernisation project, 90% are satisfied or better.

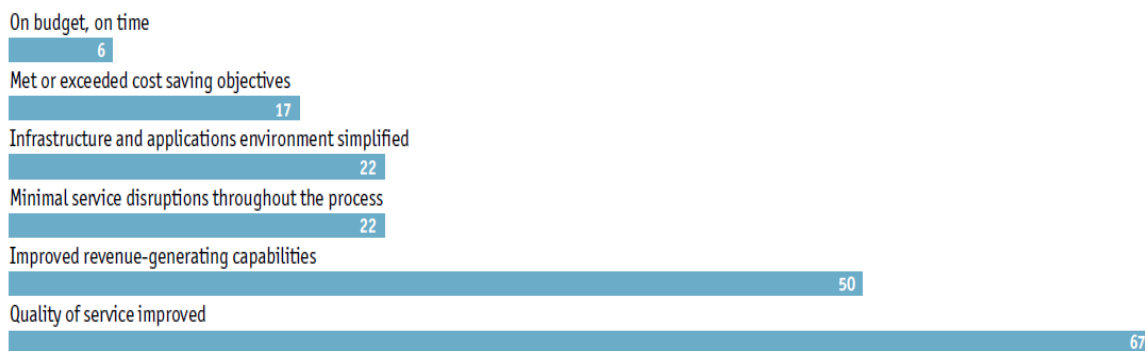
**What best describes your company's status with regard to IT modernisation?**  
(% respondents)



Source: Economist Intelligence Unit survey, February 2009.

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**For companies that have implemented IT modernisation projects, improved quality of service and revenue-generating capabilities are top reasons for satisfaction.**  
(% respondents)



Source: Economist Intelligence Unit survey, February 2009.

Outward-facing factors such as improvements in quality of service (chosen by 67% of respondents) and revenue-generating capabilities (50%) top the list of benefits. Inward-facing factors, such as simplification of the infrastructure and applications environment (22%), are also important but rank lower. The bottom line is that IT



modernisation is well understood, widely in use, and can bring concrete results if executed properly.

- **Jaguar Land Rover - UK-based Automaker Modernisation Success Story**

Simon Bolton, CIO of UK-based Automaker Company Jaguar Land Rover, found himself among the leaders of a board technological and cultural change. With a heritage dating back to 1948, the company's traditional strengths are auto design, engineering and manufacturing. Today, though, cars are becoming rolling high-tech data centres, that became a challenge for Jaguar Land Rover. Now the company is looking to gain expertise in a wide range of digital technologies, some modernising back office functions, others powering customer-facing websites and online services with data and analytics, and still more bringing advanced functions to the company's vehicles. "As a company, we have to demonstrate real leadership around technology," Bolton says. "My biggest aspiration is to help Jaguar Land Rover to be seen as a technology leader outside of the company within the automotive space" (IBM, 2018:3).

To that end, Jaguar Land Rover has set ambitious technology goals. The company has committed to offering electric power trains in all its new vehicles by 2020. Another future concept is an intelligent steering wheel, called Sayer, which uses speech-recognition software to answer a driver's question, connect them to the news, organise travel and choose in-vehicle entertainment. Jaguar Land Rover is now right at the front end of huge changes in technology capability. Everything they do is pushing boundaries. And the auto industry as a whole has great growth potential. A study by McKinsey indicated that new business models driven by shared mobility and connected cars could increase the industry's revenue by 30% between now and 2020 (IBM, 2018: 4).

### **1.5.2.1 Creating Smart Cities**

Information Technology is changing the evolution of cities. The notion of "growing" cities based on implementing correct urban planning is being replaced with the idea of making a city "smart". The Internet is changing the traditional urban planning model and compelling planners to not only consider the physical planning of a city

but also to consider the use of Information Technology to make the economy, environment, mobility and governance of a city more efficient and effective.

Even though the term “smart city” is relatively novel, the development of a smart city can vary dramatically depending on the approach that is taken regarding policymaking for the urban growth of the city (Chourabi, et al., 2012). A number of definitions for the term “smart city” exist. One of the more widely used definitions is the one that defines smart cities as, cities that utilise information and communication technologies with the aim to increase the life quality of their inhabitants while providing sustainable development (Bakici, Almirall, & Wareham, 2013, p. 137). From this definition we can see that ICT plays a pivotal role in making a city more adapted to the contemporary needs of its citizens.

Most cities want to become Smart Cities by connecting, automating all their urban services and making them accessible to all. Today many cities are seeing this as a necessity and they don't want to be left behind, but the question is how do they do it to realise value? According to Goldstuck (2018: 22) Urbanisation is increasing at such a rapid rate that 61% of the world's population will live in cities by 2030. Goldstuck further reports that at the last World Cities summit in Singapore, an overriding message was that most cities are utterly unprepared for this. Most cities, he said, attempted solutions that had never been tried before, and were often doomed to failure.

When a City starts to plan its transformation to become a Smart City, it often starts from zero, as if it's the first time the challenge has ever been faced. According to Goldstuck (2018:22) a City today should start its investigation where the last best solution was developed. That will lead to different kinds of responses, in particular public-private partnerships. Often City authorities only want to do something different. We also see the private sector only wanting to sell goods and services to make quarterly numbers. People need to think how they can unlock value in existing infrastructure.

An example is 'Transport for London', which underwent minor modifications, reusing existing components, to turn the Oyster travel card into a contactless payment

system. It resulted in savings of 100-million pounds (R1.7-billion) a year and a boom in usage. Fran Rijsberman, director-general of the intergovernmental Global Green Growth Institute, in July Business Times (2018: 22) elaborated: “There are lots of models out there, but we need more partnerships. I don’t think there is a silver bullet, but government must have an open mind to encourage innovation.”

#### ***1.5.2.2 Increasing the Value of Existing Business Applications***

Over the years, organisations have spent considerable resources increasing the value of their applications. These legacy applications continue to support core processes and provide crucial information to the business. Within their code are millions of lines of valuable business intelligence. They are at the heart of the organisation and enable management and processing of the majority of customers, product, supply chain and other business data. Yet while these applications—along with the information and functionality they contain—are invaluable to business, they may be keeping the organisation from realizing its true potential.

Complex, highly integrated portfolio of legacy applications and processes may inhibit an organisation’s ability to increase efficiency, differentiation and responsiveness. And faster time to market and improved agility can be difficult to achieve when you are burdened with large legacy applications that may support compartmentalized business processes and hide duplicate functionality and information. It’s even harder if an organisation has gone through a merger or acquisition. This complexity can increase application maintenance expenses, diverting valuable resources away from business development and innovation. In addition, the resulting long development cycles can lead to the perception that IT is not responsive to changing business requirements.

Don’t rewrite or replace legacy applications—modernize them to meet the demand for business innovation and agility, organisations are looking to improve the structure, reusability, flexibility and performance of existing

applications. Unfortunately, traditional methods for doing so, such as rewriting existing applications, are expensive. Replacing legacy applications with package solutions also can be problematic, because you risk losing the intellectual capital you have developed over the years that's buried deep in your systems (IBM,2017:2-3).

### **1.5.3 The Importance of Infrastructure Modernisation**

Digital business transformation necessitates an IT infrastructure transformation. The resulting infrastructure not only needs to manage the increased scope and scale of incoming and outgoing data, it must also, become more agile and flexible. The more innovative a business becomes at using data, the greater the likelihood new products, services and initiatives will need to pivot quickly.

IT Infrastructure transformation is not simply buying the latest and greatest hardware and software. We've had decades of technological innovation in the data centre, each delivering superior capacity compared to the previous generation. This trend will continue and isn't transformative, but it's business as usual. Contrary to prevailing wisdom, cloud isn't transformative either. Leveraging a public cloud provider, such as Amazon Web Services or Microsoft Azure, provides benefits and may feel transformative, but isn't enough. IT infrastructure transformation is all about becoming better and more efficient at allocating budget and resources to new projects and markets, and making the cost of managing day-to-day infrastructure easier and cheaper. For the purpose of this thesis more focus will be given to data storage technologies.

- **Shifting the Performance Bottleneck away from Storage**

Your storage infrastructure should deliver enough performance to ensure you can leverage the right data at the right time. It also must be capable of sufficiently and incrementally increasing that performance so you can layer on new workloads without impacting existing business processes. This is critical for business intelligence or analytics workloads. Developers need access to datasets in a timely fashion. They can't wait for the deployment of new infrastructure.

- **Multigenerational Architecture**

As infrastructure demands scale, new deployments increase in frequency. One can't afford to lose data availability each time you transition to a new hardware generation. As demands change data access must remain predictable, available and online. And data access must remain constant as infrastructure evolves around it. The hardware abstraction provided by software-defined Storage (SDS) is one way to meet this challenge by enabling the addition on new hardware generators in the same storage pool without impacting access

- **Immediate or near immediate Deployment**

When new requirements arise, access to storage capacity can't take months to get approvals and another couple of months to install. There are multiple technologies that can speed up storage infrastructure deployment, such as SDS-based converged and hyper converged infrastructures. Another one of the fastest means of accessing new infrastructure is the adoption of public cloud resources. While the cloud isn't always an option for every data type, it can dramatically speed up time to provision new storage.

If a business is going to transform itself digitally, it must dramatically reduce the time it wastes on everyday IT maintenance; and that will also entail IT

infrastructure. Adequately transforming IT infrastructure will enable IT teams to divide their time between keeping everything in the data centre and cloud running and also keeping an eye on new opportunities as they arise (Computer Weekly, 2018).

#### **1.5.4 The Importance of Network Modernisation**

With the rise of cloud computing and the rising need for mobility, networks are being tasked with greater demands than ever before. To deal with this, companies need to consider whether their network infrastructure is ready for digital transformation and geared towards an agile business – and if it is not, then they need to make changes to ensure that it is. Here are five areas to consider to ensure your network is digital transformation ready:

- **Wireless Networking**

Many businesses are using network infrastructure that was designed for a time when wireless connectivity was not mission-critical. But now that businesses of all sizes are being urged to bring products and services to market faster to improve customer experiences, it is imperative that they invest in new network infrastructure including Wi-Fi.

A wireless local-area network (LAN) uses radio waves to connect devices such as laptops and mobile phones to the Internet and to your business network and its applications. When you connect to a Wi-Fi hotspot at a cafe, a hotel, an airport lounge, or another public place, you're connecting to that business's wireless network (Cisco, 2018:1).

#### **What is the Difference between Wireless and Wired network?**

A wired network uses cables to connect devices, such as laptop or desktop computers, to the Internet or another network. A wireless network allows devices to stay connected to the network but roam untethered to any wires. Access points amplify Wi-Fi signals, so a device can be far from a router but still be connected to the network.

A wired network has some disadvantages when compared to a wireless network. The biggest disadvantage is that your device is tethered to a router. The most common wired networks use cables connected at one end to an Ethernet port on the network router and at the other end to a computer or other device.

Previously it was thought that wired networks were faster and more secure than wireless networks. But continual enhancements to wireless network technology and Wi-Fi networking standards have eroded speed and security differences between wired and wireless networks (Cisco, 2018:2).

***According to Cisco (2018:2) the following are the benefits of a wireless network:***

**Convenience:** Access your network resources from any location within your wireless network's coverage area or from any Wi-Fi hotspot.

**Mobility:** You're not tied to your desk, as you are with a wired connection. You and your employees can go online in conference room meetings, for example.

**Productivity:** Wireless access to the Internet and to your company's key applications and resources helps your staff get the job done and encourages collaboration.

**Easy setup:** You don't have to string cables, so installation can be quick and cost effective.

**Expandability:** You can easily expand wireless networks with existing equipment, whereas a wired network might require additional wiring.

**Security:** Advances in wireless networks provide robust security protections.

**Cost:** Because wireless networks eliminate or reduce wiring expenses, they can cost less to operate than wired networks.

- **Make network security a priority**

Organisations should make network security a key priority. The reason is that data has become a key asset in digital businesses, and so has the number of points where data is stored, accessed and analysed including the Internet of Things (IoT) and public cloud SaaS (Software as a Service) applications. As a result, there are more entry points for cyber-attacks on the network. Businesses therefore need to boost their security using next-generation products that focus on protection, detection and remediation, and that are integrated with the network infrastructure at its foundation, allowing for granular policy-setting and visibility (Van der Panne, 2018:1).

If you think of your company's network like a very cool, very exclusive club, with lots of valuable things inside, like your customer data, your intellectual property, and your confidential information, then it's easy to understand why criminals want to get inside. They want to steal your assets, or hold you to ransom for them, or just generally make life more difficult for you. So protecting your network is critical.

### **1.5.5 The Business Value and Benefits of Modernisation**

Continuous Technology changes and innovations require business to adapt continually, which makes it difficult for businesses to keep up. However, the fast pace isn't a good reason to avoid adopting new technology in business practices. There are many benefits of using new technology. Business owners should hire professionals if they are unsure how to implement new technology and how it benefits their businesses specifically. The benefits of adopting or new technology or modernizing are:

- **Overall Business Efficiency**

Businesses operate more efficiently when they use technology correctly. Digitizing files makes it easy to customize documents such as user agreements and contract templates. Communication is instant with email and the ability to send documents back and forth during negotiations. Customers can get information on websites and request information any time of the day or night using online forms.



Software programs continue to improve and make data collection and interpretation more powerful. Customer relationship management software records everything from client information to follow-up calendars, buying history and propensity patterns. This information makes it possible for a sales team to manage prospects and solidify client relationships effectively.

- **Automation of Operations**

Different businesses have different needs. Wherever a business can automate a process, it can redirect financial and labor resources. Automation can occur in numerous areas such as when staying in touch with customers, tracking packages for delivery, or noting miles driven by delivery truck drivers. For example, fast food restaurants are implementing ordering kiosks to focus labor resources on efficiently getting food into customers' hands.

Many companies are moving training programs to automated web-based programs and company education centers, which makes it easier for employees to learn new information and expand personal skills. It also allows people to repeat modules without costing the business any more in training costs.

- **Business Security**

Information security is a big issue every day. Hackers and thieves steal consumer information and company proprietary information daily, but technology can protect company information. If there is one key benefit to businesses that should be updated and continuously monitored, it is digital security. Hackers can interrupt business operations, cost companies thousands of dollars, and cause businesses to fall under public scrutiny.

Security goes well beyond firewalls and anti-virus software. Digitally linked security systems protect businesses from vandalism and theft. Not only do systems provide real-time alerts, but they also provide diversion tactics such as alarms. Some systems give business owners a way to speak directly to vandals from a remote location via phone, informing intruders that they are on camera and identified.

- **Employee Monitoring**

Businesses can better manage large teams using technology. Applications track customer service call times, which helps managers understand where lag times exist and provide opportunities for coaching. Speed and GSP tracking of drivers support a positive public image of employees who realize they can't get away with poor behavior. The right technology automatically tracks sales numbers and potential sales, which gives managers control of leading indicators rather than lagging behind.

### **1.5.6 Why Modernise?**

Carol Rizzo, a technology consultant and former chief technology officer (CTO) of Kaiser Permanente, AIG and Citibank, equates the IT unit that does not modernise to a family living in a 200-year-old house: "The next new appliance you plug in is likely to short circuit the whole house." To some, IT departments should constantly upgrade their systems, incrementally improving and adapting them as the business needs change. But the reality is quite different. There are dozens of ways that IT systems can become suddenly and irrevocably out of date: software vendors go out of business or are acquired; global market trends shift, as with outsourcing or globalization; and businesses are bought and sold. (Economist Intelligence, 2009:5)

Iterative upgrades simply cannot keep up with the rapid pace of business change. "What ends up happening is you modify your existing applications to meet new user demands," says James Riley, director of indirect client services at Wilmington Trust Corporation, a Delaware-based bank with US\$36bn under management. "You bolt something on here, you patch something up there, but everyone knows that you can't keep that up forever." When reality finally does catch up, a thoughtful and thorough IT modernisation effort is the only solution. (Economist Intelligence, 2009:5)

Many of the customers organisations want to attract belong to the millennial generations. This new generation of customers were born into technology and they also know how to use it. They are fascinated by what new technology can do and are constantly demanding for more. Unlike the older generation, this generation have no patience with old technology, for example- they have no patience with mobile applications or websites that don't work easily or don't do what was

advertised. Soon, they will also have no use for applications or other interfaces that are not fun (Morris, 2018:22). Many industries and businesses today are also using technology to be ahead of their competitors, expand their market share and increase sales.

## **1.6 Research Methods**

A case study research method was used to examine and answer the research question. A case study excels at bringing an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research. Case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships. Yin (2014: 16) defines the case study research method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used

### **1.6.1 Case Study Design**

According to Yin (2014:5) even a single-case study can often be used to pursue an explanatory, and not merely exploratory (or descriptive), purpose. The analyst's objective should be to pose competing explanations for the same set of events and to indicate how such explanation may apply to other situations.

In this thesis I used CoJ modernisation case study for Platform and Extranet e-Services to assess how modernisation can address legacy systems challenges and bring benefits to business. Firstly, the objective is to assess the challenges of the legacy systems before modernisation initiative. Second, the strategy or approach taken and why. Thirdly, to assess if modernisation addressed the challenges of the legacy environment, and what benefits or value was brought by modernisation initiative. This surveying nature makes it possible to get an in-depth understanding of a contemporary phenomenon where the investigator has little control over events, thereby reducing research bias. I have adopted an explanatory case study research method, primarily seeking the rationale for initiating a modernisation project and documenting the benefits of software modernisation, so that other organisations

faced with legacy challenges can use the result of these study to improve and modernise their organisations.

Despite the fact that case studies are originally used primarily for exploratory purposes, Runeson & Host (2009:131) argue that explanatory case studies are more suitable for investigating the pre and post-event situations. This research study aims at investigating pre- and post-modernisation situations, and thereby fits well with the latter.

### **1.7.1 Data Collection Methods and Sources**

Data collection in this case study was performed by consulting project documentation to assess the As-IS (state before modernisation) of the CoJ legacy environment, objectives and milestone deliverables of the modernisation initiative. To identify the rationale and objectives of the modernisation, I started with consulting project documents including, but not limited to, the AS-IS assessment report, project initiation documents (business case, project charter). For modernisation path, I consulted strategy documents, project management reports and project milestones deliverables.

From external customers – data was collected via the e-Services portal and analysed to assess customer experience (both pre and post modernisation).

I also used a focus group consisting of people from different roles to obtain a varied outlook on the CoJ modernisation initiative.

### **1.8 Reliability, Validity and Trustworthiness**

Regardless of the type of scale a measurement instrument involves, the instrument must have both validity and reliability for its purpose. They further state that the validity and reliability of measurement instruments influence the extent to which a researcher can learn something about the phenomenon under investigation; the probability that the researcher will obtain statistical significance in any data analysis; and the extent to which the researcher can draw meaningful conclusions from data. (Leedy and Ormrod, 2014:89)

In this study, the research methods, data collection instruments and data analysis tools used were tested for a reasonable degree of validity, reliability and trustworthiness, to ensure that the instruments measure what they are intended to measure and to yield reliable and valid results, including:

**Validity of a research method chosen:** The validity of a research method addresses the validity of a research as a whole, that is its accuracy, meaningfulness, and credibility (Leedy & Ormrod, 2014:89). When selecting the research method for this research, it was important to bear in mind what the objective of the research was to the extent that the method allowed drawing of meaningful and defensible conclusions from the data collected.

**Internal validity of a research study:** To ensure the internal validity of this research study, precautions were taken to ensure that it was possible to eliminate other possible explanations for the results, and that the results were accurate, valid and trustworthy.

**External validity of a research:** The extent to which the results will apply to situations beyond the study itself is very important (Leedy & Ormrod, 2014:90). In other words, the extent to which the conclusions drawn can be generalized to other contexts. The results of this research can be used by any organisation facing legacy challenges, or wanting to transform its business systems.

**Reliability:** Like validity, reliability is a way of assessing the quality of the measurement procedure used to collect data in a research. In order for the results from a study to be considered valid, the measurement procedure must first be reliable. According to Saunders *et al.*, (2007:156) reliability refers to the extent to which the data collection techniques or analysis procedures will yield consistent findings.

**Ethical Considerations:** Ethics were considered during all phases of this research study, as ethical issues may occur at any stage. Bryn and Bell (2007:127) are of the view that ethical issues cannot be disregarded as they are related directly to the integrity of the research conducted and the discipline involved.

According to Sage (2006:45), falsification, fabrication and plagiarism are clear threats to the quality of research work and are behaviours that researchers find troubling. A case study used is a real initiative taken by CoJ and data used was obtained from the original sources. Also, findings were reported in a complete and honest fashion, without misrepresentation and where data was not available, those areas were identified as opportunities for future research. Under no circumstances was data fabricated to support a particular conclusion.

## **1.9 The structure of the thesis**

The structure of the thesis is as follows: In the second chapter, I present a detailed discussion of the theoretical paradigm on the research topic. This chapter links to section 1.4 literature review above but focusing on modernisation phenomenon as a business transformation strategy. It is arranged in sections looking at the legacy systems challenges, all the topics under modernisation - from why it is necessary to modernise; the modernisation strategies; approaches; what steps to be followed in a modernisation initiative and the benefits. I also discuss software modernisation, its aspects and goals; modernisation processes from the enterprise architecture viewpoint.

The third chapter is a case study based on a CoJ modernisation initiative examining the rationale for modernisation, approaches, and steps taken. The fourth chapter is data presentation and analysis. The fifth chapter is the findings, interpretations and recommendations. In the sixth chapter, directions for future research are covered. Chapter 7 gives the limitations for the research and chapter 8 is the conclusion.

## **Chapter 2: Literature Review**

This section critically analyses relevant literature to the research topic, including sources and studies that define the topic, and addresses major aspects and significance of the research topic. It also gives a more detailed review of the studies, sources, materials relevant to the topic. The review also looked at what is known in the field, regarding the scope of this research topic.

This is the second part of literature review which should be read in conjunction with the first part of this thesis in section 1.5. This part mainly focuses on reviewing literature about topics such as – Legacy business systems challenges facing businesses, the concept of modernisation, why should a business modernise, approaches, frameworks, strategies, steps and benefits. The outline is organised in subcategories relevant to the research topic.

### **2.1. Legacy Software or Aging Software**

While in some instances such as a work of art or a multi-billion-dollar business, legacy conveys wealth and status. But when it comes to software, the term usually has a negative connotation. And the reason for this is simple, most software systems, unlike fine wines, don't get better with age, however legacy software is not always defined by its age.

It might be due to the lack of support or its inability to meet the needs of a business or organisation that a system is considered to be legacy. Such software is usually difficult (or impossible) to maintain, support, improve, or integrate with the new systems due to its architecture, underlying technology, or design.

There is no unique definition of a legacy application. Gartner (2018:1) appropriately describes legacy system that it may be based on outdated technologies, but is critical to day-to-day operations. According to BusinessDictionary.com, a legacy system is an “obsolete computer system that may still be in use because its data

cannot be changed to newer or standard formats, or its application programs cannot be upgraded.”

Indeed, descriptors such as “outdated” and “obsolete” seem to be the most accurate, though there are typically more aspects that define legacy besides age. These include performance and efficiency, compliance with modern business requirements, compatibility and integrability, security and maintenance cost. To investigate legacy issues lurking in your business systems, conduct a complex assessment, with an eye to the ***‘How do you know when it’s time to modernise your legacy software?’***

In the next sections various legacy challenges are discussed, that can tell an organisation that it is time to modernise or transform their systems.

## **2.2 Challenges of Legacy Systems**

### **2.2.1 It is slow and cumbersome; it crashes and fails to perform as expected**

If your system lacks speed, has multiple glitches, and takes ages to perform standard tasks, there are two possible reasons why. The software is either outdated or simply of poor quality. While the latter usually can be improved in the process of software quality management and testing, outdated systems typically require modernisation or complete reengineering to improve *performance and efficiency*. Waiting several minutes for a report to load might not seem like a big deal, but what if 100 of your employees lose these 3 minutes every day for a year? Then waiting for a file to load amounts to over 50 workdays wasted annually.

### **2.1.2 The system is no longer supported by the vendor**

If your business runs on third-party software, like it or not, you depend on the vendor for updates and maintenance. When something happens to the provider company, like acquisition or bankruptcy, the chances are, you will need to reconsider your software solution soon.

So, when the vendor terminates support for the product you are using, it is a clear sign that your business processes should be transferred to another system. If you decide to stick with the old solution that is no longer provider-supported, you won’t



be receiving updates nor will you be getting assistance fixing any issues, which put your business at risk.

For example, if your business operations still run on Windows XP, you won't be able to use the latest versions of other Microsoft products, and you'll be tied to the outdated software. And you cannot blame this on Microsoft. Because the operating System (OS) is officially no longer supported, you must either update your system to the latest Windows version, or upgrade your hardware if it doesn't support the updates. Another drawback of using outdated, unsupported software is that you won't be able to use your warranty in case of system failure or data loss.

### **2.1.3 The system has no mobile capabilities and is device-dependent**

It has become clear that mobile capabilities are a must for every business. From client-facing apps to internal business process management tools, 89 percent of organisations surveyed by Red Hat have already at least partially implemented mobile app strategy. Cathal Mcgloinvice, President, Mobile Platforms, Red Hat reported that Red Hat's mobile maturity survey found that 52 percent of respondents claim to have a fully implemented mobile application (app) strategy and 90 percent plan to increase mobile app development investments in 2016. Of those with a fully implemented mobile app strategy, 96 percent use KPIs to measure app success. Of respondents whose organisations are measuring mobile app success with defined KPIs, manufacturing, telecoms and construction industries saw the most positive Return on Investment (ROI):

- Manufacturing – 92 percent
- Telecoms – 83 percent
- Construction – 83 percent

This was followed by:

- Retail – 76 percent
- Distribution and Transportation – 75 percent
- Business Services – 71 percent
- Financial Services – 69 percent
- IT – 66 percent
- Chemicals and Pharmaceuticals – 56 percent

*Source: Red Hat Mobile Maturity Survey (2015)*

If your software cannot be accessed from any device other than your office computers, you may already be lagging behind your competition in terms of *performance and revenue*. In this regard, cloud-based SaaS products outperform any on premise system. If you are not ready for a complete system modernisation, it is possible to at least partially introduce your enterprise mobility strategy. Your legacy software can be complemented by mobile tools, which augment some features and provide additional benefits. Yet, you must consider possible integration issues. Old systems often require a significant amount of custom code and workarounds to be able to run with the new tools.

#### **2.1.4 Incompatibility with modern software systems**

Talking about compatibility, it is important that your software, no matter how old, integrates well with the other tools and applications you require to efficiently run your business processes. Be it a new customer Relations Management (CRM) system or live chat add-on for your website, you cannot afford to ignore the compatibility issues within your business systems. If you fail to implement a virtual customer support system, for example, on-site self-service, live chat, or email support because you are hog-tied by your old systems, most of your customers would rather find another provider than request assistance by phone. Plus, any of these customer support channels is significantly less expensive and more efficient than a traditional call center.

If you are tethered to your old systems and tools, unable to utilize all the advanced capabilities that modern technology offers, we have bad news for you. Chances are your competitors have already integrated those new tools and resources, taking advantage of their benefits. That means you will continue to lose your customers and revenue, putting your business's existence at risk.

#### **2.1.5 Excessive hardware use**

If you still need to host your business software on-premises, the chances are it is already outdated. The cost of ownership of such systems is high due to administrative expenses involved. With Amazon Web Services, Microsoft Azure and Google Cloud Platform, you don't even need to own a server to efficiently run your processes.

**Figure 2.1: Comparison between Cloud and on Premise Platforms**





	<p><b>COST</b> </p> <ul style="list-style-type: none"> <li>• Reduce initial price of system</li> </ul>	<p></p> <ul style="list-style-type: none"> <li>• Upfront investment can be seen as riskier</li> <li>• Have to pay associated hardware and IT costs</li> </ul>
	<p><b>SECURITY</b> </p> <ul style="list-style-type: none"> <li>• Data security is in the hands of the organization</li> </ul>	<p></p> <ul style="list-style-type: none"> <li>• Data security is in the hands of the organization. Some organizations might not be as adept at practicing proper data security protocols.</li> </ul>
	<p><b>CUSTOMIZATION</b> </p> <ul style="list-style-type: none"> <li>• Greater ability to customize</li> </ul>	<p></p> <ul style="list-style-type: none"> <li>• Customizations can delay implementation time</li> <li>• Customizations can result in headaches when vendor updates software</li> </ul>
	<p><b>IMPLEMENTATION</b> </p> <ul style="list-style-type: none"> <li>• Organization has more control over the implementation process</li> </ul>	<p></p> <ul style="list-style-type: none"> <li>• Implementation process can take significantly longer</li> </ul>

Source: <https://www.softwareadvice.com/resources/cloud-erp-vs-on-premise/>

According to Forrester (2018:1), even “enterprises with big budgets, data centers, and complex applications are now looking at cloud as a viable place to run core business applications.” Besides, when you run your applications in the cloud, your provider bears full responsibility for keeping your systems up at all times. If you choose a trusted provider, you won’t have to worry about outage possibilities at all.

According to Gartner (2018) digital business requires speed and agility that cloud computing provides through the use of cloud services. A key benefit of public cloud infrastructure as a service (IaaS) and platform as a service (PaaS) is to place applications closer to customers to enable a better user experience.

#### **2.1.6. Your software requires extensive training and/or special skills to be used**

Built back in the nineties, way before any modern User Interface (UI) standards were introduced, legacy software typically lacks the clarity and simplicity, rendering it extremely hard to use. Becoming an expert with such a system might take years. So, hiring and training new employees to replace the old is always more challenging and less efficient. Moreover, with the average cost-per-hire increasing even more on employee training would be simply unreasonable.

Except for making the staffing process harder and more expensive, outdated software with un-optimized, clumsy interfaces can significantly slow down your operations. If your employees struggle to use your system efficiently, simple training might not be enough to speed up operations.

#### **2.1.7 The underlying technology is obsolete**

No matter how young your software is, if it runs on outdated technologies it should be completely reengineered. This is not only about programming languages or tools that are considered old. Some of them will outlast most of the new and trendy frameworks.

The real danger lies within the tools that have officially reached their end of life. A great example of such technology is Adobe Flash, which was a really popular web development tool. Yet, most browsers have already phased out support for

Flash or plan to do so soon. Similarly, Microsoft Silverlight is considered a dying technology, since the company has given up Silverlight support for the new Edge browser.

### **2.1.8 Software no longer solves your problems**

Back in the day when you on boarded your current software system, it might have been the perfect solution to all your business problems. Since nothing remains the same, by now it might have gone from legacy to liability. So why compromise your business efficiency and revenue, just because your software cannot keep up with the new challenges?

Typewriters are nice; they have their special charm and manage to get work done. At least a part of it. But how can you make a hundred copies of a book and send them to the publisher using a typewriter? Most importantly, why use a typewriter, a copy machine, and a postal service, when your MacBook can solve all three problems at once in no time?

### **2.1.9 It lacks flexibility and cannot keep up with your business growth**

Your business is constantly evolving, or it should be. If your business model, processes, or simply the scale of operations change, your software must be able to keep up. If your systems lack the ability to accommodate your needs, you might end up adapting your business to your software and that will set you back.

If you started out as a small, local store and invested in a custom (Point of Sale) (POS) system, chances are, it won't be able to serve your needs when your store becomes a chain. With increased scale, you will require better throughput capacity and a completely new multi-tenant architecture to manage all your operations. Can your software support increased production capacity and expand with your company? Will it be able to scale and change correspondingly in the future? If you answered no, it's time to change your software or build a new system.

### **2.1.10 Hard or impossible to add new functions to your system**

Speaking of flexibility and adaptability, legacy systems can be hard or even impossible to change or expand to greater capabilities. This may be due to the outdated technology stack or overcomplicated inner architecture. As a result, it becomes increasingly difficult to build new features on top of the existing functionality. If your team needs to write large amounts of custom code to implement a simple feature on top of your system, then it is time you consider modernisation.

### **2.1.11 Security threats**

According to Greengard (2016) out-of-date and non-compliant software and hardware assets leaves the enterprise door wide open for outside and insider breaches, which take advantage of known flaws in software and assets. The root of the problem is because legacy software and hardware are no longer supported by a vendor, patches and fixes aren't available or aren't easily fixed.

BDNA's quarterly State of the Enterprise Report (2016) places a spotlight on the issue. It found that old IT assets are a major and often overlooked source of enterprise cyber-security vulnerabilities. Without processes in place to identify and remediate these "end-of-life" (EOL) assets, organisations expose themselves to cyber-criminals eager to exploit these unprotected flaws.

Indeed, old systems are usually more vulnerable to malware and breaches. What seemed secure 10 years ago may no longer be reliable today. Take for example passwords: While the methods for generating and storing passwords have changed dramatically over the past 20 years, most of the older systems still accept the same weak combinations instead of forcing users to set up more complicated passwords, as many modern systems do. With older encryption algorithms having long ago been hacked, obsolete software no longer receives security patches, exposing your data to multiple risks.

### **2.1.12 Operating costs are high**

Aspects of legacy software such as excessive hardware, staff training, inefficiency or outages make the operating costs of those systems increasingly

high. Furthermore, there are many hidden costs not stated in any budget, including employee satisfaction, brand image, and customer loyalty. Microsoft Survey (2013) reported that More than 90% of consumers said they would consider taking their business elsewhere rather than work with a company that uses outdated technology.

The Survey outlines the drawbacks of sticking with outdated technology and what it can cost a business, and how investing in modernised or new technology can pay off. The following were reported in the Microsoft Survey (2013), conducted September 13-16.

**Table 2.1 Outdated Technology vs Updated/modernised Technology**

<b>OUTDATED THECHNOLOGY WILL</b>	<b>MODERNISED TECHNOLOGY WILL</b>
<p><b>Tarnish your brand</b></p> <p>Nearly 25% of consumers think business is not professional and lacks credibility when they see it uses a free, cloud-based email service.</p> <p>61% of consumers think business is outdated if the company is still using a 5-10 year old operating system</p>	<p><b>Enhance your reputation</b></p> <p>60% Consumers anticipate modern businesses use real-time, interactive customer service.</p> <p>58% prefer modern mobile devices</p>
<p><b>Decrease Sales</b></p> <p>More than 80% of customers will leave a business' website and abandon an online purchase if the site is outdated.</p>	<p><b>Enable Success</b></p> <p>68% of consumers think the use of modern technology is critical to the success of a business.</p> <p>57% of consumers agree that businesses that use modern technology are more competitive in the marketplace.</p>
<p><b>Drive Repeat Customers Away</b></p> <p>49% of consumers never return to a business they heard has been hacked.</p>	<p><b>Spark a Loyal Following</b></p> <p>62% say they are likely to become a repeat customer of a business that uses modern technology</p>



Additionally, there is a lost opportunity cost usually involved with legacy applications. If you fail to improve your business systems, every dollar earned by your competitor using better tools and modern software can be considered a dollar you lose due to your inability to innovate. Taking that into account, it is almost impossible to calculate the true cost of operating a legacy system.

Microsoft Survey (2013) has also calculated that it costs a business \$780 per Personal Computer (PC), per year to operate a PC running on Windows XP, while for Windows 10 the cost is \$168. That said, if you think that you cannot afford the modernisation, better think again as you might be already losing more than it takes to revamp your systems.

### **2.1.13 Support and maintenance costs are even higher**

Aside from operating your software, you need to keep it up and running at all times. According to Altexsoft (2018) on average, organisations spend from 60 to 85 percent of their IT budgets maintaining cumbersome legacy applications that fail to meet the changing competitive needs of the business.

The article further states that the lack of maintenance can lead to frequent outages and even bigger waste. It reports that on average, every minute of downtime costs a business \$366,363 per year. Thus, you must invest in support and maintenance to be able to address the arising problems as fast as possible. For customer-facing systems, client support should be one of the highest priorities. Legacy systems typically cause more problems for the end-users. So, plan to invest heavily in 24/7 customer service to be able to speedily solve unavoidable, costly issues.

## **2.2. Legacy system assessment framework**

Despite the risks related to running a legacy system, you shouldn't jump on the modernisation bandwagon as soon as you notice a minor disruption in your business system. Software modernisation is an important part of the digital transformation initiative, requiring a solid implementation strategy and thorough planning.

According to Atexsoft (2018) legacy system assessment framework is necessary to analyze the state of your software on many levels, from current architecture, code quality, and performance to capacity for future growth. Based on this assessment, then you can decide what modernisation approach is suitable for your business or organisation. The assessment framework below will assist organisations to assess legacy systems from the perspective of modifying their architectural styles to comply with new ones that can easily accommodate newly emerging e-business needs.

According to Alkazemi (2014:112) there are generally, four conceptual strategies that might be followed to identify the most appropriate solution *strategies* for systems evolutions, including:

- Replacing the legacy system with a new enterprise solution;
- Maintaining the legacy system in order to proceed with the organisation's business with limited evolution;
  - Re-architecting the legacy system to comply with modern architectural styles, while keeping the functionality untouched; and
- Extending the legacy system by wrapping it as a black box and exposing its standard interfaces to interact with new systems.

Each one of these *strategies* incurs some limitations and possibly a number of benefits, if implemented properly. However, the decision to proceed with one strategy or another is relatively challenging and requires thorough investigation of the business value and the quality of the legacy system at hand (Alkazemi, 2014:112).

Alkazem (2014: 113) identified a number of dimensions for this assessment, as follows:

- **Support:** This dimension is concerned with the hardware and software support provided to the legacy system. In addition, this dimension examines the availability of source code and the team that supports it.
- **Business:** The business requirement is the key aspect by which an organisation can decide whether a system should be kept functional, replaced with a new system

that satisfies their needs, or simply shut down completely. Therefore, this dimension covers the requirements of an organisation in addition to the modelling technique used and the documentation of the business in the legacy system.

- **Architecture:** The building blocks of the system are defined in this dimension through the style used in the legacy system and the integration pattern between the different entities of that system and with external systems. It also relates to the way in which the functionality can be consumed by clients.

- **Technology:** This dimension discusses the type of technology adopted by the legacy system and whether the technology is still appropriate or not compared to emerging business needs.

This framework is abstract in nature and therefore is not exhaustive. However, it can be utilized as the basis for analysing the underlying environment of an organisation. The other Framework organisations can use is the Service Oriented Architecture (SOA) Migration framework.

According to Razavian and Lago (2010:446) the SOA migration framework addresses the question of “what does the migration of legacy systems to SOA entail”. Winter (2005:1) defines migration as a modernisation technique that moves the system to a new platform while retaining the original system data and functionality. According to Razavian and Lago (2010:446), reengineering is the examination and alteration of a subject system to reconstitute it in a new form and the subsequent implementation of the new form.

The commonalities among these two definitions are considerable. In practice, the notions of “legacy migration”, “integration” and “architectural recovery”, which all deal with legacy applications, are considered as approaches to reengineering. According to Razavian and Lago (2010:446) any type of reengineering consists of three basic reengineering processes: 1) analysis of an existing system, 2) logical transformation, and 3) development of a new system.

The SOA framework is discussed in detail under architecture reference models in the next sections. There are various modernisation approaches, which will be

analysed in the next sections as well. Before I get to them, it is important to unpack the modernisation concept and what it means in detail, especially in relation to this thesis.

### **2.3. The Concept of Modernisation**

Modernisation can mean a variety of things to different organisations or companies. But with so many different takes on modernisation, it can be hard to agree on what exactly modernisation should comprise. For the scope of this thesis the focus is on transformation of legacy Information Technology (IT) or Information and Communication Technology.

Modernisation has been defined as the continuous evolution of an organisation's existing application and infrastructure software, with the goal of aligning IT with the organisation's ever-shifting business strategies (El-Attrash, Belme, Johnson, and Steinberg, 2017:14)

For government, alignment means increasing cost efficiency while reducing expenses. Modernisation also lets organisations maximize their existing application assets as they move toward a more open, complete and integrated application and infrastructure platform. In simpler terms, an IT or ICT modernisation project aims to create new business value from new and/or existing applications or systems. According to the American Council for Technology Industry Advisory Council (ACT-IAC), a successful modernisation program is one that combines business processes, people and technology to reduce risks, promote adoption and realize potential benefits. Modernisation means agencies become more efficient and effective in performing the functions that support their missions. (El-Attrash et al., 2017:14)

In the context of this research, modernisation is about aligning the systems portfolio so that it maximizes its value to the organisation regardless of the tactic, as there are various methods to do so. Modernisation in this thesis refers to moving business to modern technology – including conversion, rewriting or porting of a legacy system to a modern computer programming language, software libraries, protocols, or

hardware platform. It refers to digital transformation and a move to fundamentally change the whole approach to business operations automation. (Raski 2017:2)

## **2.4 Why Modernisation?**

A great number of business critical systems represent legacy software, which is difficult to modify and expensive to maintain. In order to stay in line with business ever-changing business needs, these aging software systems should be modernised. However, modernisation can be a complex process, which has not only technological, but also business, organisational and environmental aspects. Some modernisation projects affect only technical layer in IT architecture, but others impact on all enterprise architecture layers (Raski 2017:2).

Legacy systems modernisation is often a large, multiyear project. Because these legacy systems are often critical, deploying them all at once introduces a level of operational risk. As a result, legacy systems are typically modernised incrementally. Initially, the system consists completely of legacy code. As each increment is completed, the percentage of legacy code decreases. Eventually, the system is completely modernised. A migration strategy must ensure that the system remains fully functional during the modernisation effort.

According to Morris (2018: 30) digital transformation is a move to fundamentally change the whole approach to Information Technology automation. This demands a total rethinking of what can and should be done with rapidly evolving technology and with the new customers and competition new technology creates. A digital transformation initiative answers the need to interact with internal and external customers the way they want you to. That will require adopting and integrating new tools to transform the way a company operates.

Today, companies are adopting new technology, including business process management results (BPMS), robotic process automation (RPA) and AI. Some are also looking at the technology horizon, and seeing next-generation tools including 3D phones, holographic tables, quantum computers and more. According to Morris (2018:3) as existing as this technology is, it is not the real issue in digital transformation initiative. The challenge for Chief Information Officers (CIOs) and

Chief Executive Officers (CEOs) and their companies is to rebuild their existing infrastructure to accommodate these new technologies. Equally important is the need to reduce or eliminate both operational and IT complexity and then streamline the work.

## **2.5 Modernisation Approaches and Strategies**

Traditionally the adoption of information systems has been described as a sequence of a varying number of phases. To name a few, Thong (1999) identifies three phases: initiation, adoption, and implementation. Gallivan (2001) identifies six phases: initiation, adoption, adaptation, acceptance, routinization, and infusion. Information System adoption initiates with the decision process in which information about the technology at hand is gathered and evaluated – the assessment phase. If the organisation decides to stay unchanged, modernisation process is discontinued and the organisation remains in the current state.

If modernisation is chosen, technical as well as organisational implementation of the functionality in the business must follow to ensure the expected result. If the implementation fails, the modernisation process is discontinued and the organisation remains in the current state. If on the other hand the technical implementation completes successfully, the organisation must adopt the functionality as their new daily routines to ensure the expected effect. If the adoption fails, the modernisation process is discontinued and the organisation remains in the current state. Failure in any of the three phases will result in the manual work processes remaining status quo and the modernisation effect will fail to appear. So, in order to reach the future state, the organisation must complete the three phases with a successful outcome.

Whether it is a custom-coded application with long-lost source code or a mainframe-based program with a proprietary interface, your company probably has an important legacy application running in its data centre. This legacy application might perform an important or irreplaceable function. It might even be mission-critical but you need to consider how you introduce new technologies that are more efficient and effective to transform and improve business.

There are various approaches and strategies that an organisation can adopt to drive their modernisation initiatives and are discussed below:

### **2.5.1 Migration & Enhancements**

This is one of the most popular approaches to system modernisation and the easiest way to make sure your product will keep serving your needs for years to come. It presupposes the system migration (typically re-hosting, using cloud solutions) and some minor enhancements. This includes, User Interface (UI) or User Experience (UX) updates, performance optimization, and database migration. (Barbier and Recoussine, 2015: 25)

Different from replacement, migration covers either a lightweight or heavyweight code transcription. Lightweight is especially the case when one moves from an obsolete COBOL dialect (e.g. COBOL Pacbase whose maintenance by IBM is no longer supported) to a “modern” COBOL. Here, “modern” means that we guarantee that the generated COBOL code is actually surrounded by perennial (efficient) maintenance tools (Barbier and Recoussine, 2015: 25).

Yet, this method has a number of limitations. Namely, the core business logic and architecture mostly remain unchanged, as this type of changes require a more invasive approach.

### **2.5.2 Correction & Growth**

If the product technology stack is relatively modern and does not represent a threat for future product growth, modernisation can involve some minor enhancements/corrections. This might be architecture optimization or code refactoring, UX updates or performance optimization without significant changes in product business logic.

As soon as the product is up to date, you can add more features on top of it. These might be third-party integrations or custom-built modules.

### **2.5.3 Complete Software Reengineering**

Considered the most extreme method, features extraction relies on your business strategy and growth outlook. This means, in order to reengineer the product, you need to identify the features that are still crucial to your business and the ones that

are no longer used or required. After that, the required features are prioritized and modified if needed.

Taking the legacy system as a basis, the team creates an up-to-date product with matching capabilities, but better performance, look and feel, modern technologies and scalable architecture. Depending on the functionality analysis and prioritization, the new product might 100% match the previous version in terms of functionality, or lack some features that are no longer required/used.

#### **2.5.4 Rehost**

Information Technology managers can shift an application to another platform while leaving the old system and agency-specific customizations largely untouched.

#### **2.5.5 Rearchitect**

Software engineers and managers can use tools to recover and reassemble the business-relevant code from legacy applications while eliminating technology-specific code.

#### **2.5.6 Replace**

Managers can switch legacy applications with new ones if the legacy application does not incorporate unique agency data and functionality. According to (Barbier and Recoussine, 2015: 24) replacement is the radical abandonment of the old system to build a new one from scratch. In the best case, the old system is a source of inspiration, but in many circumstances, the total absence of documentation, knowledge or informed people prevents such an inspiration. Independent of business concerns, the legacy system often cannot be extensible, worse, it can be “untouchable”. For example, adding a few COBOL statements at any place in the code is a sure crash followed by several weeks of repair.

#### **2.5.7 Integrate**

Architects can wrap legacy applications (support old systems that can't be retired) and create a Service-Oriented Architecture (SOA) – a style of software design where services are provided to the other components by application components, through a



communication protocol over a network. SOA can then be used to operate on a new platform but is implemented by the existing code.

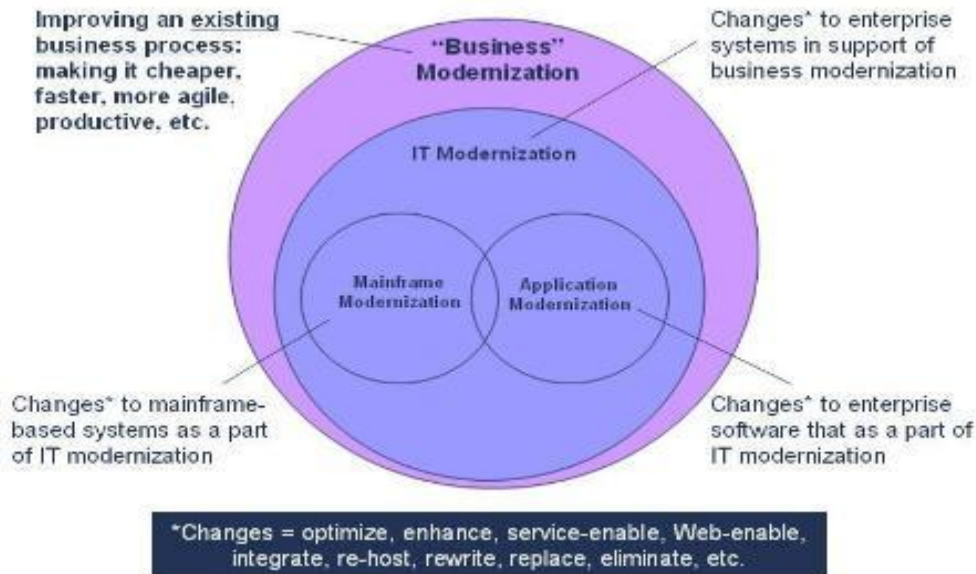
## **2.6. Modernisation Reference Architecture Models**

Reference Architecture Models enables the development of specific reference or concrete architectures using consistent standards or specifications supporting that environment. A reference model consists of a minimal set of unifying concepts, axioms and relationships within a particular problem domain, and is independent of specific standards, technologies, implementations, or other concrete details (Oasis: 2006:4).

### **2.6.1 Business-centric Modernisation Approach**

According to Fowler (2009:1) modernisation must be business-centric. The business cares about business processes that - 1) help increase revenue, 2) reduce costs, and 3) increase share price. Therefore, the definition of modernisation that excites business leaders is: "Improving current business processes to better support organisational objectives." Once modernisation is defined at the very highest level as making improvements to current business processes, all other sub-categories of modernisation fall semi-neatly into place. (See diagram below).

Figure 2.2: Business-centric Modernisation Model:



Source: (Fowler, 2009:1)

Adopting a business-centric modernisation approach will result in business process improvement that increases revenue, cuts costs, and builds share price. If business understands modernisation from this angle, the effort to win funding for modernisation becomes much more straightforward.

Even if the entire company agrees on a business-centric definition of modernisation, that still doesn't tackle the sticky subjects of when, where, how or even if modernisation should be undertaken. As the Figure2.2 suggests, modernisation typically involves the core enterprise systems of an organisation. These systems often run on a mainframe or legacy software and include application code that has been fine-tuned and expanded over years or decades. Millions of money already-spent are at stake.

### 2.6.2. Integrated Transitional and Future Architecture Model

Below is an integrated transitional and future architecture reference model that a company can follow, which is from current to the future state architecture.

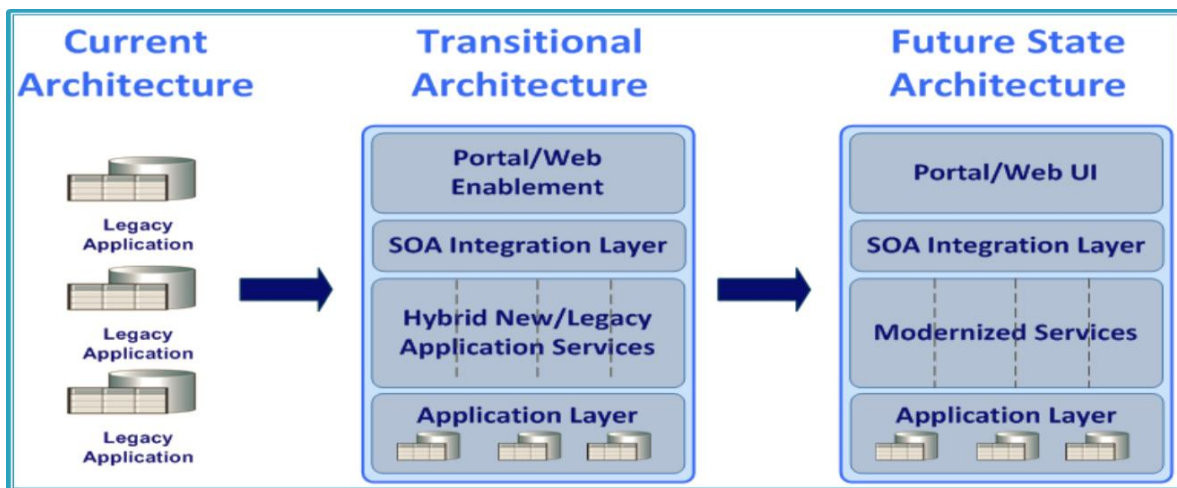


Figure 2.3: Integrated Transitional and Future Architecture Model

Source: (Oasis: 2006:4)

The above model shows an integration approach to transition from the several legacy systems through an integrated transitional architecture to a target reference architecture. In between the starting point and the target architecture, the transitional architecture and implementation plan definition is necessary as “scaffolding” to hold together the existing applications and data while the system, the users, and overall business processes are being transitioned.

### 2.6.3 Service Oriented Architecture Reference Model (SOA)

The following is a Service Oriented Architecture (SOA) reference architecture model that an organisation can base its modernisation approach on. According to Oasis (2006:4) the goal of this reference model is to define the essence of service oriented architecture, and emerge with a common understanding of SOA. It provides a normative reference that remains relevant for SOA as an abstract and powerful model, irrespective of the various and inevitable technology evolutions that will influence SOA deployment.

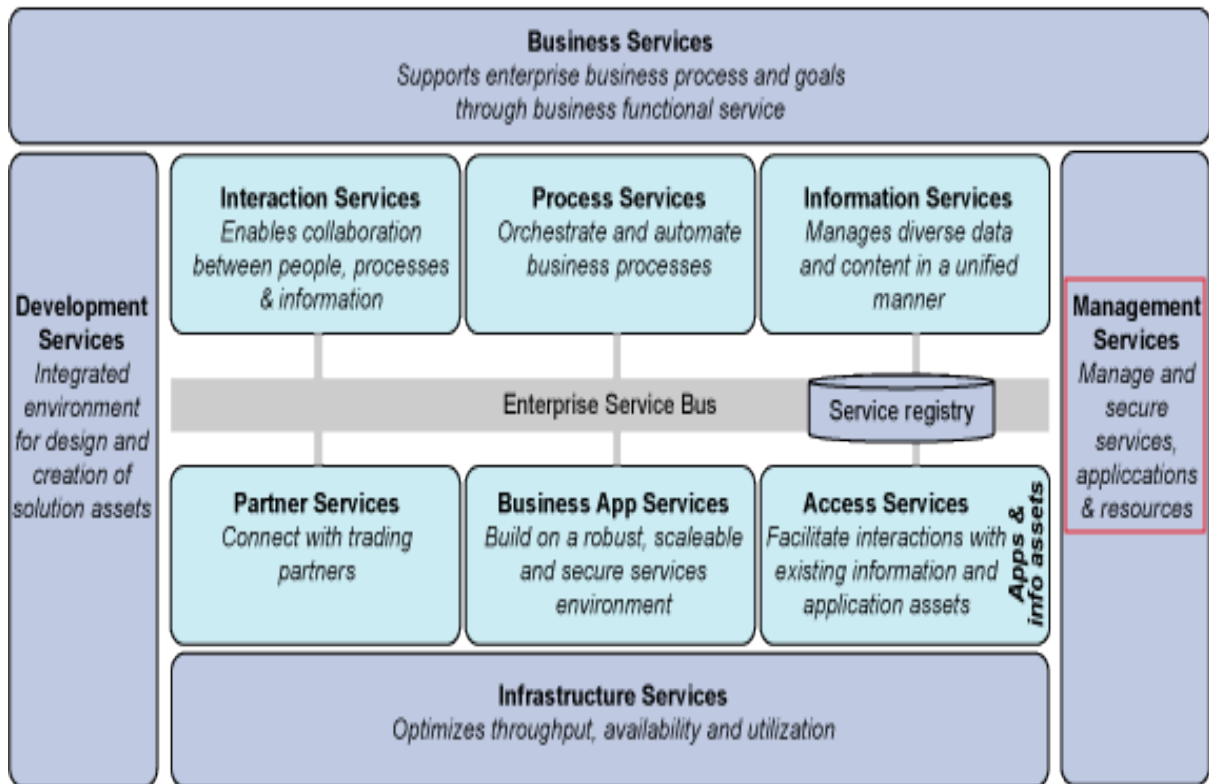


Figure 2.4: SOA Reference Architecture Model

Source: Oasis (2006:5)

According to Oasis (2006:5) SOA is a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. In general, entities (people and organisations) create capabilities to solve or support a solution for the problems they face in the course of their business. It is natural to think of one person's needs being met by capabilities offered by someone else; or, in the world of distributed computing, one computer agent's requirements being met by a computer agent belonging to a different owner. There is not necessarily a one-to-one correlation between needs and capabilities; the granularity of needs and capabilities vary from fundamental to complex, and any given need may require the combining of numerous capabilities while any single capability may address more than one need. The perceived value of SOA is that it provides a powerful framework for matching needs and capabilities and for combining capabilities to address those needs.

The Internet acts as a global village of software elements, its inhabitants. Global reasoning (opposed to "local reasoning") is due to modern software development.

Designing software and thus software architectures in a systemic way contrasts Service-Oriented Architecture (SOA). As much as possible, software architectures must be viewed as assemblies of pre-existing and/or commercial off-the-shelf (COTS) elements instead of being invented from ground zero to alleviate piling problems. (Barbier and Recoussine, 2015: 76)

SOA is, in particular, twofold. Its business facet is an ever encountered opportunity to design information systems and applications in a manner that boosts the business instead of simply viewing software as the banal automation of information processing. SOA's technical facet is what we can precisely understand behind the word "service", especially in terms of technological impacts and implications in daily software development. In fact, the SOA paradigm has become popular with the emergence and large take up of Web Services, but this standard is not the single support for SOA. In people's minds, "service" is something billable. (Barbier and Recoussine, 2015: 76).

In people's minds, "service" is something billable. It is no coincidence that "service" comes from the telecommunications field. For a very long time, telecom operators have sold services to their clients. The extraordinary convergence of computing and communication triggered by the Internet has made "service" as the natural core concept of Internet computing. Mobile computing, cloud computing, etc., are nothing else than service-oriented computing paradigms and technologies. (Barbier and Recoussine, 2015: 76).

Modernisation projects require frameworks that are pre-built, pre-modelled and pre-tested to accelerate transformation, reduce costs and mitigate operational risks. All modernisation frameworks should provide processes, tools, resources and assets that reduce much of the risks of modernisation. Such risks include deployment failure or security risks moving data to new systems.

Using frameworks for modernisation projects, organisations have more opportunities to be proactive in generating demand for updated enterprise architecture.

Frameworks not only help organisations better plan but also better inform users and stakeholders. Anyone who is affected by the project in question can easily follow

along with a framework. This, in turn, aligns with long-term organisational objectives and enables managed adoption of enterprise architecture standards. Some organisations may need to completely overhaul current applications and systems. Others may need new platforms or databases.

## 2.7. Modernisation Benefits

The following are some of the benefits that supports why modernising legacy systems is crucial for any organisation.



	<b>Competitive Advantage</b>	Operating in an industry dominated by decades-old technology behemoths, you have a chance to outperform the competitors simply by offering a modern and lightweight solution.
	<b>Happier Clients/ Employees</b>	User experience and design standards have evolved significantly over the last several years. By introducing modern, sleek UI and user-centric intuitive experiences, you can improve your customer satisfaction and employee performance, thus, increasing your revenue.
	<b>Future-Ready Business</b>	By replacing your legacy system with a modern solution, you make sure your business is ready to evolve and expand, keeping up with technology advances. Plus, keeping up with the latest technology trends creates an internal culture of business agility and innovation in your company.
	<b>Unlocking Big Data Opportunities</b>	Outdated storage solutions prevent you from accessing and making use of your data. Database migration and optimization is required to successfully tap the big data opportunities.
	<b>Better Performance and Reliability</b>	Legacy IT faults are one of the most common reasons for delays in the air transportation industry, as well as in many others. Thus, systems modernization might help you reduce the outage risks and cut the related losses.

Table 2.2: Benefits of Software Modernisation

Source: (Altexsoft: 2018)

Yet, despite all the benefits, a call to Modernise is sometimes met with reluctance, and this is due to fear of going through the change.

## **2.8. Misconceptions that Promotes Modernisation Fear**

To conservative-minded executives in the company, modernisation seems to violate the "if it isn't broken, don't fix it" principle. Who wants to tinker with the core enterprise systems upon which the health of the organisation depends when the economy is so precarious? Why not hunker down, guard the fort, and make do with systems that are "good enough" until the economic ice thaws?

The problem is that hunkering down is likely to mean giving up market share to competitors that see a down economy as a time to surge ahead. According to Fowler (2009:1) these are some of the questions most executives will justify their fears of modernisation with.

For example a study by Diamond Management and Technology Consultants (2008) looked at the performance of more than 450 companies during the recession of 2001. It discovered that certain corporate behaviours enabled 52 percent of the companies to increase their gross margins by an aggregate of 20 percent while the rest of the field remained weak or weakened. It was not just a roll of the dice; a series of strategic decisions made the difference.

The following are some of the misconceptions organisations have about modernisation:

### **2.8.1 Business Processes versus Systems**

According to Fowler (2009:2) one misconception that can hold companies back from considering modernisation is that modernising is about *replacing systems* instead of *improving processes*. Sometimes the desire for a bold initiative can translate into a move to replace an entire class of systems (get rid of the mainframe and install servers) or applications (get rid of all the custom code and buy an ERP package) or even languages (get rid of the

COBOL and rewrite in Java). Consequently, a huge IT-driven project to replace a system is presented around the company in IT search for *business* justification to obtain funding. The proverbial tail is wagging the metaphorical dog.

From the standpoint of the business, this approach makes no sense. The more reasonable approach is to first determine which business process can be modernised to make the greatest impact on business goals at the lowest cost (initial and/or long-term) in time and resources. From an IT perspective, this approach involves analysing which hardware and software resources support the process in question, and how these IT resources can be modernised to support business process change.

The good news is that sometimes a relatively small change on an IT level can make a significant business process impact. For example, at a large U.S. state government construction management agency, constituents once had to use the phone to get information from operators looking at mainframe terminals. Human resources were tied up, taxpayers and building contractors were frustrated, and many errors occurred. Through a simple modernisation project, the agency made the same information available on the Web, increasing customer satisfaction and reducing errors. (Fowler, 2009:3)

### **2.8.2 Not Always About Spending**

According to Fowler (2009:3) another misconception about modernisation is that it's always about spending, replacing, and making radical changes. But modernisation is sometimes about *saving* rather than spending. For example, through a process of modernisation, a state university in the Pacific Northwest learned that it would not have to replace its valuable mainframe system (as originally expected) in order to get widespread access to critical mainframe data. Modernisation turned out to be about making a small change rather than a radical change.



Forrester Consulting recently produced a vendor-sponsored study in which four Software AG customers were interviewed on the subject of core system replacement. Each customer had either planned to replace their core systems or was in the process of replacement. By the conclusion of the study three of the four customers decided against replacement in favor of maintaining (and potentially enhancing) their current systems; the fourth was still weighing its options. The collective outcome of this "reversal" decision was a projected average ROI of 331 percent over 5 years. Each of the five Organisations mentioned started out believing that modernisation was about replacing and spending, and they subsequently learned that it could instead be about retaining and saving. (Fowler 2009:3)

## **2.9 Legacy Software Modernisation Best Practices**

According to Atexsoft (2018:12) there are two approaches to dealing with the legacy problem: revolutionary (big-bang) and evolutionary. Yet, both have benefits as well as drawbacks.

**The revolutionary method:** It revolves around developing and carrying out a legacy system replacement strategy. Its implementation requires shutting down the old system and building a new one from scratch. The approach might be considered extreme, but sometimes it is better to retire the system completely to avoid some serious damage, such as security breaches, lost data, and system downtime. Or it can be applied in a case when the original product cannot solve the existing business problems anymore, so it makes no sense to reengineer.

**The evolutionary approach:** It presupposes a systematic, step-by-step software modernisation process. It is usually less painful: It does not disrupt the major business processes and implies significantly lower risks for the company. Yet, it often turns into a Band-Aid approach, where you focus on solving the problems instead of removing the factors that cause them.

## **2.10. Steps for Successful Application Modernisation**

Aside from adopting the best-suited strategy for your technology modernisation initiative, there is more you can do to make sure the process runs smoothly. Here is a checklist of 7 things to consider for a successful software modernisation project proposed by Altexsoft (2018: 17).

### **Step 1. Assess the current state of legacy systems.**

Legacy software does not always fall under “old” or “outdated” definitions. There are more aspects to assess when identifying the legacy technology. That is why you need to assess all systems in place to uncover the current and potential issues it can bring up in the near future. The assessment should be systematic and detailed: Study all aspects of your technology, from code and architecture to visual look and feel, taking into account your future business plans for product growth.

### **Step 2. Select the modernisation method that would be the fastest to deliver value.**

Based on the assessment conducted at the first phase, choose the modernisation approach that best fits your needs and will help you deliver results fast. Consider existing products you can use. There is no need to reinvent the wheel if there is a SaaS solution available at a fraction of cost. Yet, if your system solves rather specific tasks or you want to be able to build more features on top of it, custom product development services might be right for you. In this case, adopting agile software development practices can help you speed up the process and deliver value fast.

### **Step 3. Rethink the architecture and prioritize for simplicity.**

Legacy systems often fail to perform as needed due to their overly complex structure. When modernising your system, less is more in terms of both architecture and functionality. Start by implementing only the most important features. Consider a micro services architecture approach to make your product scalable. Additionally, make sure the newly released application will work well with the rest of the tools used in your business by default. If you plan to change any of the tools soon,

consider several possible options and keep their requirements in mind when building your application.

**Step 4. Choose the technology stack to deliver optimal performance and user experience.**

When reengineering your system, make sure you use a solid and future-ready technology stack. The choice of technologies should completely depend on the product specifics. Consult with your internal IT staff or address a professional technology consultancy. The right technology stack contributes to building a performant, reliable and efficient product.

**Step 5. Document for future system growth.**

To avoid the same mistakes that made you reengineer your current solution, introduce (or adopt best practices used by other companies) a set of coding standards and internal processes. Orderly documented and clean code make your software easy to understand, extend and maintain in the future.

**Step 6. Create a separate support and retirement schedule for your legacy system.**

Even if you have a brand-new system running like a clockwork, you will still need your legacy software, just in case. So, don't kill it all at once. Document and archive your solutions so you can easily access and refer to them when needed. Therefore, you need to support your legacy system for some time and plan for retiring your legacy system only when your new product is up and running.

**Step 7. Budget for training and system updates.**

Working with the old systems for years, your employees might need some time and guidance to master the new software. So be ready to invest in staff training for better performance and efficiency. Additionally, plan for regular system updates. If you fail to keep your product up to date, you will soon face another modernisation challenge. Regardless of the chosen approach, software modernisation is a complex, labor intensive and risky process. Yet, the results seem well-worth the risk. According to a recent Gartner survey, 45 percent of respondents state that one of the current top 5 IT project priorities is "application modernisation of installed on-premises core

enterprise applications” and a further 41 percent say that “extending capabilities of core enterprise applications” is a top five priority (Granetto 2018:20). This shows that most companies are realizing that modernisation is a necessity, if they want to turn their business around – it doesn’t matter how you look at it, it is a valuable investment.

### **Chapter 3: CoJ E-Services and Platform Modernisation Case Study**

This gives a summary description of a modernisation project for City of Johannesburg (CoJ). The Chief Information Officer (CIO) can use the results as a base to motivate for more funding from Executive Committee to modernise and transform the entire legacy environment and for other modernisation projects. The scope covers a new Platform and E-Services solution which is a citizen facing portal that was completed in 2017 September. So it will be practical to assess whether there has been any benefits realised. Data was gathered by obtaining projects documents and via discussions with various project resources involved.

#### **3.1 Business Case**

As detailed in the Statement of Work (SOW) document ZA - SITA for COJ - Non-SAP Application Modernisation Project - SOW v8 2 FINAL APPROVED (2015) the City of Johannesburg has identified that the modernisation of their application platform is an important component of the City’s Growth and Development Strategy (GDS, 2040). This also represents the first phase of the journey to get the City of Johannesburg closer to its goal of becoming a Smart City.

The Platform Deployment Stream will build a solid and scalable platform that will allow the City of Johannesburg to provide agile, innovative, collaborative and effective shared capabilities toward the aim of migrating their existing non-SAP applications as well as for building their future applications thereon. The Microsoft CityNext platform is a software platform that provides a set of key-shared capabilities that can be used by different city departments/functions by using supported devices from allowed City of Johannesburg locations and networks. The initial deployment

will focus on all platform elements required to deliver the prioritised e-Services “wave 1” delivery.

### **3.1.1 Business need/opportunity/objectives**

According to the delivery partner Microsoft (2013), their interaction with the City of Johannesburg and assessment of the environment has resulted in understanding the current situation and the future needs for the City of Johannesburg. In order to deliver on the future needs, the City of Johannesburg needs to transform its existing IT environment to a new platform that we call the City Transformation platform. The Platform implemented is a Microsoft developed platform that would support the current and future business mission critical systems in line with Group Development Strategy GDS (2040). The following were revealed by the assessment as the main challenges calling for a modernisation initiative.

- a) The ICT department has huge challenge in monitoring the application availability, challenge in operations, application performance and service level agreement resulting in end user dissatisfaction.
- b) The applications are running on obsolete technologies with very high costs to maintain and support.
- c) There are no reference architecture guidelines resulting in no standardization and governance on how to develop applications for the city.
- d) Identity, security and access management is a challenge and it has to be addressed across multiple applications and multiple departments.

### **3.2 Platform Stream**

The vision for the Platform Deployment Stream is therefore to provide a secure, maintainable and resilient software platform that has a set of key-shared capabilities that can be used by different city departments/functions by using supported devices from allowed City of Johannesburg locations and networks.

The CityNext transformation platform will provide the following capabilities that can be leveraged by existing applications and future applications:

1. Citizen centric interface
2. Electronic services (e-Services) platform
3. Process automation and citizen relationship management
4. Empower City employees with enterprise grade applications on any device
5. Communication and collaboration
6. Access from allowed locations and networks on any supported device
7. Citizen/Business engagements and interactions with social media
8. Security, Identity and Access management
  - a. Security Architecture and Strategy
  - b. Identity Management
    - i. User Account Management (Administrator, Citizen, etc.)
    - ii. Service Account Management (System)
    - iii. Single Sign-On (SSO)
    - iv. Credential Hygiene
    - v. Environment Administration
  - c. Data Leakage Prevention (DLP)
    - i. Access Control
    - ii. Data Encryption
  - d. Digital Identity (Computer and User)
    - i. Certificate based identity
  - e. Secure Development Lifecycle (SDL)
    - i. Design and implementation of secure applications and code
9. Operations management and support
10. Agility and scalability
11. Redundancy of logical layers of the architecture
12. Integration to existing and technologically heterogeneous information systems within the IT environment of City of Johannesburg.

### **3.2.1 Key Benefits**

- a) Provides an infrastructure on which to build sophisticated solutions within a particular domain.
- b) Shared between different functions domains minimizing the cost of implementing new solutions.

- c) Can be configured to bring together data from multiple domains, breaking through departmental silos to provide a comprehensive and unified view of the city, enabling new insights and new capabilities that would have been otherwise impossible.
- d) Enables transparency for citizens and government accountability by bringing people into the governance process.
- e) Enables cities to achieve a continuous cycle of insight and action to fuel new city services for citizens.

### 3.2.1 Product Description (Solution)

Successful IT projects need a solid infrastructure foundation to be built thereon. The core objective of the CityNext Platform Deployment stream is to build a solid and scalable platform that will allow the City of Johannesburg to provide agile, innovative, collaborative and effective shared capabilities toward the aim of migrating their existing non-SAP applications as well as for building their future applications thereon.

The Microsoft CityNext platform is a software platform that provides a set of key-shared capabilities that can be used by different city departments/functions by using supported devices from allowed City of Johannesburg locations and networks. This project stream will deliver the following technology blocks:

**Table 3.1: Platform Stream Technology Blocks**

Technology Block	Description	MS Product
Product Deployment and Configuration	The deployment of the Microsoft Server Production Environment. This will cover Infrastructure requirements workshops, assessment of current IT Environment, identification of any gaps, Microsoft server installation and creating the installation guide.	All technologies, namely: <ul style="list-style-type: none"> <li>• Microsoft Biz Talk Server 2013</li> <li>• Microsoft Dynamics CRM 2015</li> <li>• Microsoft SharePoint Server 2013</li> <li>• Microsoft System Center 2012 R2</li> <li>• Active Directory Rights Management Service (AD RMS)</li> <li>• Active Directory Certificate Services (AD CS) - Public Key Infrastructure (PKI)</li> </ul>
Electronic Services Enablement	Electronic Services Platform in order to enable delivery of a number of electronic services	SharePoint 2013 Dynamics CRM 2015 SQL Server 2014

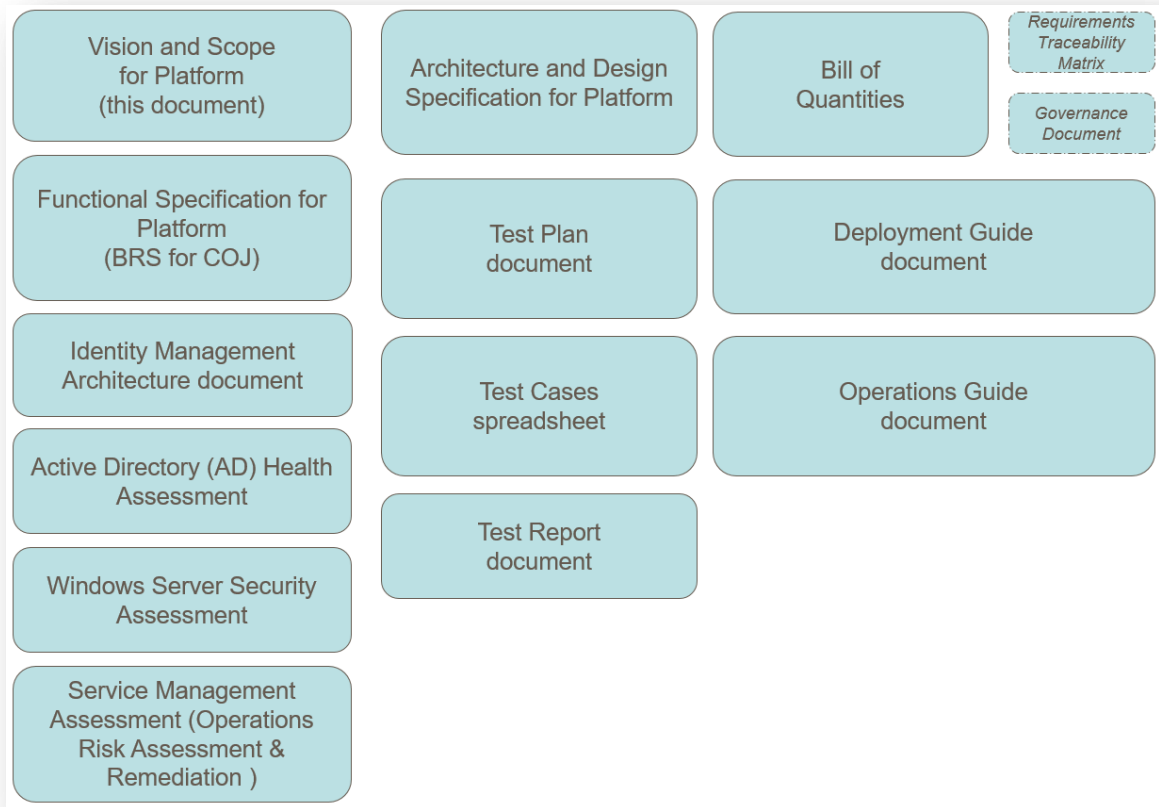
Technology Block	Description	MS Product
	<p><b>Citizen Service Portal:</b> architecting, designing, developing and deploying the features related to the external Citizen Service Portal.</p> <p><b>Citizenship Relationship Management System:</b> this covers the platform to be used to manage and track all in-context interactions with the external entities. It will serve as a back-end presentation and application layer.</p>	
Enterprise Service Bus Deployment	In general, the scope of this project stream is to architect, design and deploy service oriented infrastructure solution (platform) to support delivery of City of Johannesburg electronic services.	BizTalk Server 2013
Application Lifecycle Management	ALM is a solution for governing the process of planning, building, and managing applications over their lifecycle. It will enable City of Johannesburg to more effectively manage projects, track project progress, manage requirements, streamline team collaboration, design and develop systems, ensure quality, manage releases, and maintain workloads developed on the CityNext platform	Visual Studio Team Foundation Server
Platform Management	<p>This is made up of several components:</p> <p><b>System Centre Operations Manager (SCOM)</b> to provide the proactive services and server monitoring for the infrastructure, as well as provide long time availability and performance data about infrastructure components</p> <p><b>System Centre Configuration Manager (SCCM) and End Point Protection</b> to manage workloads operating on the Platform, and deploy new software updates and maintain configuration settings.</p> <p><b>System Centre Data</b></p>	System Center Suite



Technology Block	Description	MS Product
	<b>Protection Manager (SCDPM)</b> will provide the data protection for systems as deployed within the environment.	

**Deliverables.**

The following image and table summarize the project documentation deliverables for the Platform Deployment project stream:



**Figure 3.1: Platform Deployment Stream Deliverables**

**Table 3.2: Platform Stream Project Deliverables**

<b>Project Phase</b>	<b>Project Deliverable</b>	<b>Summary of Content</b>
Envision	Vision and Scope document for Platform Deployment stream (this document).	An envisioning document, containing the vision, requirements, project scope and high-level solution approach.
Envision	Bill of Quantities (Draft Version)	Spreadsheet of all hardware and software required for all the various environments, including CPUs, RAM and storage.
Plan	Functional Specification for Platform Deployment stream	Document reflects in-scope requirements gathered.
Plan	Bill of Quantities (Final Version)	Spreadsheet of all hardware and software required for all the various environments, including CPUs, RAM and storage.
Build	Architecture and Design Specification for Platform Deployment stream	A detailed design document providing a conceptual, logical and physical architecture and configuration related aspects based on the Functional Specification document for pre-production and production environments. Document describes the design/architecture of the solution including a logical and physical architecture depicting the layout and configuration of all in scope components.
Stabilize	Test Plan	It will include the test scenario / test cases unit/functional/integration testing for each product implemented within the production environment. Test Plans define the approach to testing, test participants, test methodologies, testing participants, test locations and dates. Word document describing how and what testing will be done and by who.
Stabilize	Test Cases	Test Cases define the use cases to be tested, the inputs, test scenarios and expected outputs. Excel sheet describing UAT test scenarios and test cases. These will be based on the functionality breakdown in the Functional Design document.
Stabilize	Test Report (of Test Results)	Test Results document the outcomes of each test conducted, inclusive of pass/fail of testing and noted defects raised during testing.
Deploy	Deployment Guide for Platform Deployment stream	Basic step-by-step user guide document on how to deploy the custom solutions and platform environments.
Deploy	Operations Guide for Platform Deployment stream	Document describing the routine tasks to operate the platform for each product implemented within the solution based on standard operational guides provided by Microsoft's web site. Operation guide that provides information about the environment administration policies and system maintenance for the deployed server technology in Production Environment.
Deploy	Secure Development Lifecycle (SDL) document	Microsoft's Recommendations for Implementing SDL Functional Components. Provides the guidance that development team members should be expected to follow in developing all new applications on the new platform.
Project	Identity Management (IdM) Architecture document	The purpose of this deliverable will be to define the Identity Management strategy in the context of the CityNext solution and how the City of Johannesburg can leverage this for managing their internal and citizen identities.

Project Phase	Project Deliverable	Summary of Content
		<p>The strategy will synchronize all identity management aspects of this solution and provide guidance for all the technology streams, delivering, architecture, strategy, governance and where required, compliance guidance.</p> <p>Define IdM strategy for the CityNext initiative in line with:</p> <ul style="list-style-type: none"> <li>• PII compliance</li> <li>• Data classification</li> <li>• Securing of user data</li> </ul> <p>Ensure that each work streams is managing identities appropriately and in line with architectural principles.</p> <p>Align Identity Management for the following streams:</p> <ul style="list-style-type: none"> <li>• User Experience</li> <li>• User Registration</li> <li>• User Management</li> <li>• Citizen</li> </ul> <p>Delivery of an overall identity management architecture.</p>

**Table 3.3: Migration Stream Project Deliverables**

The environment deliverables for the Platform Deployment Stream will be the following:

Microsoft Technology	Test Environment (aka DEV)	Pre-Production Environment (aka UAT)	Production Environment (aka PROD)
SharePoint	X	X	X
CRM	X	X	X
SQL Server	X	X	X
BizTalk	X	X	X
System Centre Suite	X	X	X

### 3.2.2 Scope Includes

#### Environmental Assessments:

In addition to the current Dell/Quest tool that will be run to provide an in-depth assessment of all the Domino applications that have been identified and grouped into the various project waves, the project team will conduct the following additional manual and automated assessments of the COJ environment as part of the scope of this project:

- MAPS (Microsoft Assessment and Planning Toolkit):
  - The Microsoft Assessment and Planning (MAP) Toolkit 9.2 is an inventory, assessment, and reporting tool that will help the COJ and

the project team to assess the current COJ IT infrastructure and determine the right Microsoft technologies for the COJ IT needs.

- The MAP Toolkit uses Windows® Management Instrumentation (WMI), Active Directory® Domain Services (AD DS), SMS Provider, and other technologies to collect data in the COJ environment and inventories computer hardware, software, and operating systems in small or large IT environments without installing any agent software on the target computers.
- This assessment is being performed through a combination of face-to-face meetings, automated tooling and physical checking of the servers through interactive logon to them.
- As part of the automated tooling assessment, the Microsoft Assessment and Planning Toolkit will be used to scan the COJ data centre networks in order generate a list of systems.
- System Centre Reporting:
  - Project team will use the Microsoft Assessment and Planning MAP Toolkit to gain an insight into the server and application landscape. The rationalization will require:
    - The installation of MAP on a server
    - The creation of a Microsoft CRM Online trial instance (a cloud service will be used for the rationalization – low impact data such as application name, version, and total number of applications is sent)
  - Network and account access will be required to inventory servers using MAP
  - Inventory data will be processed:
  - Rationalization: the data that has been collected is initially rationalized by removing noisy applications (drivers, etc.) that are discovered.
  - Categorization by type: Servers, server roles and applications are categorized “by type” (i.e. Microsoft vs Third-Party vs Custom applications).

- System Catalogue: Systems are a collection of servers and applications that relate to a particular business solution.
- PADS (Persistent Adversary Detection Service):
  - Proactively determine whether a system is under threat via a discreet incident response prior to an actual emergency and examines high value assets or a sample of systems for signs of advanced implants not typically found by commodity anti-virus or intrusion detection system technologies.
  - Benefits include:
    - Proactive analysis by incident response experts before an emergency occurs.
    - Leverages Microsoft proprietary capabilities and the same experienced consultants who help stop and mitigate attacks worldwide.
    - Malware analysis, reverse engineering, tailored cyber threat intelligence, and the ability to create discreet, custom scanners.
    - Suitable for high-value servers and endpoints used by executives or critical personnel.
    - Strategic guidance to harden against advanced and persistent attacks.
    - Understand what leading adversaries are presently doing and what defences are currently working in the real world.
    - An out briefing will be provided detailing the team's findings and recommendations to strengthen your environment and help disrupt attackers.
  - Microsoft security assessment to confirm:
    - GPO enabling Windows Error Reporting has been successfully applied.
    - Collecting data from systems under review.

- AD Risk and Health Assessment:
  - The project team has a deliverable to perform a Risk and Health Assessment for Active Directory, which is an initial assessment of the current live COJ AD environment to expose risks and provide the COJ with a report of our findings including remediation recommendations.
  - This will include an Active Directory Risk Assessment Program (RAP) and Active Directory Security Health Check performed by Microsoft Premier Services, and then the COJ will implement the recommendations made under these assessments.
  - RAP as a Service for Active Directory is a proactive service delivered by a Microsoft accredited engineer to diagnose potential issues with your Active Directory environment. This service is available for a single Active Directory forest including Domain Controllers running Windows Server® 2008/R2, and Windows Server® 2012/R2.
  - The data is collected remotely allowing you to maintain the utmost privacy and run the assessment on your own schedule. A Microsoft accredited engineer will review the findings, provide recommendations and knowledge transfer, and build a remediation plan with your staff.
  - RAP as a Service for Active Directory collects information on the key technology, people, and process areas in your environment and analyses this information against best practices obtained from over thousands of customer assessments.
  - Solutions for each of the issues are identified and articulated in the Technical Findings report. All critical and important issues are explained by the Microsoft accredited engineer and a remediation plan is provided as one of the key deliverables.
  - The tool will be tested to ensure connectivity to a subset of systems to ensure all required access rights/permissions as well as network connectivity is in place.

- Windows Server Health Check:
  - The project team has a deliverable to perform a Security Assessment of the current Microsoft Windows environment. This assessment is performed through a number of tools forming part of the toolkit that are temporarily introduced into the network.
  - The following tools were be used:
    - 1. SERA – Security Enhanced Reporting & Analysis.
      - This is a Microsoft IP tool that uses Windows Error Reporting and the collection of both user mode app hangs/crashes and kernel dumps when they occur on impacted endpoints.
    - 2. MSERT – Microsoft Security Scanner, designed to search and identify what types of malware exist on the endpoints, (server and client) it is executed on.
      - This data is the primary start point to give an idea of what commodity malware exists in the customer’s enterprise.
      - It is best run on high value systems, (production or mission critical servers) during low peak hours to avoid any potential overhead.
    - 3. ASEP scanner – Auto Start Execution Points.
      - This is another MS IP scanner type tool that perform an endpoint ‘inventory’ of each machine to help build a picture of what versions and types of Windows Operating files (non customer data) exist in the enterprise.
      - It is a once only run scan and does not touch or change any files, merely reports on their existence. This tool yields the most profitable information regarding indicators of compromise
  - It is best run on high value systems, (production or mission critical servers) during low peak hours to avoid any potential overhead.

- Validate that the administrative account provided can access servers under evaluation. Validate that server running tool can access through firewall on machines under test.

## **Product Deployment and Configuration**

Scope for the platform deployment project stream will include:

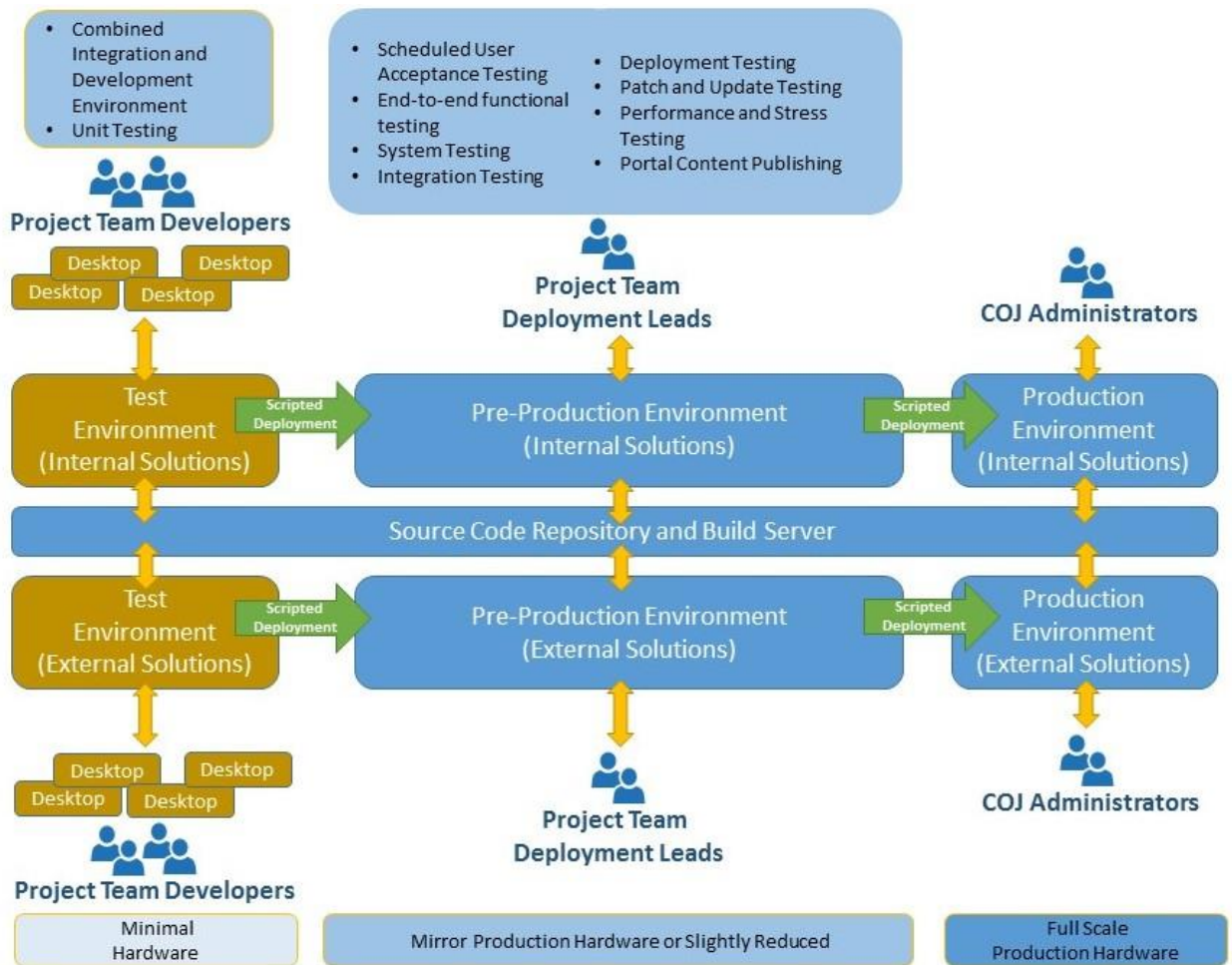
1. Infrastructure requirements workshops (functional, non-functional).
2. Assessment of current IT environment, and identification of potential gaps.
3. Microsoft server products installation on environments in the deliverables section above.
4. Creation and Delivery of a “CityNext Platform Installation Guide”.

A detailed Bill of Quantities (BOQ) for all of the environments will be provided by the end of the Planning Phase for the CityNext Platform Deployment project stream, upon more detailed analysis of the requirements. A draft BOQ has been created during the Envision phase and is available on the project team site.

The following environments will be created by the project team, as illustrated below:

- Test Environment (aka DEV), which will primarily be used as the integrated development environment, as well as for unit testing by the development team.
- Pre-Production Environment (aka UAT), which will primarily be used for end-to-end functional testing and the formal scheduled COJ user acceptance testing during this project, as well as for patch and update testing and performance and stress testing in the future by the COJ.
- Production Environment (aka PROD), which will host all the internal and external solutions developed and configured by the COJ modernisation project.





**Figure 3.2: COJ Modernisation Project Environments**

Source:

<https://teams.joburg.org.za/services/ICT/ADS/Shared%20Documents/Forms/AllItems.aspx>

### **Citizen Relationship Management (CRM) System Infrastructure Setup**

Microsoft will perform the following activities with regards to the Dynamics CRM infrastructure setup:

- An infrastructure analysis workshop to analyse the infrastructure requirements for the CRM Solution.
- Prepare solution deployment guide and update the design document.
- Setting up of Microsoft CRM solution software requirements on Testing (TEST aka DEV), Production (PROD) and Pre-Production (PRE-PROD aka UAT) environments including installation:

- Microsoft Dynamics CRM 2015 servers
- Microsoft SQL Server 2014 Database and Reporting Services
- Configuring E-mail integration with Exchange Server: E-mail router component will be integrated with one (1) Microsoft Exchange Server only.

### **Application Lifecycle Management (ALM)**

The following items are in scope for Application Lifecycle Management (ALM) sub project stream:

**Table 3.4: In Scope Items for ALM**

<b>Item</b>	<b>Description</b>
Application Lifecycle Management Implementation Services Environment Installation	Microsoft team will conduct a series of workshops to gather the requirements as follows: <ul style="list-style-type: none"> <li>▪ One (1), two (2) day requirements gathering workshop</li> </ul> Microsoft will work with your technical team to install the Application Lifecycle Management Implementation Services environment and document the key considerations.
User access and security planning	Microsoft will conduct one workshop to plan the managing user accounts approach and security access to the online Visual Studio Online environment. <ul style="list-style-type: none"> <li>▪ One (1), one (1) day long planning workshop</li> </ul>

### **Platform Management**

The Platform Management solution is essential to operate and keep the platform integrity; this project stream is composed of the following components:

1. System Center 2016 Operations Manager (SCOM)
2. System Center 2016 Configuration Manager and Endpoint Protection (SCCM)
3. Server Hardening
4. Certificate Management Services
5. Data Leakage Prevention (DLP)

### **System Centre Operations Manager**

The following is in scope for System Center Operations Manager deployment as part of the City of Johannesburg CityNext platform:

**Table 3.5: System Center In Scope Items**

In Scope	Description/Considerations	Scope Assumptions
<b>Environment</b>	<ul style="list-style-type: none"> <li>▪ The Platform Management Components will be deployed in               <ul style="list-style-type: none"> <li>▪ Pre-production Environment</li> <li>▪ Production Environment</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Pre-Production Environment cover a single Site</li> <li>▪ Production Environment cover the Main and DR Site</li> </ul>
<b>Operation Manager 2012 architecture</b>	<ul style="list-style-type: none"> <li>▪ Design and deploy the Operation Manager 2012 architecture and core functionalities based on a multiple server/single management group Operations Manager 2012 R2 hierarchy</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deployment of one SCOM Management Server in Each Site</li> <li>▪ Secondary site is Disaster Recovery Site</li> <li>▪ Monitoring of all Servers with this Statement of Work</li> </ul>
<b>Management Packs</b>	<ul style="list-style-type: none"> <li>▪ Design and Deploy Management Packs of Microsoft Components within the scope of this Statement of Work, including five Distributed Applications.</li> </ul>	Management Packs in Scope are: <ul style="list-style-type: none"> <li>▪ Windows Operating System</li> <li>▪ System Center 2012 R2 Configuration Manager</li> <li>▪ System Center 2012 R2 Operations Manager</li> <li>▪ Active Directory Domain Services</li> <li>▪ Microsoft SharePoint</li> <li>▪ Microsoft CRM</li> <li>▪ Microsoft BizTalk</li> <li>▪ Microsoft SQL Server</li> <li>▪ Windows Cluster</li> <li>▪ Internet Information Services (IIS)</li> </ul>
<b>SQL Server</b>	<ul style="list-style-type: none"> <li>▪ Design and Deploy of an SQL Server 2012 for All System Center components               <ul style="list-style-type: none"> <li>▪ Database Role</li> <li>▪ management tools</li> <li>▪ Reporting</li> </ul> </li> <li>▪ Capacity planning of SQL Server 2014</li> <li>▪ Access Security configuration</li> </ul>	<ul style="list-style-type: none"> <li>▪ SQL Server Always On will be used</li> <li>▪ SQL Replication is used for DR Site</li> <li>▪ SQL Server is only utilized for System Center Components</li> </ul>
<b>Reporting</b>	<ul style="list-style-type: none"> <li>▪ Design and deploy Reporting Services of Operations Manager 2012, and use of built in report to provide:               <ul style="list-style-type: none"> <li>▪ Five (5) Distributed Applications</li> <li>▪ Five (5) Dashboards</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Scope is limited to built-in reports in Management packs</li> </ul>
<b>Functional Specification and Design Document</b>	<ul style="list-style-type: none"> <li>▪ A detailed design document providing a logical architecture, physical architecture and configuration related aspects based on the Vision and Scope document for pre-production and production environment</li> </ul>	<ul style="list-style-type: none"> <li>▪ Function Specification and Design document. Acceptance will be based on the acceptance criteria defined in section <b>Errore. L'origine riferimento non è stata trovata.</b> Document Acceptance Criteria in the SOW.</li> </ul>
<b>Test Plan</b>	<ul style="list-style-type: none"> <li>▪ Description of test scenario and test cases for unit/functional/integration testing for each product implemented within the production environment</li> <li>▪ Run and execute Test Plan as part of the acceptance test.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Test Plan document. Acceptance will be based on the acceptance criteria defined in section <b>Errore. L'origine riferimento non è stata trovata.</b> Document Acceptance Criteria in the SOW.</li> <li>▪ Tests scenarios completed as</li> </ul>

In Scope	Description/Considerations	Scope Assumptions
		per plan and signed by City of Johannesburg
<b>Operation</b>	<ul style="list-style-type: none"> <li>▪ Design Notification Configuration</li> <li>▪ Design Security Roles (up to five /5/ roles)</li> <li>▪ Fine Tune In-Scope Management Packs</li> <li>▪ Develop operation guide Document describing the routine tasks to operate the platform for each product implemented within the solution based on standard operational guides provided by Microsoft's web site.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Operation Guide Document. Acceptance will be based on the acceptance criteria defined in section <b>Errore. L'origine riferimento non è stata trovata.</b> Document Acceptance Criteria in the SOW.</li> </ul>

### System Centre Configuration Manager and Endpoint Protection

The following is in scope for System Centre Configuration Manager and Endpoint Protection deployment as part of the City of Johannesburg CityNext platform:

**Table 1.6: System Centre 2016 Configuration Manager In Scope Items**

In Scope	Description/Considerations	Scope Assumptions
Environment	<ul style="list-style-type: none"> <li>▪ The Platform Management Components will be deployed in <ul style="list-style-type: none"> <li>▪ Pre-production Environment</li> <li>▪ Production Environment</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Pre-Production Environment cover a single Site</li> <li>▪ Production Environment cover the Main and DR Site</li> </ul>
Configuration Manager 2012 architecture	<ul style="list-style-type: none"> <li>▪ Design and deploy the Configuration Manager 2012 architecture and core functionalities based on a centralized primary Configuration Manager 2012 site with: <ul style="list-style-type: none"> <li>▪ Distribution Point Server in DR Site</li> <li>▪ Creation and targeting of baselines for compliance monitoring, limited to compliance checking of SCEP-related attributes only</li> <li>▪ Software distribution feature, with up to 1 simple application to be distributed</li> <li>▪ Enable Hardware and software inventory</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Deployment of one SCCM Server in Main Site</li> <li>▪ Deployment of one Distribution Point Server in DR Site</li> <li>▪ Deploy of SCCM Agents on all servers within the statement of Work</li> </ul>
Update Management	<ul style="list-style-type: none"> <li>▪ Enable Software Updates for Microsoft Updates provided by WSUS to provide patch management for all in-scope servers</li> </ul>	<ul style="list-style-type: none"> <li>▪ Scope is limited to servers within the statement of work</li> <li>▪ Only Required Updates provided by Windows Updates Will be approved</li> </ul>
Endpoint Protection	<ul style="list-style-type: none"> <li>▪ Design and Deploy SCCM integration with System Center 2012 Endpoint Protection</li> <li>▪ Design and Configuration of host protection server components, client policies, and the antivirus client and signature update deployment strategy</li> </ul>	<ul style="list-style-type: none"> <li>▪ Scope is limited to servers within the statement of work</li> </ul>

In Scope	Description/Considerations	Scope Assumptions
SQL Server	<ul style="list-style-type: none"> <li>Capacity planning of SQL Server 2014</li> <li>Access Security configuration</li> </ul>	<ul style="list-style-type: none"> <li>Utilize the shared SQL Server for all system Center Components.</li> </ul>
Functional Specification and Design Document	<ul style="list-style-type: none"> <li>A detailed design document providing a logical architecture, physical architecture and configuration related aspects based on the Vision and Scope document for pre-production and production environment</li> </ul>	<ul style="list-style-type: none"> <li>Function Specification and Design document. Acceptance will be based on the acceptance criteria defined in section <b>Errore. L'origine riferimento non è stata trovata.</b> Document Acceptance Criteria in the SOW.</li> </ul>
Test Plan	<ul style="list-style-type: none"> <li>Description of test scenario and test cases for unit/functional/integration testing for each product implemented within the production environment</li> <li>Run and execute Test Plan as part of the acceptance test.</li> </ul>	<ul style="list-style-type: none"> <li>Test Plan document. Acceptance will be based on the acceptance criteria defined in section <b>Errore. L'origine riferimento non è stata trovata.</b> Document Acceptance Criteria in the SOW.</li> <li>Tests scenarios completed as per plan and signed by City of Johannesburg.</li> </ul>
Operation	<ul style="list-style-type: none"> <li>Develop operation guide Document describing the routine tasks to operate the platform for each product implemented within the solution based on standard operational guides provided by Microsoft's web site.</li> </ul>	<ul style="list-style-type: none"> <li>Operation Guide Document Acceptance will be based on the acceptance criteria defined in section <b>Errore. L'origine riferimento non è stata trovata.</b> Document Acceptance Criteria in the SOW.</li> </ul>

### Server Hardening (Environments)

The scope of the statement of work is the Envisioning, Planning, Developing, Stabilizing, and Deployment of a server hardening solution.

This sub project stream assumes an existing stable production Active Directory environment, and it consists of the following activities:

**Table 3.7: Server Hardening In Scope Items**

Scope Items	Descriptions
Define server and workload profiles based on business processes and requirements for the CityNext solution.	The GPO settings should be based on business process and requirements to enable users to do the functions that they are responsible for.
Draft test case documentation regarding business scenarios that would be required to be testing during the development phase.	This document will outline the business requirements needed to be testing during the development phase. These tests will not be performed as part of the planning phase.
Create functional requirements based on business process goals to support the definition of the profiles.	The functionality provided in the Group Policies should be based on business requirements and user function models.
Design a Group Policy structure that will support the different user profiles within Active Directory. The GPOs needs to fit and be designed around an already implemented Active Directory OU structure. Minimal alterations to this can be done.	The Active Directory structure enables the management of the GPOs. The structure has the ability to simplify the administration of the Active Directory and User Functions.
Design and implement GPOs specifically for the	The deployment of the GPOs will be focused on the

Scope Items	Descriptions
Windows Server environment for the CityNext solutions.	windows server environment for the CityNext platform only.
Design and implement GPOs based on the GPO accelerator Windows Templates for each of the Group Policies (profiles) as well as the default domain and domain controller policy provided as part of this guide. Minimal alterations to these policies are allowed to meet business requirements.	The accelerators will save time in setting the basic settings for GPOs and in the creation of the GPOs. The GPOs will be altered according to business requirements and documented accordingly in the detailed design why the deviation took place from the Microsoft recommended Security template.
Create detailed design and test case documentation. Testing of the hardening components in an isolated release management environment.	Information on how the Group Policies has been designed and test cases that will be done in the Active Directory environment against the created Group Policy Objects defined in this planning phase project.
Deploy the Server Hardening Policies as follows: <ul style="list-style-type: none"> <li>▪ Deploy up to five (5) GPOs</li> <li>▪ Create the required Organisation Unit (OU) structures as per design</li> <li>▪ Deploy in Testing, Pre-Production and production (including DR)</li> </ul>	

## Certificate Management Services

This sub project stream has been scoped to provide a self-managed internal Public Key Infrastructure (PKI) solution that can support City of Johannesburg's security solutions.

**Table 3.8: Certificate Services (PKI) In Scope Items**

Scope Items
<ul style="list-style-type: none"> <li>▪ Conduct a Project Kick-off Workshop to review and place a roadmap on the execution of the project/s and concluding all project logistics.</li> <li>▪ To review the City of Johannesburg environment and the PKI's operational impact.</li> <li>▪ Develop a detailed Project Plan and Schedule for the execution of the project</li> <li>▪ Conduct Technical Design Workshops</li> <li>▪ Develop Functional Specifications</li> <li>▪ To develop a deployment plan for the PKI solution, detailing a phased deployment strategy and specifying the resources needed for each phase</li> <li>▪ Creation of a Test Plan to validate the solution, which describes the lab configuration and the test cases, including: <ul style="list-style-type: none"> <li>▪ Customization of the deployment scripts and checklists</li> <li>▪ Planning Phase Deliverables and Phase Sign-off</li> <li>▪ Guidance will be provided for application of the IANA OID</li> </ul> </li> <li>To develop a solution design document that will include: <ul style="list-style-type: none"> <li>▪ Design of the CA hierarchy (including CA configuration, validity and key size, and trust establishment)</li> <li>▪ Definition of the roles and responsibilities for operating the CAs.</li> <li>▪ Definition of the certificate enrolment and renewal strategy.</li> <li>▪ Design of the certificate revocation strategy</li> <li>▪ Design of the key archival and recovery strategy</li> <li>▪ Design of the operations strategy, including high-availability mechanisms, backup and restore, and monitoring</li> <li>▪ Specification of the certificate templates required by solutions that will leverage the PKI</li> <li>▪ Certification authorities (CAs) based on Windows Server 2012 R2 AD CS</li> <li>▪ Certificate templates that define the various types of certificates the PKI supports</li> <li>▪ Certificate enrolment processes using features such as auto enrolment, Web enrolment pages, and device certificates using Network Device Enrolment Service (NDES)</li> <li>▪ Designing for secure archival and encryption key recovery</li> <li>▪ Certificate revocation using both certificate revocation lists (CRLs) periodically issued by the CAs and Online Certificate Status Protocol (OCSP). Publishing of the CRLs to the internet by means of OCSP.</li> <li>▪ Roaming support for the certificates and private keys, using the Microsoft Windows Credential Roaming feature</li> </ul> </li> </ul>

<b>Scope Items</b>	
	<ul style="list-style-type: none"> <li>▪ Identification of solution requirements:</li> <li>▪ Backup and Continuity management of AD CS</li> <li>▪ Certificate enrolment and renewal procedures</li> <li>▪ Certificate revocation</li> <li>▪ Physical and logical security</li> <li>▪ Operational roles and responsibilities</li> <li>▪ Availability and operations</li> <li>▪ Creation of a Solution Design document describing the solution.</li> <li>▪ Creation of the deployment plan for the PKI solution, detailing a phased deployment strategy and specifying the resources needed for each phase.</li> <li>▪ Create the policies that will be used to install and configure the domain clients</li> <li>▪ Creation of a Test Plan to validate the solution, which describes the lab configuration and the test cases, including: <ul style="list-style-type: none"> <li>▪ The Deployment guide describes the process of installing and configuring the solution, along with the deployment schedule and checklists.</li> <li>▪ Customization of the deployment scripts and checklists.</li> <li>▪ Customization of the Deployment and Operations Guide, documenting the installation strategy, deployment schedule, configuration checklists and transfer to operations.</li> </ul> </li> <li>▪ Prepare Active Directory and install the CAs</li> <li>▪ Create the policies that will be used to install and configure the domain clients</li> <li>▪ Provide backup scripts and procedures</li> <li>▪ Defined lab test cases will be executed according to the high-level lab and project plan. Execution of the detailed test cases will be conducted by the assigned City of Johannesburg project team members in assistance with the assigned MS project resources to provide the assigned City of Johannesburg resources with a structured approach to obtaining knowledge transfer from the Microsoft team members.</li> <li>▪ Developing Phase Deliverables and Phase Sign-off</li> <li>▪ Pre-Production Solution Validation</li> <li>▪ Issue Resolution – Any issues or bugs defined as “in scope” will be addressed as required to ensure the solution is ready for pilot deployment.</li> <li>▪ Prepare Active Directory and install the CAs</li> <li>▪ Implement policies to install and configure the domain clients</li> </ul>

### **Data Leakage Prevention (DLP)**

The scope of the sub project stream is the Envisioning, Planning, Developing, Stabilizing, and Deployment of an Information Protection using Active Directory Rights Management Services (AD RMS) solution, consisting of:

**Table 3.9: Active Directory Rights Management Services In Scope Items**

<b>Scope Items</b>	<b>Description</b>
AD RMS-Protected Content	AD RMS Templates for quick AD RMS rights application. AD RMS content will be accessible from the internet via a SSL/TLS AD RMS Pipeline. This would require a third party x509.v3 (SSL) digital certificate to be purchased by City of Johannesburg.
Business Requirements	Evaluation of relevant City of Johannesburg security policies, document management policies and procedures, and identification of Rights Management Services requirements. Assistance with defining a data classification strategy. AD RMS is dependent on this strategy.
Technical Configurations	Assessment of the network topology, Active Directory environment, messaging and portal Rights Management Services integration. Design of a solution that meets the City of Johannesburg's requirements, including scalability, geography and clustering considerations

Scope Items	Description
	Microsoft Office Information Rights Management usage with integration with SharePoint document libraries. Publishing of AD RMS secure pipelines to the internet for mobile consumption of encrypted content
Knowledge Transfer	Informal knowledge transfer during the envisioning, design and implementation phases
Design	Definition of a detailed implementation plan and schedule.
Testing	Validation of proposed solution in limited production environment or testing environment. This would be test and development environments.
Deployment	Implementation of the rights management solution components outlined in the design document.

### System Centre Data Protection Manager

This sub project stream has been scoped to provide a Microsoft backup solution that can support City of Johannesburg’s backup requirement for e-Services.

**Table 3.10: System Center Data Protection Manager In Scope Items**

Scope Items
<ul style="list-style-type: none"> <li>▪ Conduct a Project Kick-off Workshop to review and place a roadmap on the execution of the project/s and concluding all project logistics.</li> <li>▪ An envisioning document, containing the vision, requirements, project scope and high level solution approach</li> <li>▪ Design and deploy the Data Protection Manager 2016 architecture and core functionalities</li> <li>▪ Design and Deployment of DPM Agents to servers forming part of the designed and deployed eServices platform.</li> <li>▪ Design and Deploy DPM 2016 storage pool and Protection Group based on the configuration and nature of the Microsoft applications installed</li> <li>▪ Capacity planning of SQL Server 2016 and access security configuration for DPM.</li> <li>▪ A detailed design document providing a logical architecture, physical architecture and configuration related aspects based on the Vision and Scope document for pre-production and production environment</li> <li>▪ Test Plans with Description of test scenario and test cases for unit/functional/integration testing for each product implemented within the production environment</li> <li>▪ Run and execute Test Plan as part of the acceptance test.</li> <li>▪ Design Security Roles up to 5 roles</li> <li>▪ Develop operation guide Document describing the routine tasks to operate the platform for each product implemented within the solution based on standard operational guides provided by Microsoft’s web site.</li> </ul>

### Completion Criteria

The Platform Deployment Stream will be considered complete once the following has been satisfied:

- All documents listed in the Deliverables section have been completed and delivered by the project.
- All products have been installed and configured in the environments listed in the Deliverables section of this document.



Deployment Stream will be the provisioning and configuration of the server infrastructure which the platform will be installed upon.

As the e-Services migration “wave” has been prioritized, the Platform Deployment Stream has also been prioritized to deliver the various environments and technologies required to support this “wave” through the development lifecycle.

The successful delivery of the Application Migration stream is dependent on the products and environments listed in this document being deployed and configured correctly and timeously. Any delays in the Platform Deployment stream could have significant impact on deliverables of the Application Migration and Customization stream.

### **Impacts**

During the installation and configuration of the various technologies on the platform the CoJ employees responsible for maintaining and monitoring the servers will need to be trained in the deployment and operational running of the various technologies in the platform.

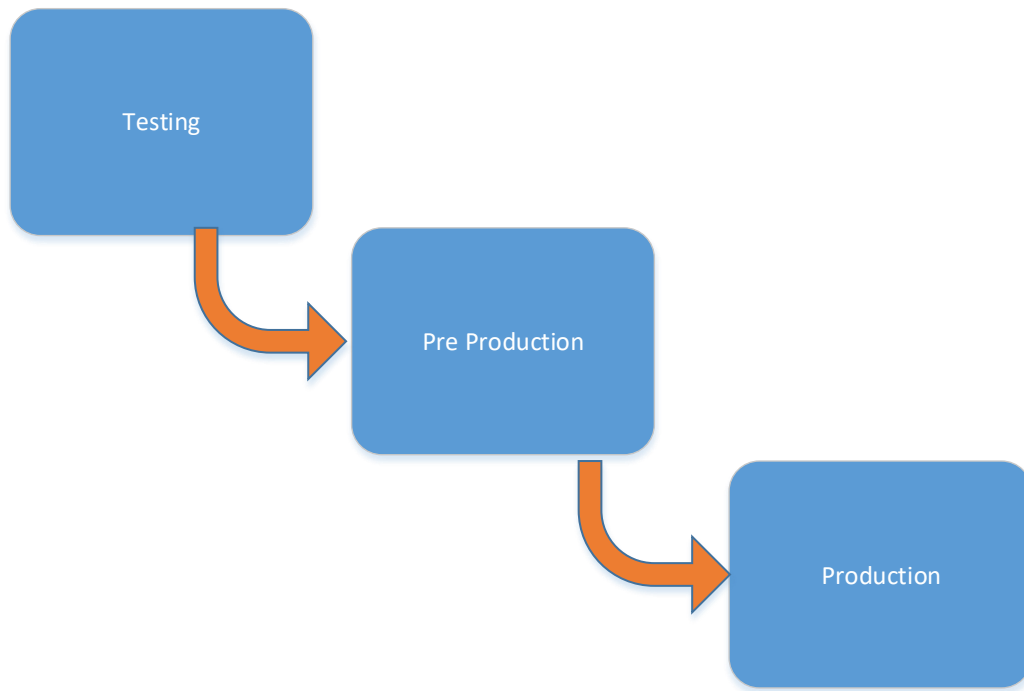
### **Measures of Project Success**

Each environment will be considered successfully delivered if the related completion criteria as specified earlier in this document have been met.

### **Project Approach**

#### **Planned Approach**

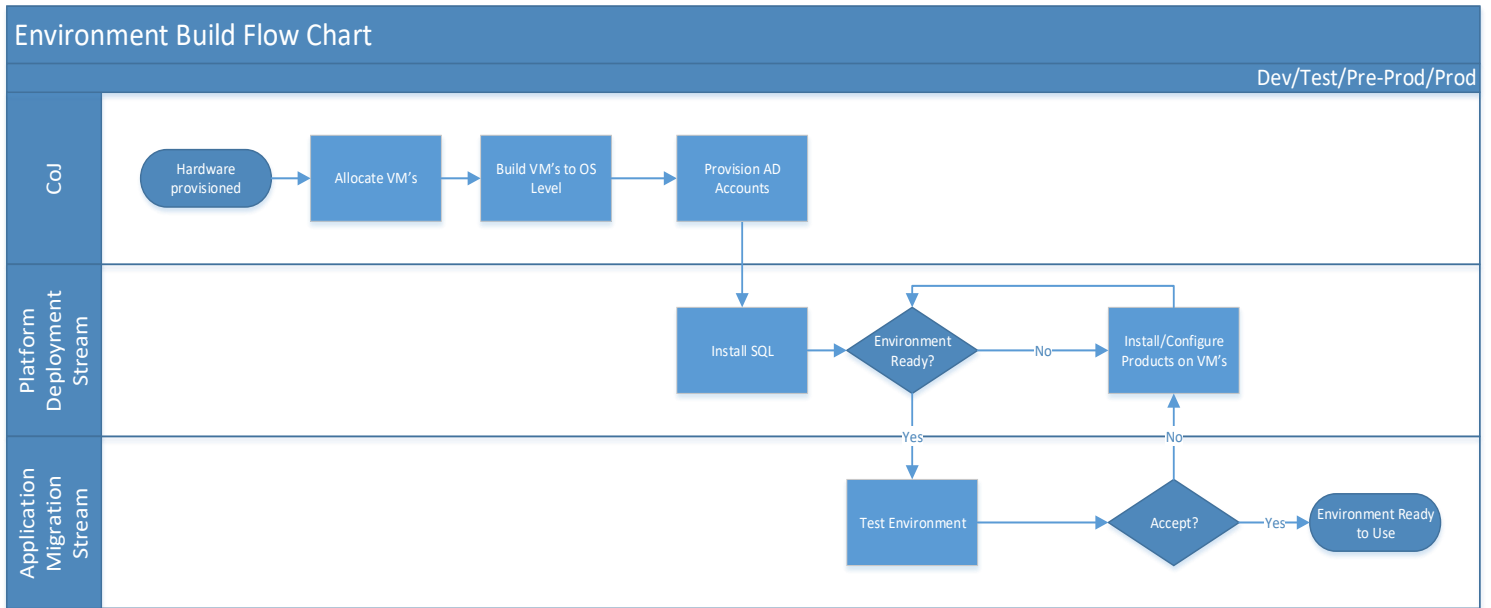
The planned approach for the Platform Development Stream is to progressively build each of the environments from the Test Environment through to Production as illustrated below:



**Figure 3.3: Environment Approach**

This will ensure that any lessons learned from building each environment can be used to progressively improve the build process and minimize rework. This will also follow the logical phases of the Application Migration Stream ensuring that time is spent efficiently to deliver the required environments ahead of the Application Migration Stream.

The approach to building each environment will follow the process below:

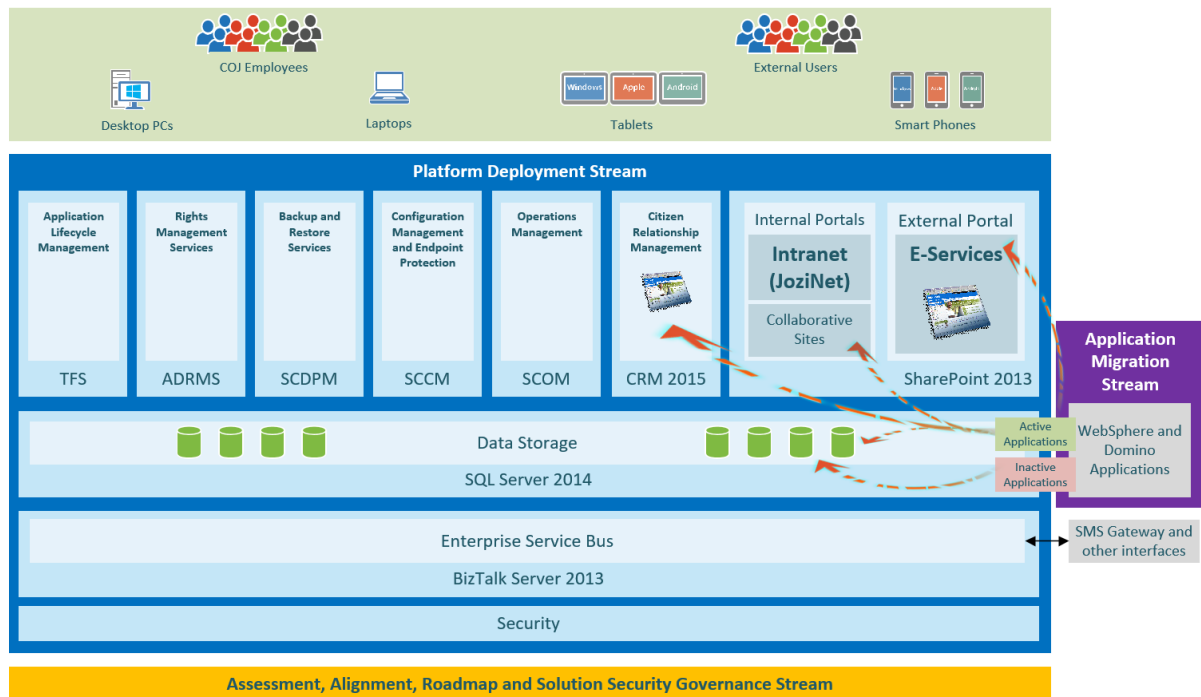


**Figure 1.4: Approach for Building the Environments**

Source:

<https://teams.joburg.org.za/services/ICT/ADS/Shared%20Documents/Forms/AllItems.aspx>

**Figure 3.5: Target Architecture and Solution Overview**



Source:

<https://teams.joburg.org.za/services/ICT/ADS/Shared%20Documents/Forms/AllItems.aspx>

### 3.3 E-Services Portal Modernisation

The citizen services portal, known as e-Services, has been identified as the first of the City of Johannesburg’s group of applications to be modernized and migrated to the new CityNext platform as part of the extranet applications wave.

The primary drivers for this selection are to increase visibility, reliability and usability of some of the City of Johannesburg’s electronic services within the citizenry of Johannesburg. Specifically, the applications that make up the first “wave” are “User Registration”, “Account by e-mail”, “Corporate GIS”, “Online Maps (GIS)”, “Building Plan Progress”, “Valuation Services”, as well as the existing static content of the e-Services site. This document details the degree to which each of these applications can be migrated in this first “wave”. Some applications can be migrated in their entirety, while others can only have their user interface migrated due to dependencies on later migration “waves”.

### **3.3.1 Business Need/Opportunity/Objectives**

The specific business opportunities addressed by the Application Migration Stream portion of the solution are:

- User satisfaction is very low due to complexity, availability and poor performance.
- The applications are running on obsolete technologies with very high costs to maintain and support.
- Inability to incorporate modern application features in existing applications without the need to rewrite the entire application again. These includes mobility features and web 2.0 features.

From an e-Services perspective, the vision for the Application Migration Stream is therefore to improve the usability, reliability and availability of specific citizen services, while providing the City of Johannesburg with a platform that can better support further growth and development of electronic services for citizens.

The goal of the e-Services migration “wave” supports this by aiming to:

- Increase the use and value of the e-Services portal to the citizens
- Ensure the e-Services portal is highly available and performing
- Reduce costs associated with the maintenance and support of the existing platform
- Refresh the design of the portal, in support of efforts to raise its visibility
- Ensure the e-Services capabilities are available to as many of the citizens as possible
- Provide users with the same functionality they currently have on the e-Services portal
- Improve the quality of the user experience when interacting with the portal
- Ensure users with mobile devices are able to access and use the e-Services content and functions, where it is possible to do so without requiring changes to functionality
- Ensure that the e-Services portal is highly available and can withstand occasional hardware outages
- Increase the performance of the e-Services portal, thereby improving the user’s experience when utilising electronic services
- Provide the operational team with the tools and the skills to monitor with the e-Services portal
- Provide the support team with the skills and guidance on how to support and maintain the e-Services portal once deployed

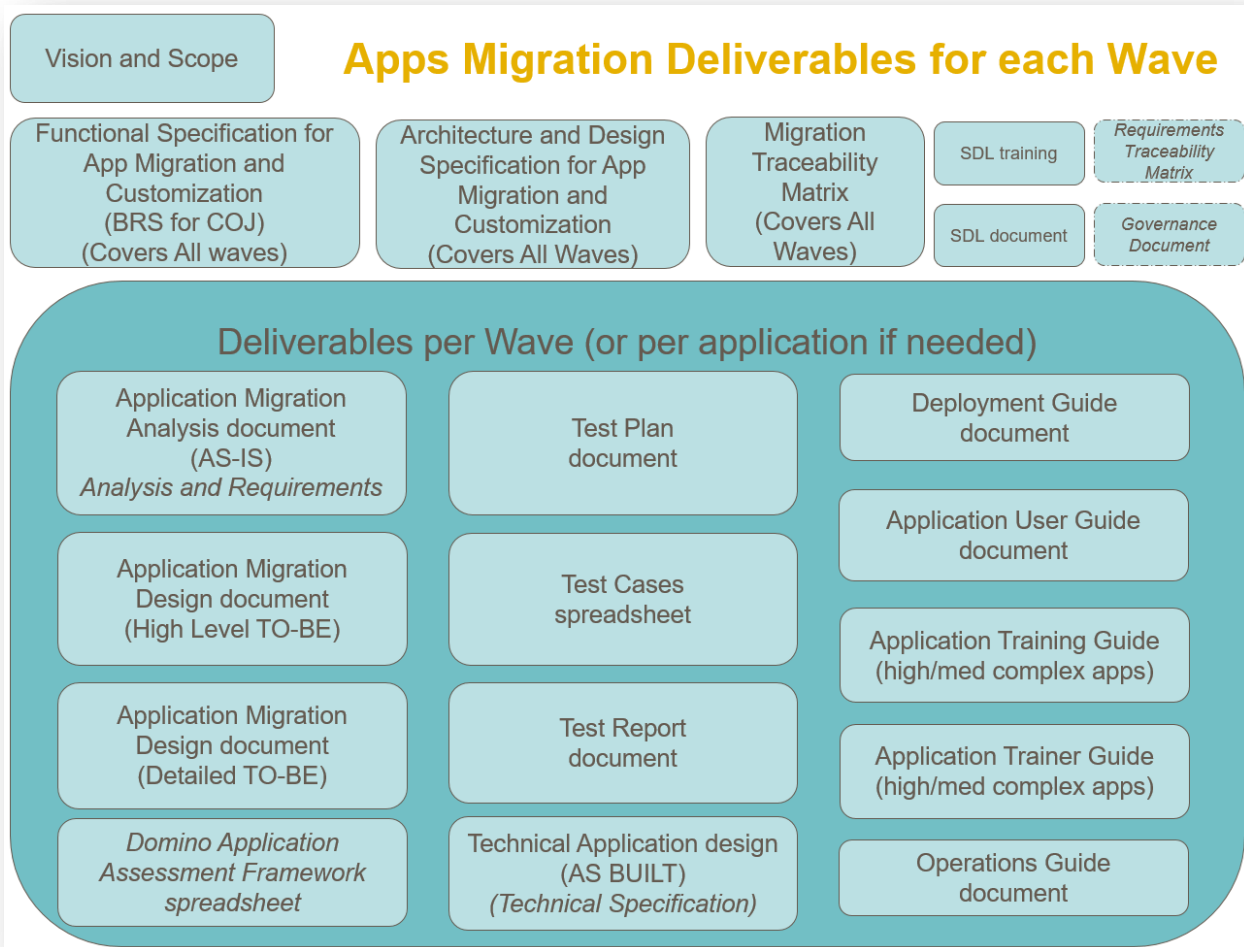
### **3.3.2 Product Description (Solution)**

The identified solution for the overall project is based on providing the City of Johannesburg with a modern platform and a set of migrated applications that, together, will enable the City of Johannesburg to move significantly closer to the goals set out in GDS 2040.

The first migration “wave” is composed of the group of applications that are available in the e-Services portal. The goal of this migration is to provide the portal users with the same content and functionality that they have on the current e-Services portal, while improving the usability and reliability. The static content for the portal, the static content for the applications, and the functionality for the applications will migrate to the CityNext platform. Analysis of each application will determine the extent to which its functionality can either be moved in its entirety to the new platform, or where dependencies on later migrations necessitate a delay in the application’s complete migration. Where such dependencies exist the migration of the application’s user interface will occur in this “wave” and the complete migration will occur in a later “wave”. All this will be documented in the wave AS-IS and TO-BE document design deliverables described below.

#### **Deliverables**

The following image and table summarize the project documentation deliverables for the Application Migration project stream, both for the overall project, as well as for each wave of the migrations:



**Figure 3.6: Application Migration Stream Deliverables**

**Table 3.11: Migration Stream Project Deliverables**

<b>Project Phase</b>	<b>Project Deliverable</b>	<b>Summary of Content</b>
Envision	Vision and Scope document for Application Migration and Customization stream (this document).	An envisioning document, containing the vision, requirements, project scope and high level solution approach.
Plan	Functional Specification for Application Migration and Customization stream	Document reflects in-scope requirements gathered applicable to the application migration stream as a whole. This will be used as the Business Requirements Specification (BRS) required by the COJ project process.
Plan	Wireframes/Mobile Wireframes	Up to twenty (20) browser wireframes and twenty (20) mobile wireframes will be provided for the external portal, and up to ten (10) browser wireframes and ten (10) mobile wireframes will be provided for the internal portal. Document reflects how the key pages are laid out as per workshops.
Plan	Visual Graphic Designs (x2)	A single design in a series of visual design screens that shows the key pages of the portal. The design uses the artefacts (images, logo, logotypes photo...etc.) and confirm to branding provided by City of Johannesburg. There will be 2 designs, 1 for the external portal and 1 for the internal portal.
Plan	Secure Development Lifecycle (SDL) document	The summarized guidance of the SDL training workshop. In addition, creating a formal security support portal to provide a centrally controlled, but broadly distributed means to share security-related guidance.
Plan	Application Migration Traceability Matrix	Provides a control mechanism for managing the overall migration project. Document traces the process, constraints and decisions made for migrated applications from the assessment and through production deployment.
Plan	Application Migration Analysis document (AS-IS); a document per wave or per application as necessary	Provides a detailed view of the application data, code constructs, access controls and usage for inputs into definition of migration designs. Document will contain the features, constraints and relevant variables for the migration design.
Plan	Application Migration Design (TO-BE); a document per wave or per application as necessary.  Due to the size and complexity of the document, the document will be split into two separate documents, namely a High-Level TO-BE design document per wave, and a Detailed TO-BE design document per wave (only exception is the extranet TO-BE design which is delivered in a single document)	Provides definition of the target application and data environment, high-level functional specifications and details the mechanisms to be used for migration. Document describes how applications will behave in the new platform in terms of functional, integration and user experience elements, and how the applications will be migrated. Technical application designs provide detailed specifications of the target data locations and sources, functional applications components, user interface definitions and security constructs. Document contains the technical dependencies and factors that will be enabled to migrate application into a production environment.



<b>Project Phase</b>	<b>Project Deliverable</b>	<b>Summary of Content</b>
Build	Architecture and Design Specification for Application Migration and Customization stream	A detailed design document providing a conceptual, logical and physical architecture and configuration related aspects based on the Functional Specification document for pre-production and production environments. Document describes the design/architecture of the solution including a logical and physical architecture depicting the layout and configuration of all in scope components.
Stabilize	Test Plan	It will includes the test scenario / test cases unit/functional/integration testing for each product implemented within the production environment. Test Plans define the approach to testing, test participants, test methodologies, testing participants, test locations and dates. Word document describing how and what testing will be done and by who.
Stabilize	Test Cases	Test Cases define the use cases to be tested and define the inputs, test scenarios and expected outputs. Excel sheet describing UAT test scenarios and test cases. These will be based on the functionality breakdown in the Functional Design document.
Stabilize	Test Report (of Test Results)	Test Results document the outcomes of each test conducted, inclusive of pass/fail of testing and noted defects raised during testing.
Deploy	Application User Guide	Documentation defining operational use procedures for applications, for reference by end-users.
Deploy	Application Training Guides (high/medium complex applications only)	Documentation providing step-by-step instructions for accessing and using applications, with accompanying narrative relating to the rationale for use of application features.
Deploy	Application Trainer Guides (high/medium complex applications only)	Enhanced application training guides with additional annotations providing instruction to trainers in presentation of training to end users.
Deploy	Deployment Guide for Application Migration and Customization stream	Basic step-by-step user guide document on how to deploy the custom solutions and platform environments.
Deploy	Operations Guide for Application Migration and Customization stream	Document describing the routine tasks to operate the platform for each product implemented within the solution based on standard operational guides provided by Microsoft's web site. Operation guide that provides information about the environment administration policies and system maintenance for the deployed server technology in Production Environment.
Deploy	Technical application design (AS BUILT); a document per wave or per application as necessary	Technical document detailing the technical production environment of the application. Includes identification of servers, locations of executable files, code versions, database locations and access controls.

**Initially these deliverables will focus on the e-Services group of applications or wave to be migrated, but will develop over time to include**

**the balance of the applications included in the other waves in scope of this project.**

### **3.3.3 Project Description and Scope**

#### **Assessment of non-SAP applications:**

In addition to the current Dell/Quest tool that will be run to provide an in-depth assessment of all the Domino applications that have been identified and grouped into the various project waves mentioned earlier in the document, the project team will conduct the following additional manual and automated assessments of the COJ environment in order to produce a comprehensive list of in-scope active and inactive applications that will be migrated on to the new platform by the application migration stream as well as to highlight any additional active or inactive applications which may be identified during the assessment:

- **MAPS (Microsoft Assessment and Planning Toolkit):**
  - The Microsoft Assessment and Planning (MAP) Toolkit 9.2 is an inventory, assessment, and reporting tool that will help the COJ and the project team to assess the current COJ IT infrastructure and determine the right Microsoft technologies for the COJ IT needs.
  - The MAP Toolkit uses Windows® Management Instrumentation (WMI), Active Directory® Domain Services (AD DS), SMS Provider, and other technologies to collect data in the COJ environment and inventories computer hardware, software, and operating systems in small or large IT environments without installing any agent software on the target computers.
  - This assessment is being performed through a combination of face-to-face meetings, automated tooling and physical checking of the servers through interactive logon to them.
  - As part of the automated tooling assessment, the Microsoft Assessment and Planning Toolkit will be used to scan the COJ data centre networks in order generate a list of systems.
- **System Centre Reporting:**
  - Project team will use the Microsoft Assessment and Planning MAP Toolkit to gain an insight into the server and application landscape. The rationalization will require:
    - The installation of MAP on a server
    - The creation of a Microsoft CRM Online trail instance (a cloud service will be used for the rationalization – low impact data such as application name, version, and total number of applications is sent)
  - Network and account access will be required to inventory servers using MAP

- Inventory data will be processed:
- Rationalization: the data that has been collected is initially rationalized by removing noisy applications (drivers, etc.) that are discovered.
- Categorization by type: Servers, server roles and applications are categorized “by type” (i.e. Microsoft vs Third-Party vs Custom applications).
- System Catalogue: Systems are a collection of servers and applications that relate to a particular business solution.
- Manual checking of all applications with certain business owners to ensure a final list can be drawn up from all these assessments.

**Scope:**

The scope included the migration of all the Non-SAP applications listed in Addendum A, which will be either retired, modernised, re-written, or migrated to the new Microsoft CityNext platform.

- For the e-Services migration “wave” specifically, which is already completed and used in this case study, the following were covered:
  - Migration of the existing e-Services’ portal’s static content to SharePoint 2013.
  - Redesign of the portal’s User Experience, to refresh the design and to support smartphones and tablets via a responsive design. The mobile platforms and browsers that will be supported will be fully defined in the Architecture and Design document deliverables.
  - Migration of the user base against which access to the portal is controlled, with user accounts stored in Active Directory Light Directory Services and user profiles stored in XRM.
  - Migration of the “User Registration” application in its entirety.
  - Migration of the user interface pages for the “Account by email”, “Corporate GIS”, “Online Maps (GIS)”, “Building Plan Progress” and “Valuation Services” applications only. Later “waves” may migrate the back-end and data components of the application.
  - Updating “Account by email” delivery data in SAP.
  - Updating the “Corporate GIS” user interface pages to reference the newer ESRI GIS platform rather than the current platform (project team will also need to clarify if the Corporate GIS platform can work with the e-Services portal user base, rather than having a separate user base).
  - Enhancement of the e-Services portal logic to retrieve eStatements from cojestatements application via web services rather than

redirecting the user to the cojestatements web site, as is done on the current portal.

### **Completion Criteria**

The e-Services migration “wave” will be considered complete once the following have been satisfied:

- The same functionality and content available to citizens on the current Domino- and WebSphere based e-Services portal is available on the new Sharepoint 2013 portal, hosted by the CityNext platform.
- The New e-Services portal utilises a new responsive design, which supports the defined set of mobile devices.
- The e-Services User Guide and Training Guide have been completed.

### **Constraints**

Progress and completion of the e-Services migration “wave” has the following constraints:

- Involvement of the relevant application owners is crucial to ensuring the functionality of each application is correctly defined, the relevant dependencies are accurately identified, and application test cases cover all use cases.
- Deployment of the required platform components in the development, test, pre-production and production environments in preparation for the appropriate deployment stages of the e-Services portal and applications.

### **Impacts**

During the migration process, COJ employees will be responsible for maintaining the e-Services portal and content managers will need to be trained in the use of the application. Once the migration process is complete and signed off the existing e-Services portal will also need to be decommissioned.

### **Measures of Project Success**

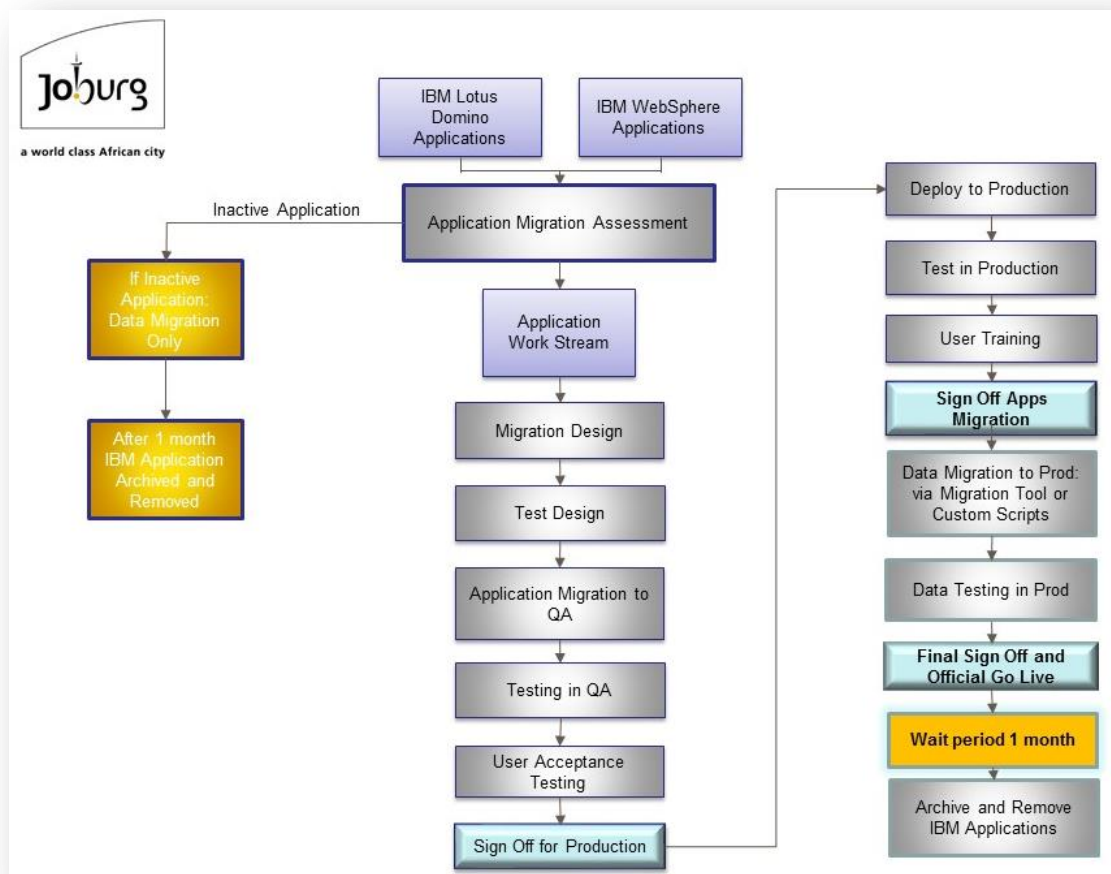
Each migration “wave” will be considered a success if the related completion criteria (as defined earlier in this document) have been met, if the implemented components have functioned for a month without issue, and if this has been achieved within stated timelines.

### **Planned Approach**

Due to the large number of applications to be migrated, e-Services being the first one, a big-bang approach to the migration is not feasible. These applications will therefore be grouped logically together to form migration “waves”, and each “wave” will be taken through the following process:

- Analyse each application in the “wave”
- Design the implementation of these applications on the new platform
- Performing the migration effort in the development environment
- Perform functional testing the “wave” of applications in the test environment
- Perform user acceptance testing of the “wave” of applications in the pre-production environment
- Create user and training guides for the applications included in the current “wave”
- Deploy the “wave” of applications to the production environment
- Monitor the “wave” of applications in the production environment for a month

The following image illustrates the migration process:



**Figure 3.7: Planned Migration Approach**

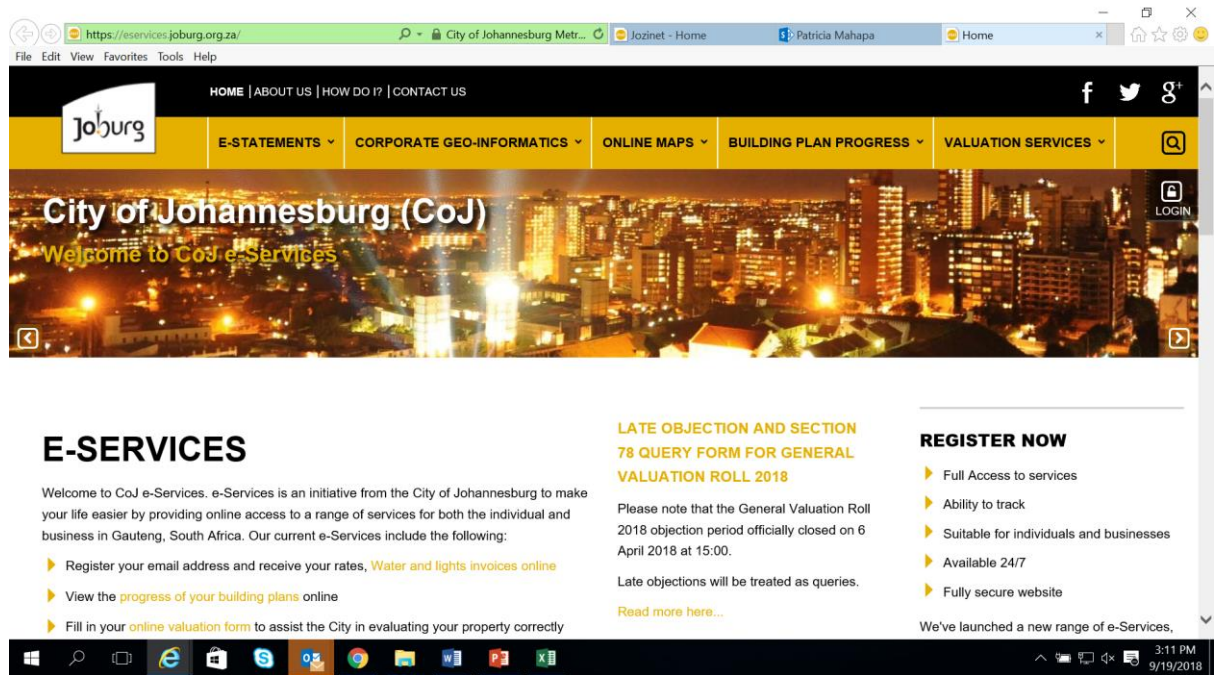
For the e-Services migration “wave” the planned approach is to make use of Microsoft SharePoint 2013 as the primary platform on which e-Services will be

hosted. This platform will provide the content and document management functionality that the City of Johannesburg will be able to use to maintain and grow the content available on e-Services. The e-Services applications will also be hosted in SharePoint 2013, as provider hosted applications, and will make use of Active Directory Lightweight Directory Services (AD LDS) for user accounts and XRM for user profile information. Where the applications need to interact with backend systems they will do so via the Microsoft BizTalk Server platform. In cases where latency is an issue, however, the applications may need to access application data directly and will do so using an appropriate data access technology.

#### **3.3.4 COJ E-Services Modernised Solution:**

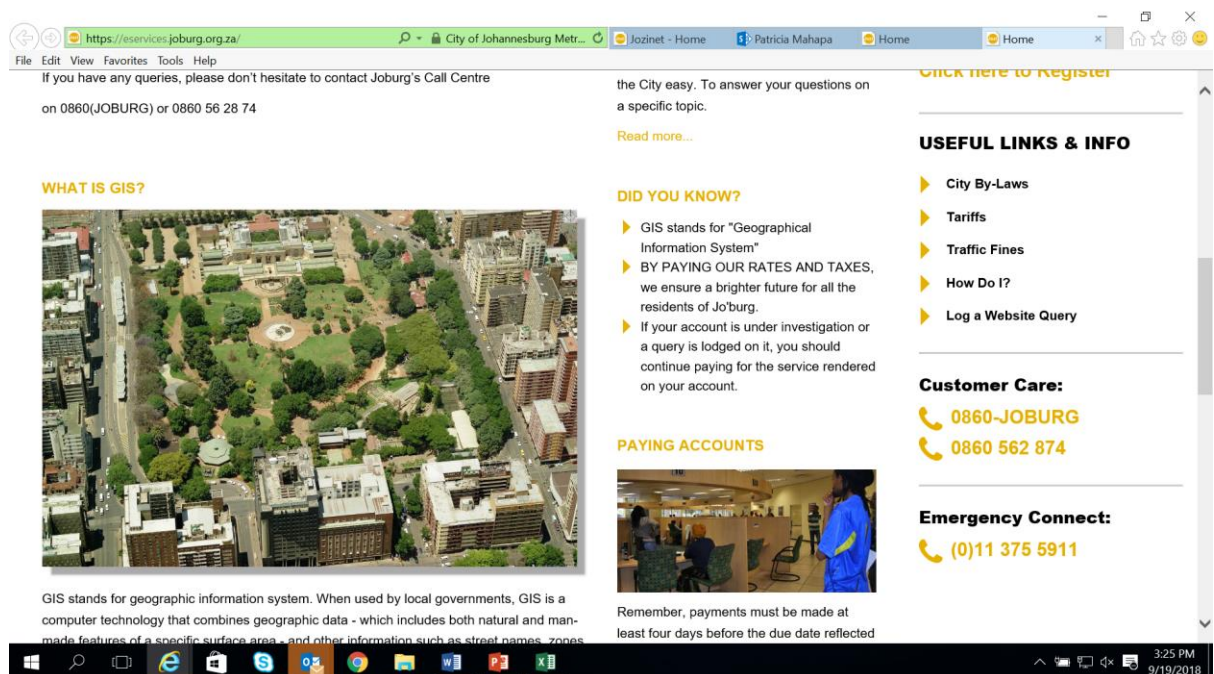
The following is the current home page of CoJ modernised e-Services solution. The e-Services solution went live 2017 October. Below is the analysis of the modernised SharePoint e-Services solution running on a New Microsoft CityNext Platform. It has replaced the old Domino Websphere that has now been decommissioned.

Figure 3.8: E-Services Home Page\_1



Source: <https://eservices.joburg.org.za/>

Figure 3.9: E-Services home Page\_2



Source: <https://eservices.joburg.org.za/>

## Chapter 4: Data Presentation and Analysis

### 4.1 Challenges vs Benefits Alignment

Analysis from data collected from project documentation, to assess whether the project will address the current challenges experienced by CoJ due to Legacy systems.

The top part represents benefits expected by CoJ after modernising the current legacy environment under the scope of the project surveyed. The right –hand side indicates the challenges experienced due to legacy Applications. The ticks indicate where the project is addressing the challenges and also showing what benefit is addressing the challenge identified.

**Table 4.1 Challenges vs Benefits Alignment**

	Introduce citizen-centric & service-oriented user experience	Empower CoJ employees with enterprise-grade solutions	Reduce reliance on service providers	Improve access and identity management	Improve operations and support management	Improve agility and responsiveness
Applications are running in silos;		✓		✓		✓
Applications are focused on internal use and only addressing parts of the business requirements	✓	✓				✓
The ICT department has huge challenges in monitoring the applications availability, challenge in operations, applications performance and service level agreement resulting in end user dissatisfaction					✓	
User satisfaction is very low due to complexity, availability and poor performance;	✓	✓				
Applications are running on obsolete technologies with very high costs to maintain and support;			✓		✓	✓
There is a lack of integration and information sharing between applications;				✓		✓
Audit trail features in the applications are not standardised and some applications lack any audit trail features;		✓		✓	✓	



**Table 4.2 Challenges vs Benefits Alignment**

	Introduce citizen-centric & service-oriented user experience	Empower CoJ employees with enterprise-grade solutions	Reduce reliance on service providers	Improve access and identity management	Improve operations and support management	Improve agility and responsiveness
Data accessibility is restricted resulting in challenges relating to reporting and business intelligence;	✓	✓		✓		✓
Wide spread duplication of applications resulting increased maintenance costs and complexity;		✓			✓	✓
There are no reference architecture guidelines resulting in lack of standardisation and governance on applications framework		✓				✓
Lack of skills and readiness of the IT department employees to operate and maintain the current environment with heavy reliance on specialised IT skills for application operation and maintenance;			✓		✓	
Inability to incorporate modern application features to existing applications without the need to rewrite the entire application again; and	✓	✓		✓		✓
Lack of centralised Security, Identity and Access Management.				✓		
Data accessibility is restricted resulting in challenges relating to reporting and business intelligence;	✓	✓		✓		✓

#### 4.2 E-Services Value Realisation Analysis.

This is based on the data analysed from the e-Services solution. The usage report is generated from the website reporting tool and it collects data about registrations, existing users, new visits etc. The data was analysed and interpreted below.

##### 4.2.1 E-Services Website Stats for June 2018

- **Comparison between Old e-Services daily unique visits vs New e-Services daily unique Visits**

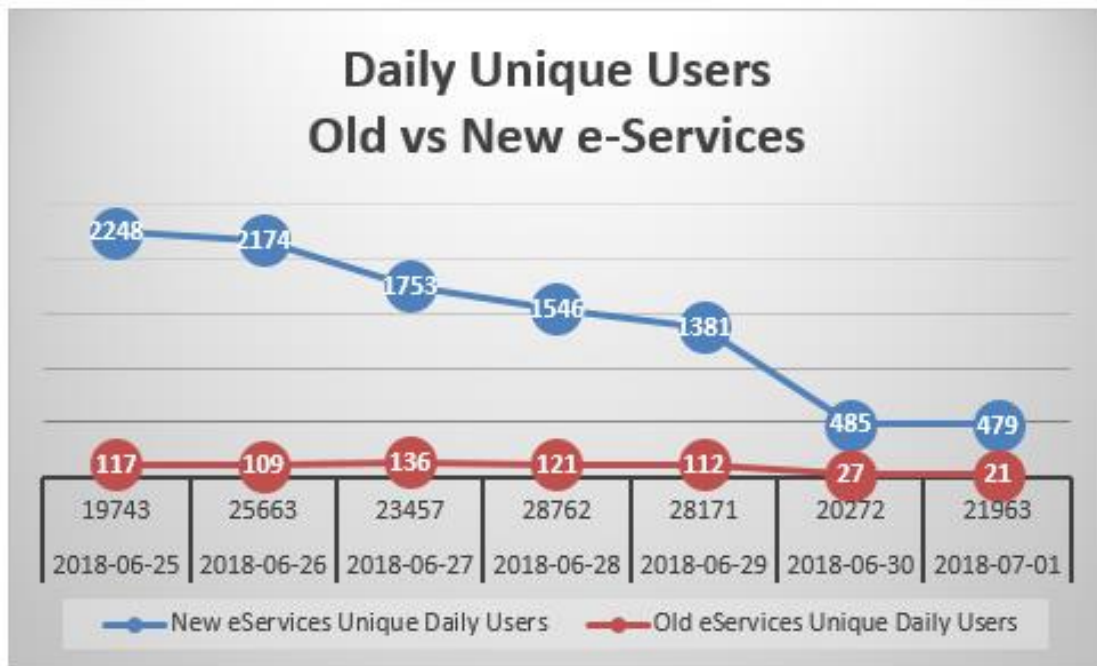
This shows an increase in Daily Usage – Unique Users – Compared to old e-Services Site.

**Table 4.3: Unique visits per day (Old vs new E-Services)**

Day	Hits	Unique Users
2018-01-22	13537	1399
2018-01-23	13498	1135
2018-01-24	15251	1440
2018-01-25	15091	1544
2018-01-26	13619	1254
2018-01-27	5819	392
2018-01-28	6107	429
2018-01-29	16357	1730
2018-01-30	14629	1470
2018-01-31	15717	1574

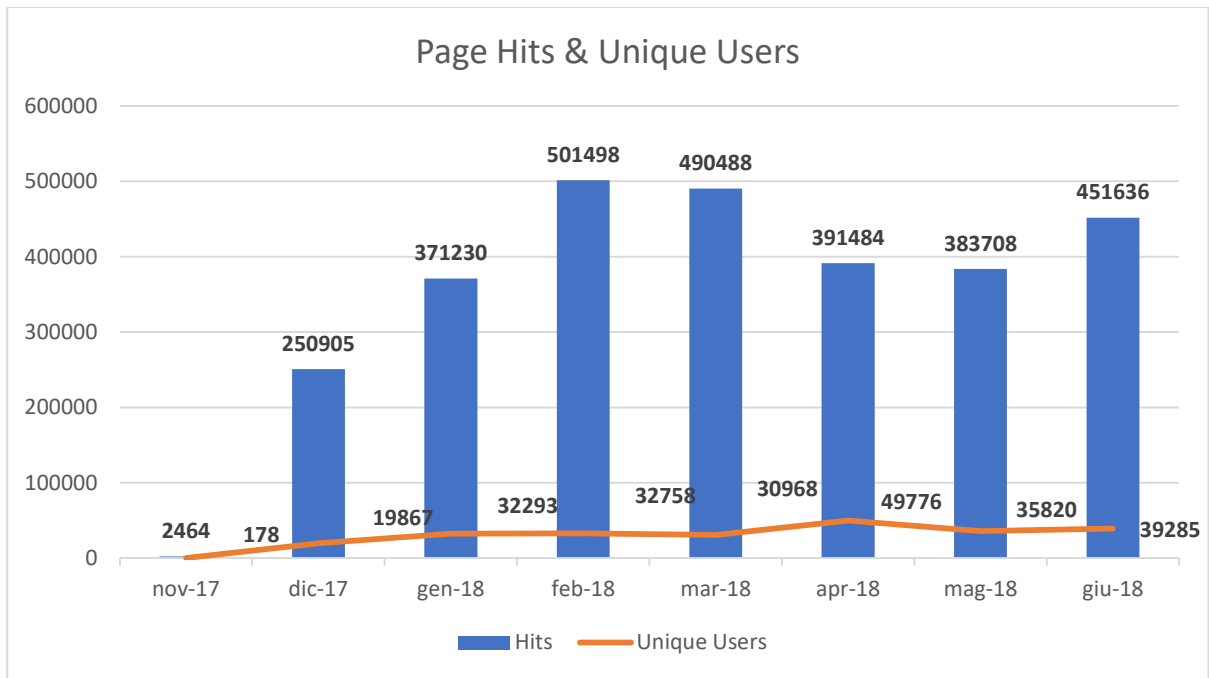
  

Unique Visits per day on old e-Services	
16 Oct 2017	117
17 Oct 2017	109
18 Oct 2017	136
19 Oct 2017	121
20 Oct 2017	112
21 Oct 2017	27
22 Oct 2017	21
23 Oct 2017	94
24 Oct 2017	111
25 Oct 2017	91
26 Oct 2017	105
27 Oct 2017	88



**Figure 4.1: E-services Hits and Unique Site Visits**

Daily unique visits to the new e-Services has increased from an average of 120 to 1800 per day since the launch of the Modernised e-Services Website in November 2017.



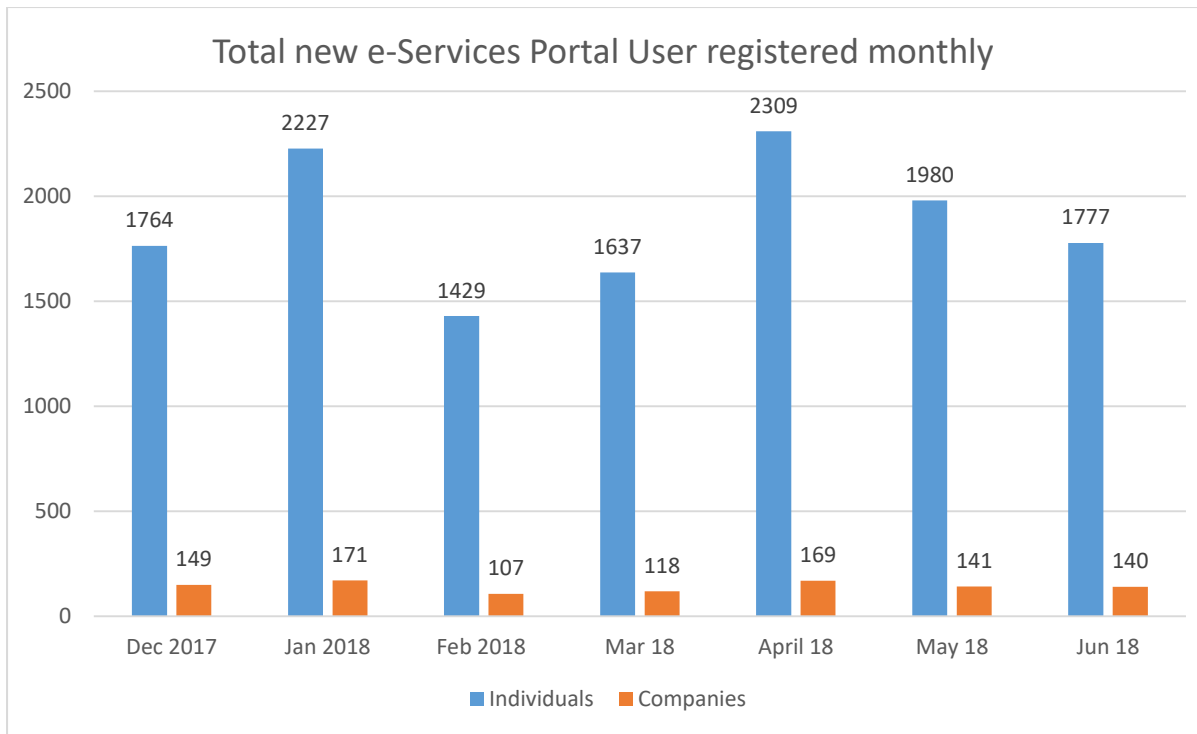
**Figure 4.2: E-services Page Hits & Unique Users**

In total the CoJ has 439 025 registered users on the e-Services Website who logs in with a username and password.

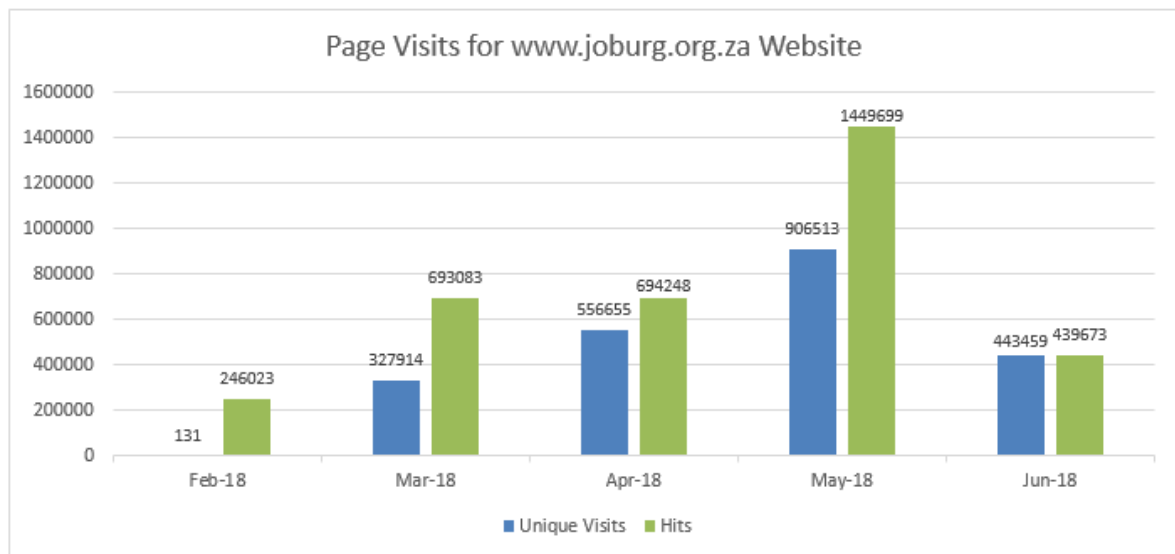
An average of 1 800 new users register monthly on the new e-Services Website.

Daily unique visits to the new e-Services has increased from an average of 120 to 1800 per day since the launch of the Modernised e-Services Website in November 2017.

*The graph below indicates the total new users registered in a month on e-Services platform.*



**Figure 4.3: Modernised E-Services Monthly Registrations**



**Figure 4.4: Modernised Website Hits and Unique Site Visits**

The new Joburg website serves as a gateway for citizens to access E-services. The visit to E-services means that citizens have to first visit Joburg website. Since the lounge of E-service, the website saw a tremendous increase in unique visits and hits.

## **4.2 CoJ Modernisation Project Focus Group: Project Evaluation**

There were 9 participants in the focus group as follows: Project Manager, Web administrator, Applications Management Support Specialists (2), Change Management Consultant, and Systems Trainers (4).

The participants brought their varied analysis based on their experience on the project, see minutes on appendix D. Management support specialists and web administrator provided a rationale for modernisation supporting what is in the business case, as they support business and external customers and citizens. They also from the support perspective can see lots of improvements based on the queries they used to get and now. They could testify that the new e-Services and platform have addressed the challenges business used to experience, and is far much advanced and user friendly.

Project manager helped in clarifying most of project documents, provided necessary reports and gave background on the project. All members contributed to the journey and lessons learned, and what could be done better next time, see appendix D. Change management and trainers helped in giving the analysis on adoption rate, the positive culture change, utilisation of the tools and the transition from old to new technology, which has been positive. Training and change management made it much better for people to adopt the new technology faster.

## **Chapter 5: Findings, Interpretation and Recommendations**

### **5.1 Introduction**

This research's focus was to show that modernising your business environment can benefit business, and make an organisation perform better. The research did so by analysing relevant literature, modernisation project documents of CoJ, a case study, and analysing the statistical results and comments from the CoJ focus group, which show that there is improved customer experience, a lot of benefits realised within one year of going live with a new technology. The results showed that modernisation indeed address legacy challenges and make business perform more efficiently. The statistics results also showed high customer retention and increased market share. The Literature review also covered a lot of modernisation aspects and strategies that any organisation can use to modernise their environments to ensure benefit realisation.

### **5.2. Summary of the Research Findings and Interpretation**

The data gathered and analysed shows that the COJ modernisation though managed to partially implement its modernisation strategy covering the platform, the extranet and e-Services waves, it's already realising value (Chapter 4). It also shows that the modernisation initiative is aligned with the benefits expected. This will encourage the organisation to channel their efforts and budget to address the remaining scope in all Domino Legacy Applications (see Addendum A), which should also be modernised and be migrated to the newly implemented Microsoft CityNext platform. The result shows that a modernisation investment is a necessity for any organisation to address legacy challenges and improve performance.

The research results showed that there is an alignment between a modernisation initiative benefits and the challenges of legacy systems, meaning the challenges have been addressed. This means less technical issues, and more business hours, which also means increase in productivity. The results also showed increase in market share and most positively customer retention. This can mean customers are happy and more customers are now attracted to use CoJ services on e-Services

platform as a result of the modernised technology. In monetary terms this means increased in revenue, so the results show that there is already financial and non-financial benefits, i.e. improved customer experience coming with new technology (non-financial) and increased market share and customer retention, meaning increased revenue collection (financial benefits).

The overall results show a trend of continuous improvement daily and monthly, meaning high utilisation of services migrated on e-Services. It also shows that the modernised solutions have attracted more people not only to e-Services, but to the organisation as a whole. On the websites, which is also new, there are more hits, people seeing the organisation as a whole as we see more hits on their website monthly and more unique users as well. This can be interpreted as the new modernised solutions has also gave a boost to COJ brand image that is attracting more new customers, while retaining the old.

The company can now migrate more services to the e-Services platform to take advantage of these 439 025 customers who have already registered for their online services, plus the growing 1800 per day experienced by CoJ since the launch of the Modernised e-Services. This shows that modernised technology indeed can enable an organisation to retain customers and also grow market share. The growth of 120 to 1800 per day from November 2017 to June 2018, (in 7 months) is a much significant growth. This growth is more than enough to convince any executive of a company that modernised technology is a worthy investment, and can turn your business around.

This is a motivation for more budget to be used to modernise the rest of legacy systems in CoJ since the entire organisation is using outdated technology. This is a motivation that it will not be a fruitless exercise, but will take the organisation to a new level and bring more value and also improve the way CoJ does business. With such benefits realised and improvements within a short space of time, it shows that Modernising your technology is not a fruitless expenditure, but will indeed boost any organisation's image and performance.





## **5.2 Recommendations**

### **5.2.1 Recommendation 1: Lay Infrastructure and Network Foundation for Modernisation.**

IT is obvious that no system or application can work or perform optimally if the network is poor, interrupted or unavailable. It is also true that no server infrastructure can be accessible to applications or any system if the network is unavailable or poor. So it is important that CoJ or any organisation that wants to see maximum value in also invest in network improvement projects to ensure a reliable network at all times. This will ensure maximum support of all ICT resources and modernised systems and enable realisation of the full value of modernisation.

It is also important to ensure that the capacity of the servers hosting the applications and systems is sufficient to avoid system crashes. Finally, that all the legacy systems are modernised and migrated to the new platform to accommodate modern technology and integrations, aligned with new ways of doing business.

### **5.2.2 Recommendation 2: Have a Suitable Modernisation Strategy.**

Organisations today understand that if they are not evolving to more modern business solutions they are falling behind. A suitable legacy modernisation strategy is crucial for maximizing the value of any business's existing investment in business systems, applications and technology platforms, reducing the total cost of ownership of those technologies, and developing the agility to bring IT investments into alignment with business imperatives.

Legacy modernisation provides many choices and can take several forms, including systems integration, application replacement, application and data migration, and application redevelopment. These choices can be used individually or in combination as we have seen from the CoJ study. The old Domino WebSphere was replaced by a modern Microsoft SharePoint. Data from old e-Services was migrated to the new e-Services as a valuable business asset. The new CityNext platform allows integration of systems through the Biztalk layer.

### **5.2.3 Recommendation 3: Have a Suitable Modernisation Approach.**

Every business needs a suitable business modernisation approach to address its challenges, so it is recommended that a thorough assessment of your legacy

environment be done using proper tools like what CoJ did. By so doing the organisation will know what to re-use, replace or modernise. No matter which product vendors to be aligned with, to ensure an agile and scalable business solution, the first step should be to establish a target architecture around a robust and stable application integration strategy. This application integration approach will likely be used both during a transitional implementation and for the final implementation.

- The integration approach should be based on standards-based solutions that support vendor interoperability and independence, broader availability of skills and tools, and a longer lifetime.
- Emerging trends such as Software as a Service (SaaS), Virtualization, Open source etc. should be considered.
- A loosely coupled, service oriented integration infrastructure – A Service Oriented Architecture (SOA) provides agility for mid-stream adjustment to the modernisation effort and long-term agility that allows you to integrate new packaged and custom software as needed.
- It is important to build in architectural capabilities at the foundation - characteristics such as scalability, reliability, maintainability, availability, extensibility and security are expensive or infeasible to add in later.
- Establish a common IT asset governance model over integration practices – this ensures reusability of integration processes and best practices within and across applications. Myopia during the development of individual applications or services is one of the biggest impediments and hidden cost factors in modernisation and integration efforts.
- Alignment with widely established enterprise architecture models will allow separation of application functionality and component reuse for long-lived solutions vs. applications built with broad and hybrid responsibility. Flexibility and agility to create composite applications in the future will be greatly increased.

#### **5.2.4 Recommendation 4: Consider Adopting a Reference Architecture Model.**

A Service Oriented Architecture (SOA) reference model is an architectural style that enables the integration of your business as linked services. You can build, deploy, integrate and reuse these services, drawing on existing custom or package applications to deliver their required functions. By combining functionality that originates in separate systems and exposing it as a single service, you can reduce system complexity and eliminate redundancy. (IBM, 2017:2)

The reason the SOA model is recommended is that , when implemented, the applications will be less expensive to maintain, more flexible, better able to accommodate new requirements and easier to leverage across the organisation and with external stakeholders. Best of all the applications will be able to handle the planned business growth.

#### **5.2.5 Recommendation5: Consider Deploying Broadband Networks**

When considering the implementation of a smart ICT plan for an organisation, the first step for any policymaker is to foster the development of a rich environment of broadband networks that support digital applications, ensuring that these networks are available throughout the City and to all customers or citizens. (Komninos, Pallot, & Schaffers, 2013)

This plan for easy access to broadband should include a broadband infrastructure that combines cable, optical fibre, and wireless networks. This will offer maximum connectivity and bandwidth to customers and organisations located in the city. The latest broadband service is fibre-optic, which is the fastest Internet connection available. However, in many places this type of Internet service is still in its infancy (Taylor & Schejter, 2013).

Expanding this service across a City is an essential part of any Smart City agenda. With these fibre-optic cables connectivity increases in critical areas around the City such as universities, business centres, technical and research institutes, government offices and emergency response units. These fibre optic

networks are fundamental in acting as a backbone for ensuring high-speed access to the Internet. Additionally, they facilitate the installation of sensors<sup>4</sup>, which are key to the development of intelligent solutions for the City. They also ensure access to any electronic public services that the city plans to offer its constituents (Bakici, Almirall, & Wareham, 2013).

The long term goal of setting up such an infrastructure is to facilitate broadband access and ensure is widespread enough, an open broadband network that the entire city population, i.e. organisations, companies, municipalities and individuals can use. This widespread availability of fast Internet speeds has often been shown to lead to the development of innovative approaches to particular social challenges and to the establishment of new businesses and business models (Komninos, Pallot, & Schaffers, 2013).

#### **5.2.6 Recommendation 6: Consider the Use of Smart Devices and Agents**

The second step for smart city planners to consider when implementing a smart ICT plan for a City is to ensure that the physical space and infrastructures of the City are enriched with embedded systems,<sup>5</sup> smart devices, sensors, and actuators,<sup>6</sup> offering real-time data management, alerts, and information processing for the City administration. The presence of these devices combined with wireless connectivity throughout a City facilitates a richer and more complex digital space within the City, which in turn can increase the collective embedded intelligence of a City.

This collective embedded intelligence allows relevant stakeholders of the City to be informed about the City's physical environment and facilitates the deployment of advanced services like spatial intelligence. It also paves the way for developing other innovative ecosystems that help to link the City with its people and visitors through technology.

#### **5.2.7 Recommendation 7: Consider Developing More Web-based Applications and e-Services.**

The availability of ubiquitous ICT infrastructures like those discussed above stimulates the development of new services and applications by various types of

users, and allows for the gathering of a more realistic assessment of users' perspectives by conducting acceptability tests directly on the infrastructures already in place and functioning in the Smart City.

Smart cities commonly deploy online services across different sectors of the City, for instance a City airport will require different e-Services to a City hospital. Smart City e-Services include services for the local economy and its development, tourism, the City environment, its energy and transport services, security services, education and health services and so on. Horizon 2020, the most recent EU research and innovation framework supports the development of such e-Services as part of its objective to meet a range of pertinent societal challenges currently faced by Europeans.

The Horizon 2020 framework aims to help European governments engage further with their citizens and local businesses by enabling governments to more easily create their own e-Services through the use of open source ICT tools and through access to research funds under the Horizon 2020 framework. Governments are aware of the increasing role technology plays in the business sector and in the economy in general. As a result, they are looking to create digital strategies, which maintain or increase the country or region's competitiveness. One critical element to this strategy is to ensure that their constituents possess the adequate skills to compete in the digital world (Government of Canada, 2010).

Going forward CoJ can learn from such EU 2020 Framework initiatives discussed above and extend their e-Services functionality and usage. It can also expand its services and include building management services like smart meters and monitoring devices to help monitor and manage water consumption, heating, air conditioning, lighting and physical security.

ICT services can change the way citizens work by providing remote working and e-commerce services for businesses, entertainment and communications for individuals. Integration of the e-services is a key-factor, enabling the above processes to work together and create environments more efficient in collaborative problem-solving and innovation (Komninos, 2006). Innovative entrepreneurs and

start-ups should be encouraged and supported to leverage these original technologies and adapt them to offer novel services to the citizens and businesses of the City.

### **5.2.8 Recommendation 8: Have a Checklist for your Modernisation Project**

For every organisation to ensure a successful modernisation project, have a checklist that will guide you throughout the process. The following is my recommended one from AltexSoft Whitepaper (2018:5), which can help you to ensure the process run smoothly. AltexSoft lists 7 things you must consider, of which most of them have been covered in this study, and also applied on the CoJ project, they are as follows:

- ✓ Assess the current state of legacy systems.
- ✓ Select the modernization method that would be the fastest to deliver value.
- ✓ Rethink the architecture and prioritize for simplicity.
- ✓ Choose the technology stack to deliver optimal performance and user experience.
- ✓ Document for future system growth.
- ✓ Create a separate support and retirement schedule for your legacy system.
- ✓ Budget for training and system updates.

## **6. Directions for Future Research**

Opportunities for future research will be to mature the value realisation framework that will quantify the value realised into monetary value. It is clear on the results analysis that market share increase is represented by more customers, which means more revenue collection. It is clear that legacy challenges addressed means less business interruptions and more business up time, meaning productivity and revenue increase. Right now the research shows that there is customer retention and there is also a continuous increase in market share that can even be quantified on modernised solution. Future research can be directed to, how much of a value, in monetary terms can these benefits amount to? Data can be collected and analysed to show this. Also in future, data can be collected that will indicate reduction in cost of maintenance on the modernised solution versus old technology.

## **7. Limitations of the Study**

The limitation of the study was time and cost which channelled the selection of the data collection methods used. It was not possible to wait until all the phases were completed to assess the results of the entire project as it was going to be long, costly and time-consuming as the scope was also going to be too big. The approach used however showed that the completed phases surveyed were sufficient and cost effective enough to show the positive results and benefits of modernisation.

## **8. Conclusion**

This report outlines what modernisation is, its strategies, approaches and benefits. The study reviewed various literature about the topic to answer the research question. It also analysed a modernisation project, and its related documentations. It also used as a case study method to unpack the modernisation initiative carried out by CoJ in order to address the challenges of legacy systems. It also shows the value modernisation can bring to the organisation and present the results of the case study and the data collected about the modernised solution, make interpretations of the findings.

To assist CoJ, and other organisations that may be faced with legacy systems challenges, the report presents detailed recommendations that can aid a successful modernisation initiative, taking into cognisance the literature reviewed and the CoJ case study. Direction for future research that may help extend and contribute to the study, was also presented.

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## **Appendices**

**Appendix A: Project Registration Form with background, Objectives, Milestones and Deliverables**



a world class African city

## PROJECT REGISTRATION FORM

<b>FOR OFFICE USE ONLY:</b>			
Project Registration Number:		Registration Date:	

<b>1. PROJECT DETAILS:</b>			
1.1 Project Name:	Non SAP Application Modernisation	1.2 INC Number:	
1.3 Project Manager:	Richard Nene	1.4 SOW Number & Date	
1.3.1 Contact Details:	(011) 0186320		
1.5 Project Sponsor:	Tumelo Kganane	1.6 Project Customer:	CoJ
1.7 APPROVALS:	EAC	1.7.1 PMREC Approval Date:	
1.7.2 BRS Approval Date:	N/A	1.7.3 Approval Date:	

<b>2. PROJECT INFORMATION:</b>			
2.1 Project Start Date:		2.2 Proposed End Date:	
2.3 Project Estimated Cost:			
2.4 Project Background	<p>“As the City of Johannesburg grows, its business requirements and needs also grows. The City of Johannesburg strives to become a smart city, by providing services that are easy to access and use, while being efficient, responsive – in open and transparent way and ensuring sustainability and the inclusion of environmental considerations. Application Development &amp; System Support (AD &amp; SS), is therefore responsible to provide an IT solution aimed at enabling this type of transformation the City plans to undertake in the foreseeable future.</p> <p>The City’s current application landscape consists of SAP and Non-SAP applications. Currently the Non-SAP applications are faced with various challenges calling for the modernisation of this environment. These applications automate and govern the core operations, so they must be well-aligned with the needs of COJ business in order to yield value.”</p> <p>The Non-SAP modernisation project should address the following challenges currently experienced by the Non-SAP environment.</p> <p><b>Technology Obsolescence which includes:</b> Outdated hardware, operating systems and applications platforms. Reliability concerns, increased outages, risk of fatal crash, unable to develop modern application features.</p>		



## PROJECT REGISTRATION FORM

	<p><b>Application Silos which include:</b> Monolithic design. Close coupling of UI, logic, rules and data. No re-use of code, large code base, complexity in support/maintenance, changes in business require major projects.</p> <p><b>Application Duplication:</b> Copies of applications to provide same functionality for other business units. Increased application footprint, increased complexity in support/maintenance, increased infrastructure requirement, difficulty in managing changes.</p>
<p>2.5 Project Objectives:</p>	<p>Thus, the main objective of the project will be to modernize the Non-SAP environment in order to meet the City of Johannesburg current and future business needs by providing:</p> <ul style="list-style-type: none"> <li>▪ Design, architect, build and deploy a scalable, highly available, and extensible and standardized IT platform that can host current and future workloads.</li> <li>▪ Upgrade and migrate the current Non-SAP applications, currently running in a Lotus Domino environment, into the new Platform.</li> <li>▪ Migrate the data from current Non-SAP applications, currently being hosted but not running in a Lotus Domino environment, into the new platform.</li> <li>▪ Reduce external service provider reliability and build the City's internal resources' capacity.</li> </ul>
<p>2.6 Project Deliverables / Milestones</p>	<ol style="list-style-type: none"> <li>1. Assessment (On site and Technical)</li> <li>2. Platform Implementation (IT Platform that can host current and future workloads)</li> <li>3. Application Migration (Design, test and deploy)</li> <li>4. Integration to existing and different technologies</li> <li>5. Archive and Remove Inactive Applications</li> <li>6. User Training</li> <li>7. Transformation Roadmap and Reference Architecture for future Applications</li> <li>8. Critical Support of the New Platform and Application Environment</li> <li>9. Documentation</li> </ol>
<p>2.7 Other Information:</p>	<p>In order to ensure business operations requiring access to and support of the Domino/WebSphere applications are not adversely affected during the migration project, it is imperative that provision is made for the continued support of the current platform and application environment.</p> <p>As applications are migrated to the new environment, it is equally imperative that provision is made for continued support of the new platform and application environment.</p>



**Appendix B: Old CoJ Legacy Applications – AS IS  
(Still to be modernised)**

System Name	Status	Development Software	Date of Implementation
Social Services Funding Database	Active	Lotus Domino R6	10/17/2005
Libraries DB & Jozinet Page	Active	Lotus Domino R5	9/1/2003
Building Plans Archive	Active	Lotus Domino R5	
Development Application System (TAS)	Active	Lotus Domino R6	6/24/2002
Development Application System (DAS)	Active	Lotus Domino R5	10/2/2000
GIS Projects	Active	Lotus Domino R6	3/17/2003
LIS - Deeds Enquiry	Active	Java	8/18/2003
GIS Fax Service	Active	Lotus Domino R6	1/26/2004
GIS Helpdesk System (Queuing)	Active	Lotus Domino R6	10/29/2004
GIS Amendment Scheme Search	Active	Lotus Domino R6	1/21/2005
GIS Questionnaire	Active	Lotus Domino R6	11/15/2006
GIS DB & Jozinet Page	Active	Lotus Domino R6	9/12/2005
GIS Workflow System	Active	Lotus Domino R6	2/20/2007
GIS IMS DB & e-Services Page	Active	Lotus Domino R6	10/6/2003
GIS - CIS	Active	Lotus Domino R6	10/16/2008 9:23
GIS DB & e-Services Page	Active	Lotus Domino R6	10/6/2003
LIS Production DB2 Database (Land Information Database)	Active	DB2	5/8/2007
GIS Problem Management System	Active	Lotus Domino R6	10/13/2008 16:02
Public Holidays	Active	Lotus Domino R6	6/6/2007

CGIS Homepage on Jozinet	Active	Lotus Domino R6	
SG Office xml interface	Active	Java	
Land Management System (LMS)	Active		
Building Plans (BAS)	Active	Lotus Domino R6	3/1/2003
Building Plans (BAS) - History	Active	Lotus Domino R5	6/30/2003
Law Enforcement System	Active	Lotus Domino R6	3/14/2005
LIS Admin Client	Active	Lotus Domino R5	
Community Development	Active	Lotus Domino R6	
Environmental Impact Management	Active	Lotus Domino R6	9/6/2004
Electronic Records Management System (ERMS) - JRAS	Active	Lotus Domino R5	5/24/2004
By-Laws	Active	Lotus Domino R5	4/28/2003
Electronic Records Management System (ERMS) - Group Communications	Active	Lotus Domino R5	5/17/2004
Organisational Structures on Jozinet	Active	Lotus Domino R6	10/22/2004
Procedures and Forms	Active	Lotus Domino R5	4/14/2003
Competitions	Active	Lotus Domino R5	9/22/2003
Newsletters	Active	Lotus Domino R5	12/8/2003
Jozinet Content Management DB	Active	Lotus Domino R6	4/7/2003
Public Liaison	Active	Lotus Domino R6	1/15/2007 10:50
Staff Vacancies	Active	Lotus Domino R5	8/19/2002
Corporate Identity	Active	Lotus Domino R5	8/11/2003

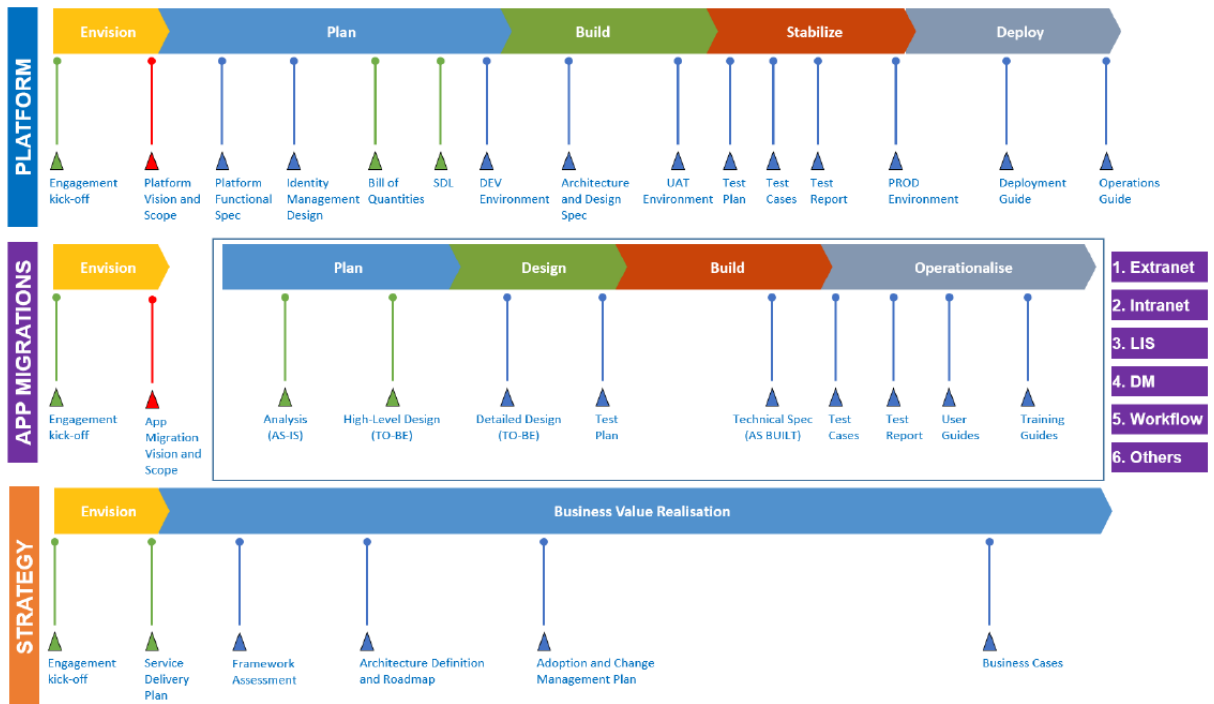
JoburgOpen Website	Active		
Advertisements	Active	Lotus Domino R5	8/19/2002
Jozinet	Active	Lotus Domino R6	4/7/2003
Message Mail Facility (COJ Message)	Active	Lotus Domino R5	9/27/2004
Fax, Private Line Information	Active	Lotus Domino R5	10/2/2000
Electronic Records Management System (ERMS) - Central (Group Corporate&Shared Services)	Active	Lotus Domino R5	3/24/2003
Management Decision Support System (MDSS) - Labour Relations	Active	Lotus Domino R5	5/31/2004
ITSPP's	Active	Lotus Domino R5	8/19/2002
ECD (External Customer DB)	Active	DB2	8/18/2003
Downloads	Active	Lotus Domino R6	3/15/2004
IT DB & Jozinet Page (GICT & IM Service Desk)	Active	Lotus Domino R6	5/21/2004
Statistics Viewer (Awstats for JoziNet & e-Services)	Active	Java	5/31/2004
Active Directory	Active	Lotus Domino R6	10/1/2004
Sametime	Active	Lotus Domino R5	1/6/2001
COJMessage / TeamIT	Active	Lotus Domino R6	
Masana COJ Invoicing	Active		

Trunk Calls and Fault Reports	Active	Lotus Domino R5	10/2/2000
City Surveys	Active	Lotus Domino R6	
Towns and Provinces	Active	Lotus Domino R5	10/18/1999
Jozi Address Book	Active	Lotus Domino R5	4/28/2003
Policies	Active	Lotus Domino R5	4/14/2003
HR Services (Employee Services on Jozinet)	Active	Lotus Domino R5	11/15/2005
Electronic Records Management System (ERMS) - Region C	Active	Lotus Domino R5	3/23/2003
Electronic Records Management System (ERMS) - Region E	Active	Lotus Domino R5	3/24/2003
Electronic Records Management System (ERMS) - Region A	Active	Lotus Domino R5	6/23/2003
Electronic Records Management System (ERMS) - Region D	Active	Lotus Domino R5	6/23/2003
Electronic Records Management System (ERMS) - Region B	Active	Lotus Domino R5	6/23/2003
Finance Forms Library and Process Documents	Active	Lotus Domino R5	
Electronic Records Management System (ERMS) - Revenue	Active	Lotus Domino R6	
Valuation Section 49 notices by e-mail	Active	Java	
Electronic Records Management System (ERMS) - Valuations	Active	Lotus Domino R5	6/23/2003
Valuations Web Page via e-Services	Active	Lotus Domino R5	5/3/2004
Data Search for Valuation Roll & Supplementary Roll	Active	Lotus Domino R6	6/21/2004
LIS - Valuations Workflow System (VWS)	Active	Lotus Domino R6	6/21/2004
Valuation Admin Database	Active	Lotus Domino R5	

Revenue SMS Service	Active	Lotus Domino R5	7/21/2006
Metro Cash Router (MCR)	Active	WebSphere v5@DB2	9/1/2001
CCMS City Power	Active	Lotus Domino R6	1/4/2005
CCMS Joburg Water	Active	Lotus Domino R6	6/9/2008 10:02
Correspondence System (Revenue) - Archiving	Active	Lotus Domino R5	8/19/2002
e-Statements	Active	Java	
Supply Chain Management Website (Current Tenders on Joynet)	Active	Lotus Domino R5	11/3/2003
Supplier Management Database	Active	Lotus Domino R6	4/3/2006
Committee System	Active	Lotus Domino R6	3/25/2002
Ethics Committee Councillor Declarations	Active	Lotus Domino R5	6/2/2003
Law Library Indexing System	Active	Access	
Services Directory	Active	Lotus Domino R5	6/16/2003
Committee Decisions (Archive)	Active	Lotus Domino R5	1/31/1998
Electronic Records Management System (ERMS) - JIKE	Active	Lotus Domino R5	5/24/2004
Joburg's Future	Active	Lotus Domino R5	7/21/2003
Electronic Records Management System (ERMS) - Health	Active	Lotus Domino R5	3/24/2003
Trade Licenses	Active	Lotus Domino R6	12/15/2003
Health Dispensary System - (Rx Solution)	Active	Lotus Domino R6	2/2/2004
Health Clinics and Services	Active	Lotus Domino R5	6/3/2003

Electronic Business Management System (EBMS) - Safety Health Environment & Quality (SHEQ)	Active	Lotus Domino R5	6/21/2004
Housing Waiting List	Active	Lotus Domino R6	4/2/2001
Housing Task Monitoring DB	Active	Lotus Domino R5	2/4/2005
Electronic Records Management System (ERMS) - Housing	Active	Lotus Domino R5	11/19/2004
Electronic Records Management System (ERMS) - City Manager	Active	Lotus Domino R6	2/24/2003
Electronic Records Management System (ERMS) - Office of the Speaker	Active	Lotus Domino R6	5/24/2004
Unicity Information Services	Active	Lotus Domino R5	8/16/1999
Public Participation DB	Active	Lotus Domino R6	3/11/2005
Speaker's List for Council Meeting	Active	Lotus Domino R6	4/19/2004
External Stakeholders DB	Active	Lotus Domino R6	6/10/2004
EMS Volunteers DB	Active	Lotus Domino R6	11/1/2004
Emergency Management Website	Active	Lotus Domino R6	
Fire Arms Management System	Active	Lotus Domino R6	10/1/2004
EMS Disaster Management Stakeholders DB	Active	Lotus Domino R6	11/1/2004
Electronic Records Management System (ERMS) - JMPD	Active	Lotus Domino R5	3/24/2003
Electronic Records Management System (ERMS) - Social Development	Active	Lotus Domino R5	6/23/2003
Facilities Management Service Requests	Active	Lotus Domino R5	7/7/2003
Online Parking System	Active	Lotus Domino R6	7/7/2003

# Appendix C: Project Scope and Deliverables



**Appendix D: Minutes of the Focus Group**





# Minutes

<b>Meeting</b>	COJ Modernisation Project Value Realization – Focus Group
<b>Venue</b>	Nande Boardroom
<b>Date</b>	31 Oct 2018
<b>Time</b>	02:00pm – 15:00pm
<b>Members present</b>	Patricia Mahapa (MP) (Chairperson) Lesego Letshwene (LL) (Project Manager) Leonie Pretorius (LP) (Web administrator) Keikanetswe Teme (KT) (Applications Management Support Specialist) Nthabiseng Mokoena (NT) (Applications Management Support Specialist) Nombeko Nhlapo (Change Management) Zuko Ngwabane (Systems Trainer) Nombulelo Tshabalala (Systems Trainer) Selloane Leisa (Systems trainer)
<b>Agenda</b>	<b>Modernisation Value Realisation</b> <ul style="list-style-type: none"> <li>• Background of the project</li> <li>• Previous challenges in the environment</li> <li>• Value/Benefits Brought by CityNext Platform and new Solutions</li> <li>• Lessons Learned from the modernisation journey</li> </ul>

No	Discussion/Resolution	Responsible person	Due Date
1.	PM opened the meeting and welcomed everyone and explained the reason for the meeting.		
2.	<p><b>Non SAP modernisation Background</b></p> <p>Tlhabologo project was initiated develop and roll out new CityNext platform, address IBM legacy Applications challenges in the Non SAP space and to migrate modernized Applications to a new platform.</p> <p><b>The objectives</b></p> <p>Built and deploy new platform</p> <p>Roll out new SharePoint solutions (e-Service, Intranet, Joburg website, document management)</p> <p>Rewrite other old applications in modern language</p> <p>Inactive Apps will not be re-written but retired</p> <p>7 waves – e-services, intranet, document management, PVC application wave, added wave redesign of Joburg.org, etc</p>	LL	

No	Discussion/Resolution	Responsible person	Due Date
	<p>3 Project streams - Platform, Strategy stream, and applications streams.</p> <p>Strategy stream was a starting point - to assess value realization (non-financial, financial benefits) the financial not yet realized visible, but non-financial benefits are visible</p> <p><b>Platform Challenges:</b> IBM platform could not manage the workload anymore, server related challenges, and software challenges were experienced due to old technology constraints. Server crashes, client dissatisfaction.</p> <p><b>Applications challenges:</b> Old applications, running in silos, high cost of maintenance, Technology constraint, lack of integration, old versions unsupported etc.</p> <p><b>The project was to rewrite the application and also allow collaboration and also bring new functionality and technology. 3 solutions have completed and they are live and handed over for business use.</b></p>		
3.	<p><b>Value/ Benefits realized:</b></p> <p>No more service interruptions, the new e-Services is highly availability and more stable.</p> <p>No more browser version issues that were experienced before.</p> <p>The new e-Services is more user friendly.</p> <p>User experience has improved.</p> <p>Less technical queries.</p> <p>Improved turnaround times in query resolution due to advanced technology.</p> <p>More new users every month that are using the tool.</p> <p>Many functions have been decentralized to business, people are able to focus on their functions.</p> <p>No more reliant IT for everything, business more empowered.</p>	Inputs from various members	
4.	<p><b>What is not yet fully functional</b></p> <p>EDMS – Indexing - functionality (developed, in QA still to be tested)</p>	Trainers, Change management, Applications support	

No	Discussion/Resolution	Responsible person	Due Date
	<p>MOE's Access - In the project office – a roadmap of the roll out was discussed. Microsoft will implement once contractual issues have been sorted out.</p> <p>EDMS – not handed over – support is an issue (SITA to request handover to be done)</p> <p>Trainers to be granted full access to the solution.</p>		
5.	<p><b>Lessons learned:</b></p> <p>Project management: Transition with handover, BAU support team must walk the path, attend walkthrough sessions. This will make a handover process very easy because it will address many teething issues. Stakeholder education and involvement across the City including IT.</p> <p>Change management: Political transition delayed the technology transition, and it happened also in COJ that the political transition affected the pace of the project and the objectives. Post implementation assessment could not be done properly.</p> <p>CoJ Applications Support: Critical support was not sufficient. 30 days was not enough and was not managed properly. There were calls that went back and forth and Microsoft did not want to acknowledge them.</p> <p>Trainers: Business don't release enough testers, people complained during training that they never tested the solution. Training was never prioritized as a leg of the project. After training people start seeing the value. Next time prioritize training on key business people. People ask for access long after they have been trained. They then don't know how to use the system and require re-training.</p>	Inputs from various members	