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WORLD MARITIME UNIVERSITY

Malmö, Sweden

**THE HUMAN ELEMENT IN THE ERA OF
DIGITALIZATION AND AUTOMATION OF PORTS: A
CASE STUDY OF SOUTH AFRICA**

LUCKY NJABULO SITHOLE
SOUTH AFRICA

A dissertation submitted to the World Maritime University in partial
fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE
in
MARITIME AFFAIRS
(MARITIME LAW AND POLICY)

2022

Declaration

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

(Signature):

(Date):

Supervised by: **George Theocharidis**

Supervisor's affiliation: **Maritime Law and Policy**

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Abstract

Title of Dissertation: **The Human Element in the Era of Digitalization and Automation of Ports: A Case Study of South Africa**

Degree: **Master of Science**

The maritime and port industry is undergoing significant transformations as a result of technological and operational advancements. Considering these main trends shaping the port competitive environment, the study assesses the effect of the human element on the success of digitalization and automation of ports, and the extent to which the South African Commercial Ports Policy, 2002 addresses this issue.

Around the world, the evolution and changes in organizational structure of port labour is argued to be driven by technology related factor such as digitalization and automation. The South African ports are still largely in use of manual operations systems and relies on port labour to sustain the port. This has prevented the South African port industry from reaching its fullest potential. Therefore, the government and the Transnet National Port Authority intend to invest and ride the technological wave, where they will be able to use digitalization and automation to improve port efficiency through improved port operations due to process standardization, increased quality in port services, and effective strategic planning.

However, these trends are forming a new framework, posing new challenges and threats to port labour, given the increasing demand for new jobs focusing on high-skilled personnel and possible loss of jobs since a few selective workers will be required to operate new systems. The study demonstrates that the anticipated transition from strength to skill will necessitate new worker capabilities as well as significant changes to South African policy and laws. The study also contributes on the ongoing debate on the challenges and the opportunities that technology brings into the port industry.

Key words: Human element, Digitalization, Automation, Ports.

List of Abbreviations

AI	Artificial Intelligence
CMTF	Comprehensive Maritime Transport Policy
ILO	International Labour Organization
IMO	International Maritime Organisation
IOT	Internet Of Things
ITF	International Transport Forum
JIT	Just In Time
NDA	Nigerian Port Authority
NDLS	National Dock Labour Scheme
NDP	National Development Plan
PCS	Port Community System
PMIS	Port Management and Information System
PPE	Personal Protection Equipment
RWG	Rotterdam World Gateway
SMME	Small, Medium and Micro Enterprise
SOE	State Owned Enterprise
TNPA	Transnet National Port Authority
TPT	Transnet Port Terminals

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Chapter One: Introduction

1.1. Background of Study

Maritime transportation is the invisible backbone of the global economy, without which international seaborne trade would be impossible (Wan et al., 2021). Approximately 90% of global trade is carried by sea, and global seaports handle more than 80% of global merchandise trade in volume and more than two-thirds of its value (United Nations Conference on Trade and Development, 2018). Ports, as maritime transportation hubs, have grown in significance in fostering global trade and regional economic growth and development. Their role has evolved from traditional cargo loading and unloading to being an essential component of the entire supply chain (Chen et al., 2019).

Since the early twentieth century, there has been a constant drive to improve the speed, productivity and efficiency of cargo handling operations in ports, and as a result, technological changes in the shipping industry have occurred frequently (Dubbeld, 2003). Unitization, of which containerization was the most visible manifestation, was the most dramatic change in the industry, reordering the entire operation of work on the docks (Dubbeld, 2003).

Already in its infancy, containerization was associated with digitalization and automation, which was argued to be the strategic approach and practice for the majority of ports worldwide (McKinsey and Company, 1967). Containerisation and early technologies have been credited with significant growth in global trade, owing to rationalised cargo handling, significantly increased cargo turnaround times, promoted flexible labour, and coordinated container ships via integrated computer networking systems (Dubbeld, 2003). Trade unions, however, from the outset vehemently opposed these developments due to its potential to eliminate many dockworkers and expose most ports to political and social instability as well as legal uncertainty (Levinson, 2006).

More than 60 years after the emergence of containers, indeed technology appears to have significantly reduced the number of dockworkers and created a new environment for port labour with a demand for new set of skills (Vaggelas & Leotta, 2019). Although, only about 53 container terminals can be deemed fully or semi-automated, accounting for about 4% of total container terminal capacity, it is estimated that up to 90% of current dock work may be obsolete by 2040 due to increased digitalization and automation (International Transport Forum [ITF], 2021). Considering this argument, trying to move with the global technological trend for most ports will be faced with massive resistance from employees and labour unions, especially if policies and the legislation fail to address the human-technology interaction.

In most countries, the human element remains the focal point of the maritime system, influencing every decision taken in the maritime industry directly or indirectly, this includes plans concerning the introduction of technologies (Rothblum, 2000). Therefore, the human-technology interaction in ports has not been a swift transition, especially for developing countries, where port labour is not multi-skilled and believes that technology threatens their jobs and well-being (Vaggelas & Leotta, 2019).

However, the maritime industry, led by the fourth industrial revolution, continues to invest in new technologies, and rely heavily on technology-driven operational systems and equipment, tools and methods aimed at maximizing profits in a highly competitive market and strengthening the resilience and sustainability of their ports in the global supply network (Bichou & Gray, 2005). This looks ideal for ports, but in reality, port success is determined by a variety of factors, including port geographical location, port organisation, port size and specialisation (ITF, 2021). In addition, innovations in ports depend heavily on local labour costs, the degree or level to which machines replace port labour, and the updated policy framework addressing the changes and effects (Dubbeld, 2003).

Most ports seem to have not paid cognisance to these factors. For instance, a lack of proper regulation has resulted in an imbalance between human resource

development and port digitalization and automation projects, which have proven to be the source of resistance and social conflict in ports worldwide (Dubbeld, 2003). This scenario resembles that of South African ports industry, where historical events have largely effected the legal framework covering ports and labour. Given this position, the Government continues to invest in technological projects, promoting customer focused infrastructure and services without improving the policy and legislation to address the human element in ports.

The recent controversial World Bank report published in May 2021, ranking the Ports of Cape Town, Durban, Gqeberha, and Ngqura as four of the five worst ports in the world in operational efficiency, has prompted the need to modernize South African ports (International Trade Administration, 2021). To address this issue, the government generally refers to the National Ports Act, 2005, which aims to promote the development of an effective and productive South African port industry capable of contributing to the country's economic growth and development. The South African legal framework places the Commercial Ports Policy, 2002 as the main policy that is intended to ensure affordable, internationally competitive systems, efficient, technologically advanced and safe port services, an increase in infrastructure investment and service delivery levels based on user needs.

The South African National Development Plan 2030 (NDP) strongly maintains that social factors must be carefully considered by the Government when planning to effect any improvements for economic gains. This include the introduction of digitalization and automation into the port system aimed at maximising profits. With a high rate of unemployment in the country, the aim is not to lose more jobs, but to create employment. The development of technologies and new knowledge (for example, investments in training and upskilling) are arguably enablers for ports to achieve a high level of attractiveness and competitiveness in comparison to nearby logistic nodes. However, this requires close cooperation and collaboration of stakeholders operating in the port (Vaggelas & Leotta, 2019).

In this perspective, it is apparent that for South African ports to reach higher levels of innovation, an assessment and improvement of policy and legislative framework is a very important consideration to ensure greater alignment between the port strategy (including port labour) and digitalization or automation strategy.

1.2. Problem Statement

The history of South African ports displays multiple factors shaping the current ports system. The Apartheid laws, containerization and technology, rejection of a common labour pool for dock workers, curtailment of labour union powers by the Government and private labour companies, permanent regulation of ports by the Government, all led to the supposed exploitation of the human element in ports. Casual workers without job security remained in the port while those who went on massive strikes contesting technology suffered retrenchment (Dubbeld, 2003).

In 1994, the democratic government took power and South African workers had hope for radical transformation. However, despite a deliberate emphasis on redressing past imbalances, the new government hardly considered the position of dock workers in its framework for new port developments. It was far more concerned with issues of customer satisfaction, the construction of new container terminals, and the overall growth of the industry. In the era of digitalization and automation, the government made no serious attempt to address and regulate port labour.

This problem is evident in section 3(10) of the Commercial Ports Policy, 2002, where this provision addresses the human element as a major challenge limiting the prospect of success for technological innovations in South African ports. It expressly stipulates that:

“A large proportion of workers involved in port operations have low levels of skill and high levels of illiteracy. There is a high degree of reliance on casual labour. These factors limit the ability of the industry to adapt to technological change and

improve efficiency and levels of service. The ability of the industry to adhere to internationally acceptable standards is also affected”.

Ntuli (2022) re-emphasized this issue during the Mid-term Comprehensive Maritime Transport Policy Review, mentioning that, *“until we have dealt with the human element in South African Ports, we must forget about making our ports rediscover their role and purpose”*. Although this policy does not extensively address ports, it highlighted that port workers have displayed high levels of demotivation.

It is obvious that the rapid pace of technological trends has pushed port labour to the forefront and epicentre of port-related initiatives. In this era, there is a growing demand for new jobs that require highly skilled personnel and the development of new hard and soft skills (Vaggelas & Leotta, 2019). This perspective is not clearly articulated in any South African policy or strategy document, which presents an imbalance between human resource development and port digitalization and automation projects. The ITF (2021) argues that when the benefits of technological projects are ambiguous, and the policy remains unimproved, most stakeholders or port players will interpret any push for technological developments as an attempt to diminish port labour or dockworkers’ unions. This is an imminent problem in South African ports industry, and this issue must be addressed in the policy during the early stages of transitioning to “smart people’s ports”.

1.3. Motivation of Study

There are instances where through proper policy, port authorities, terminal operators and labour unions co-operate constructively to introduce digitalization and automation under conditions considered favourable and appropriate by all involved (ITF, 2021). However, in South Africa, until today, the challenge stipulated in Section 3(10) of the Commercial Ports Policy, 2002, seems to have not been resolved by any law, including the Labour Relations Act 66 of 1995.

Also, there is limited literature covering this issue, thus presenting a gap in both the policy and literature. This necessitates the need for this study, which assesses the effect of human element on the success of digitalization and automation in South African ports and the extent to which the Commercial Ports Policy, 2002 addresses this issue. This paper also investigates the consultation and cooperation processes within the port stakeholders, the initiatives used by developed ports to deal with the human element, and comment on the most suitable direction for South Africa.

1.4. Aims and Objectives

This study aims to ensure that the human element in South African ports does not hinder technological innovations in ports, and that clear policy is in place to allow labour unions, port authorities and terminal operators to cooperate constructively to introduce digitalization and automation under conditions considered appropriate by all involved. In order to achieve this, the following objectives have been set.

- i. Assess the effect of human element on the success of digitalization and automation in South African ports.
- ii. Evaluate the extent to which the Commercial Port Policy, 2002 addresses the issue of human element in the process of Port digitalization and automation.
- iii. Assess the cooperation of different stakeholders within the ports in addressing the issue of human element in the process of port digitalization and automation.
- iv. Identify initiatives used by technologically advanced ports to deal with the effect of human element in port digitalization and automation.

1.5. Research Questions

To achieve the objectives outlined above, the research will attempt to answer the following questions.

- i. What is the effect of human element on the success of digitalization and automation in South African ports?
- ii. How does the Commercial Ports Policy, 2022 address the issue of human element in the process of port digitalization and automation?
- iii. What is the level of cooperation between different stakeholders to address the issue of human element in the process of port digitalization and automation?
- iv. What are the initiatives used by technologically advanced ports to deal with the effect of human element in port digitalization and automation?

1.6. Research Methodology

This study employed qualitative and legal research methodologies. According to Sofaer (1999), the qualitative method was useful in providing rich descriptions of complex phenomena as well as illuminating the experience and interpretation of events by actors with widely disparate stakes and roles. The assessment of the effect of human element on the success of digitalization and automation in South African ports, and the extent to which the laws and policy addresses this issue was conducted to fulfil the objectives of this study.

This included the consultation of primary and secondary literature documents. Furthermore, semi-structured interviews were conducted on Transnet National Port Authority Management, Transnet Port Administration and Labour Unions to gather first-hand data on the current state, plans and needs of the ports, and the port labour's position on proposed port technological developments. Non-probability sampling was used for the semi-structured interview questions because this research needed specific respondents for the interviews, and purposive-sampling method was used because

specific participants were needed for the interviews as described by McCombes (2019).

It is important to state that prior to the collection of data, the approval of the WMU Research Ethics Committee was duly obtained. Also a detailed presentation of the methodology and specific methods is contained in the third chapter of this research.

1.7. Organization of Research

The study consists of five chapters. Chapter One is the introduction section providing the context within which the study is conducted; the overview of the problem statement; the motivation and need of the study; the objectives; research questions; and the organization of the study. Chapter Two first give an overview of the South African ports context, and focuses on the human element in ports; port digitalization, port automation, the international and national legal framework, and a view on technologically advanced ports. Chapter Three includes the research methodology, comprising research design, sampling and data analysis. The data findings, analyses, and discussions are presented in Chapter Four. Chapter Five summarises and concludes the study, make recommendations for South African port sector and the Government, and conclusions identifies suggested research areas for future consideration.

Chapter Two: Literature Review

This chapter contains the operational and theoretical discussion of concepts included as key components of the study. These concepts are explained with the intention of showing how they correlate with one another, and also their contribution towards achieving the objectives of the study. The discussion takes off with a brief discussion of the ILO's position for policy makers to regulate the worker-technology interface. Following is an overview on the South African ports context, and the paper ventures into the human element in ports, the digitalization and automation of ports, and concludes with assessment of the South African legal framework.

2.1. ILO - Dock Work Convention 137 of 1973

When considering the digitalization and automation of ports and their impact on the port labour, the legal constraints are embedded in regulation and legislation, as well as industry-wide labour and safety regulations (International Labour Organization, 2021). National governments and international organizations, such as the International Labour Organization (ILO), both have a role to play in this case. The Dock Work Convention (No. 137) of 1973 addresses the social consequences of new cargo handling methods in docks. This convention places a high importance on the worker-technology relationship in ports, particularly in terms of efficiency and training. Article 6 of the Convention states that each member must ensure that dockworkers have adequate safety, health, welfare, and vocational training provisions. This provision does not advocate or support laying off of port labour because of the new technologies, but requires states to improve worker-technology relationship that is safe, and the upskilling of labour. The ILO also issues recommendations that outline guidelines that can be used to guide national policy and action, as well as supplement corresponding conventions.

It is important to note that the theme of social conditions, including labour relations, is complex, and also difficult to define and quantify. Dockworkers prefer employment systems that combine job freedom with labour conditions found in

permanent contracts, as well as job security and guaranteed wages. However, employers in the industry hold a different interest. The degree of technology and the extent which terminal operators can deploy new technology to improve dimensions of dock labour performance, as discussed below, is never certain, so as the future of dock work. Therefore, the topic of introducing technologies in ports have not only demotivated port labour, but also caused high levels of frustrations. This is true with the South African port industry known for its unique history and political instability, influencing port policy framework today.

2.2. South African Ports Context

2.2.1. Historical Background

Exploring the tensions between global shipping industry innovations and South African local conditions provides a framework for a more in-depth legal and theoretical engagement. In the ports of South Africa, particularly Durban, dock workers or stevedores were the most physically powerful workers of all, known as “*onyathi*” in Zulu, or buffalo, which aptly described the physical and collective nature of their work (Dubbeld, 2003). Throughout the centuries, dock work was labour intensive, necessitating teams of workers, who were predominately illiterate casual workers without any job security.

This paper does not dwell on the history; however, it is important to highlight that since the 1940s the South African port industry lacked proper policy regulation, because the Government’s focus was on the control and segregation of the people. When containerization and technology surfaced in the 1970s, reordering cargo handling methods, heated conflicts spiked between labour unions and the Apartheid Government. Labour unions were demanding job security, better working conditions and adequate regulation of the industry to stop the exploitation of labour, while the Government was joining the global trend and maximising profits. For many years, the negotiations did not yield any positive outcome to address the worker-technology interface.

These confrontations occurred frequently and had adverse effects on the business. Upon realizing that the dock workers in Durban had been over-exploited and were ill-equipped to provide the new skills required for containerization and other technologies, stevedoring companies set about forging a new system policy of industrial relations on the docks (Dubbeld, 2003). A key component of the adopted policy was the introduction of multi-skilling of workers within the companies. This entailed training and teaching each member of the work-gang new roles, so that each could function in any position within the gang as needed or specific work required. However, while the companies touted multi-skilling as a progressive move that would eliminate idle time, it also set the conditions in place to reduce the size of the gang and retrench or lay off workers. As containerization developed in South Africa, the number of dock workers required in a work-gang declined because the skills required for securing a container were substantially less labour-intensive than those required for loading break-bulk cargo, resulting to massive retrenchments (Dubbeld, 2003).

Along with these changes came the computerization of all stevedoring work, which altered the processes formerly coordinated by foremen using time cards. The computerization process was very much a control process, inextricably linked to the individualization of work and the fragmentation of societies. The work-gang was the society that was fragmenting in this case. Thus, the development of containerization and other technologies carried important aspects of the modern world economy within it.

The transformation of work in Durban was more than just machines replacing men; it was also about how this process occurred. An examination of the effects of this transformation reveals that a consistent result in each port did not occur. Instead, global technological innovation coincided with the local conditions of a South African port, where workers had a significantly different history and were in a fundamentally weaker position.

Whereas well-organized dockworkers in certain ports in the United States and Western Europe were able to limit retrenchment and prevent casualization, containerization in South Africa resulted in retrenchment and casualization due to oppressed and poorly organized trade unions, an unsympathetic government, and a legacy of super-exploitative labour relations (Dubbeld, 2003). This is due to historical legacies of division, difference, and misunderstanding, as well as decisions that have been made. In short, the local seems very decisive in the global. Technology alters environments, but the shape of these changes appears to be determined by specific societal conditions.

2.2.2. South African Ports today

With the democratic Government in power, South African maritime industry has witnessed an influx of laws and policies aimed at regulating the industry. These changes were expected and brought so much hope to the people of South Africa. The country's port industry has grown in strides, now consisting of eight commercial seaports recognised under paragraph 1(1) of the National Ports Act, 2005. These ports include Richards Bay, Durban, East London, Ngqura, Port Elizabeth, Mossel Bay, Cape Town, Saldanha Bay, and Port Nolloth. The port of Durban continues its dominance, not only in South Africa but also in Africa. As the hub and the main port of the country, it is where decisions concerning the legal, political, social and technological transformations take place.

Established under the National Ports Act, 2005, Transnet National Ports Authority (TNPA) and Transnet Port Terminals (TPT), forms two of five operating divisions of Transnet State-Owned Enterprise (SOE). TNPA is fully responsible for the safe, effective, and economically efficient functioning of the national ports system, while TPT is in charge of the operations of 16 port terminals across South African ports.

These ports, as key nodes in global transport chains, providing access to markets, supporting supply chains and connecting consumers and producers, play a significant role in the South African economy and people's lives. Cargo handling operations at terminals are at the heart of these ports' operations, and they continue to create jobs in the form of dockworkers, management, and administrators through terminal and stevedoring companies (Notteboom, 2017).

Port workers under Transnet and casual dock workers employed by stevedoring companies work every day to ensure that containers, bulk, vehicles, and break-bulk cargo moves efficiently across the quay walls (Transnet Port Terminals, 2022). Although some dock work is still available in harbours today, it has decline up to 75% compared to the 1950s (Dubbeld, 2003). Dockworkers, according to Notteboom (2017), are critical to terminal performance and overall port competitiveness, however, it is perceived that changing market demands necessitate dock labour reform and changes in traditional working practices.

In this perspective, major drivers for change include increased port competition; liner shipping strategies; technological developments; commercialization; new organizational models, and the ever expanding containerization (Vaggelas & Leotta, 2019). These drivers significantly reorder port operations, and port workers face the challenge of having to respond and adapt to the new environments in the port context (Satta et al., 2019).

The South African Government and Transnet have conceded to digitalization and automation as valuable enabling technologies. This describes what most ports do, shifting from asset operators to service orchestrator in order to generate more value (Chu, 2018). According to paragraph section 3(6) of the Commercial Ports Policy, 2002, South Africa, through technological innovations, aims to reach a “Smart People’s Port” status. A Smart People's Port concept, is aimed to achieve an efficient data-rich and information-rich eco-system connecting port assets, terminal operators, port employees and the port community, including road and rail. It will also assist ports in developing more focused customer-centric technology, which will reduce

information-sharing latency and result in more informed decision-making (Logistics and Transport, 2016).

This buzzing theme connotes that these technological developments will improve general working conditions and not leave people behind, however, in reality this new technological paradigm facilitates and supports the improvement of several operations and procedures, which involve and benefit specific or selective port labour (Vaggelas & Leotta, 2019).

In October 2016, the port of Durban began using drone and track-and-trace technology as part of a pilot project, forming part of TNPA's plans to roll out smart ports. The Ariel and underwater drones are also being used to inspect infrastructure, conditions of the seabed, and collect data on port traffic (Bagwandeen, 2022). These activities were inspected by humans before, and it seems as if the new technology systems demand new skills from specific individuals who are mostly from private companies or service providers (Bagwandeen, 2022).

In the midst of huge investments intended to further digitalize and automate port operations, the elephant in the room is still ignored. Being a member in international instruments, South Africa has not improved their policy or legislative framework to address the human element in the era of technological innovations. The problem raised in section 3(10) of the Commercial Ports Policy, 2002 is still not addressed and thus, the human element still poses a threat to the introduction and success of some technologies in ports. Labour unions are still resistant to change, and they wish to lessen the injustices of the past in expense of profit making by the ports. The lack of proper stakeholder engagement and well defined policies have a great effect on the transition from manual to automated work. This was evident in the ports of Los Angeles and Vancouver where dockworkers continuously protested the expected job losses at Container Terminal (Roosevelt, 2019), and resisted the port industry's increasing reliance on machines to do work previously performed by human beings (Smith et al., 2019). Other ports have harmonised their technological systems to

benefit the labour, however, it can never be denied that dock workers have become substantially less important for port operations.

2.3. The Human Element in Ports

Understanding the human element in ports is vital for the purposes of ascertaining its importance or rather neglect in contemporary ports. The human element refers to a process for addressing and resolving workplace human issues. It is also a multifaceted issue that has an impact on maritime and port safety, security, and marine environmental protection across the entire range of human activities performed by ship crews, shore-based management, dock workers, and regulatory bodies (International Maritime Organization, 2022).

Port workers are employed by a variety of employers, including public port authorities, terminal operators and private stevedoring companies. Some workers are permanent, working under employment contracts for an indefinite or definite term that are fully governed by general labour law, whereas many ports rely on registered pool workers who are hired on a daily basis (or for a shift or a half shift) and are entitled to unemployment benefits while not working (Dubbeld, 2003).

These workers perform general operational work as well as special operations like driving forklifts, straddle carriers, reach stackers, conveyor belts, and cranes; signalmen; lashers; and tallymen. Foremen and supervisors are frequently in charge of the gangs. Port or cargo handling companies also employ administrative, sales, marketing, information technology, and legal personnel.

While the dock labour force typically accounts for a small proportion of total direct jobs in many ports, it is a key production factor and an important component of port terminal production, and is also part of the port terminal supply profile (ITF, 2021). However, dock labour performance also has an impact on several other criteria. Such impacts might be found on supply profile factors such as container handling rates, service reliability, vessel turnaround times, and berth availability. Furthermore,

factors related to the market profile of the port can also be strongly affected by dock labour performance. In practice, shippers, shipping lines and third-party logistics service providers put pressure on terminal operators to meet their market requirements (ITF, 2021). The demands and requirements from these market actors push terminal operators to maximize dock worker performance.

According to Vaggelas & Leotta (2019), the three most considered dimensions when considering the introduction of technologies in ports, include labour productivity, cost efficiency, and qualitative aspects. This paper looks at these dimensions at a wider set of legal and social conditions.

Labour productivity measures the extent to which the human capital adds value to the port. With the increasing importance of integrating ports and terminals into value-driven supply chains, many port and terminal operators have become more interested in creating value-added, in addition to the more traditional approach of maximizing cargo tons handled (ITF, 2021). The second dimension of labour performance is cost efficiency. At general cargo terminals, dock labour costs account for 40% to 75% of total terminal operating costs. In capital-intensive container handling, the share of dock labour costs in total operating costs can account for up to 50% (Vaggelas & Leotta, 2019).

Labour productivity and cost efficiency are mostly affected by more qualitative aspects such as labour flexibility, service reliability and quality, and dependability. Vaggelas & Leotta (2019) argues that low service reliability, quality, and dependability of dock workers expose terminal operators and the larger maritime and logistics community to a slew of indirect and unanticipated costs. This has a negative impact on productivity and cost recovery targets in the following ways:

- i) The service reliability is compromised when there is a shortage of dock workers or gangs in some ports, leading to significant delays in vessel loading and unloading operations. These shortages may result from sudden non-anticipated peaks in demand or a short term, sharp decline in the

availability of dock workers due to holiday periods, weekends and other personal issues.

- ii) Damage-free terminal operations are one indicator of service quality. Cargo damage incidents at the terminal can disrupt normal operations and cost cargo owners' money. A high number of damage cases or incidents may indicate a lack of training or a lack of commitment on the part of the dockworker (the reflection of a 'we do not care' attitude).
- iii) Accidents and absenteeism can cause service reliability issues, lower productivity, and additional costs for a port or terminal. Absenteeism can be caused by a company's ineffective selection and placement procedures, excessive fatigue, ineffective use of skills, poor supervision, insufficient training, or promotion programs. On the other hand, it may result from personal causes, such as dual occupation, alcoholism, substances or drugs. Absenteeism, like in other industries, can relate to job dissatisfaction, and unwillingness to fulfil workers' responsibilities.
- iv) Strikes have a negative impact on service reliability, quality, and dependability. Dockworker strikes, both short and long-term, reduce or even halt labour productivity while imposing costs on the port and logistics communities, affecting an entire economic system. Strikes also cost shipowners port deviation fees, time costs for ships in port, revenue losses for inland transport operators and other port-related businesses, time costs and broader logistics costs for cargo owners, and potentially high costs for factories due to major disruptions in the production line.

Disputes between labour unions and employer organizations concerning various issues have been endemic in the history of the port industry. Most of the time, strikes resulted from proposed changes to traditional ways of working. A recent example is that of a fierce battle over automation which broke out at the Port of Los Angeles

where dockworkers continuously protested the expected job losses at the Long Beach Container Terminal. Members of the International Longshore and Warehouse Union resisted the introduction of driverless electric-powered vehicle cargo handlers by Maersk (Roosevelt, 2019). According to Maersk, "Los Angeles dockworkers work 16 hours a day, while unmanned vehicles can operate 24 hours a day." As a result, resisting or preventing port terminals from evolving and keeping up with the global economy risks causing long-term harm to jobs, tax revenue, and economic vitality for the entire state of California.

Another strike action happened in the port of Vancouver, where Longshore workers went on strike resisting automation. The union argued that the introduction of automation had the potential to eliminate 80 to 90 percent of the labour (Smith, 2019). This is perceived as a threat by the workers, however, McKinsey and Company (2018) argues that automation can increase port safety, decrease human-related disruptions, and make performance more predictable.

Matinlauri (2016) expected that by 2020 approximately 100 ports will be fully automated, however, many ports are facing a challenge with the human element present in their ports. The Unions fear that with self-driving trucks, automated RMGs in the container stacking areas and even remote control of container gantry cranes being already a port reality, further port automation is seen as a direct threat for their job safety (Vaggelas & Leotta, 2019). This situation presents a similar problem looming large in the South African port industry. Here the Unions were legitimately concerned about the impact of automation on jobs, while the terminal operators were concerned about humans being a barrier for the port to compete in the market.

2.4. Ports Digitalization

Digitalization refers to a sociotechnical process that involves the application of digitizing techniques to broader social and institutional contexts (Tilson et al., 2010). Technology and related tools like Big Data, the Internet of Things, Blockchain, and the creation of digital supply chains are all part of the digitalization process (Vaggelas & Leotta, 2019). In the port industry Big Data is used for reporting on several port operational issues such as financial and operational efficiency, and damage control (Hamalainen and Inkinen, 2017).

Overall, this enabling technology is expected to significantly increase port efficiency through its business applications, either through automation of port operations, such as the automated RWG container terminal at the port of Rotterdam, or through automation of port processes, such as the Port Community System (PCS) of the port of Hamburg operated by DAKOSY (Marianos et al., 2011). Adoption of these digital technologies enables operators to better measure, monitor, and control port operations at the port terminal level, as well as improve the management of real-time information about vessels, trucks, passengers, and goods entering and exiting the port (Vaggelas & Leotta, 2019).

Therefore, in light of the changes and benefits brought about by these technologies, it is clear that the extensive work done by a large number of labour hired for port administration will be simplified, and only a few personnel will be required. During the Covid-19 pandemic, this effect was visible in the majority of ports.

2.5. Port Automation

Automation is the development and application of technology to perform tasks or execute processes with minimal to zero human assistance, intervention or oversight (Gurumurthy & Bharthur, 2019). Port automation, as defined by Martin-Soberon et al. (2014), involves the automation of significant part of port cargo handling activities linked to digitisation and datafication, the use of mechanical, hydraulic, pneumatic,

electronic, and computerized elements or systems which control the equipment and processes.

Across the world today, there are around 53 automated container terminals representing around 4% of the total global container terminal capacity, and most of these automated container terminals are in Europe (28%), Asia (32%), Oceania (13%) and the United States (11%) (ITF, 2021). The vast majority of automated terminals are brand new, with only a few being converted from manual terminals.

It is important to note at this point that there is not much automation in African port terminals. This is because, cargo handling has always been performed with great involvement of humans in quayside operations, yard operations and landside operations. However, with the increasing global technological trend, most African ports have proposed innovations to stay competitive and attractive. Namibia, for example, announced that in August 2019, digital and automation technology would be implemented to make Walvis Bay more competitive with other Southern African ports. Namport intended to roll out the technology in stages, the first of which would focus on yard management. Smart Stack, a container position recording system, would be used to reduce container placement errors (Bagwandeem, 2022). Furthermore, among other automation initiatives, the speed of loading operations will be increased by using automation software that will automatically select the shortest route between the container and its destination on the vessel or on the ground.

According to Bagwandeem (2022), the Nigerian Ports Authority (NPA) announced in December 2021 that it was considering implementing fully digital and paperless port management systems throughout Nigeria by 2025. Tangier Med Port in Morocco partnered with Wartsila, a Finnish firm, in April 2021 to co-develop a new Port Management and Information System (PMIS). Modern smart port tools such as Just in Time (JIT) solutions, machine learning, Artificial Intelligence (AI), and other innovative solutions will be implemented as part of the agreement. The new PMIS digitizes the entire port call process, which reduces human error and increases efficiency.

2.5.1 Drivers of Port Automation

In South Africa, the port authority is also a container terminal operator responsible for decisions regarding the introduction and implementation of digitalization, automation, and port system regulation. Other ports in the are more privatised and thus presents a different system, where container terminal operators are the primary driving force behind terminal automation projects thanks to a right granted to them by port authorities, often through concession or lease agreements (ITF, 2021). Under such agreements, terminal operators commit to using port berths and investing in terminal handling equipment such as quay and yard cranes. These terminal operators also employ and/or pay port workers so they can balance trade-offs between labour costs and automation costs (ITF, 2021).

The primary reasons or motivation for terminal operators to automate are related to increased productivity and lower handling costs. Container shipping companies frequently request that their ships be loaded and unloaded as quickly as possible in order to minimise the amount of time ships spend in port and to keep ships on tight schedules while operating at lower, more fuel-efficient ship speeds (Stahlbock & Voss, 2008). The introduction of mega ships has put additional pressure on terminal operators and port authorities to improve terminal productivity, with container carriers indicating that more terminal automation may be required (Vaggelas & Leotta, 2019). Many of the world's largest container lines have integrated terminal companies, and some even have automated terminals.

Furthermore, port authorities have driven many port gate automation projects due to security and congestion concerns (Dubbeld, 2003). Time-consuming checks at the port entrance easily clog port cities, whereas automation at the port gate appears to speed up information exchange and control, avoiding congestion (Chao & Lin, 2017).

2.5.2 Effects of Port Automation

Automation at container terminals has undoubtedly led to dockworkers losing their jobs (Vaggelas & Leotta, 2019). This is demonstrated by the labour reductions at various automated terminals, which ranged from 40% to 50% at the TraPac terminal in Los Angeles, to 50% at Patrick's terminal in Sydney and up to 85% at the automated terminal in Qingdao (Prism Economics and Analysis, 2019).

Governments have taken opposing positions on port automation. Several governments have developed maritime innovation or maritime cluster strategies that include port automation. For example, the ITF (2021) show that the South Korean government's 2030 Port Policy and Implementation Strategy focuses on the establishment of a smart logistics system, which includes port automation. Furthermore, the 13th Five-Year Plan of China (2016-2020) promotes the development of smart ports, which include automation to increase productivity. Some countries prioritize worker safety with these policies. However, some governments in the United States have taken legislative action to limit port automation projects because they are more concerned about potential job losses as a result of port automation (ITF, 2021).

In this perspective, ITF (2021) shows that with good policies in, trade unions' attitudes toward automation projects have ranged from outright antagonistic to constructive, depending on the ability to negotiate package deals favourable to existing or new dockworkers. These trade unions engage with all other stakeholders and participate in the implementation of port automation projects, whereas discussions in ports without proper policies have been highly confrontational, often fuelled by suspicions that port automation projects are primarily motivated by employers' desire to diminish union power.

2.5.3 Social Relations and Social costs of automation

Port automation projects regularly provoke serious social conflict and unrest within ports. Aside from the countries already mentioned, announcements of port automation in the United States and Australia sparked opposition from trade unions, resulting in port strikes. Many of these social conflicts are caused by an ambiguous articulation of costs and benefits.

When the benefits of automation are unclear and ambiguous, some stakeholders will see pushing for automation as a means of weakening dockworker unions (Oliveira & Varela, 2017). Strikes and strong union opposition appear to provide employers with validation that they are correct to automate, as they will use strikes as justification for automation. As such, arguing that automation would reduce labour conflicts, without taking into account that labour conflicts would be reduced if the prospects of automation were clearly articulated and regulated.

The social costs of port automation are often overlooked in most projects. This includes social security expenses (in the event of layoffs) and lost tax revenue (when port workers are replaced by machines) (ITF, 2021). The majority of people earn a living through work, and personal income tax revenues are generally higher than corporate tax revenues. As a result, in many cases, the personal tax income lost due to the replacement of a worker by a machine is not compensated by higher corporate tax revenues. Although there may be additional tax income derived from the profits earned by the manufacture of automated equipment, this money is often made in the nation where the equipment is made, not the one where the worker is typically replaced by the machine.

The social costs of automation will naturally be ignored by those who benefit, but governments should consider them when making decisions about port automation. The inclusion of societal costs as a standard part of the political debate on port automation should become the norm. This would be facilitated by ensuring that ex-ante assessments of port automation projects always account for these social costs.

There have been instances where unions, port authorities, and terminal operators have worked cooperatively to implement forms of automation deemed appropriate by all parties. Strong unions can aid in the advancement of automation and the avoidance of deadlocks in port automation projects. Essentially, meaningful social dialogue between employer, employee, and government representatives is required (Dubbeld, 2003).

In some port automation projects, the fruits and benefits of automation have been shared with workers (ITF, 2021). This can take the form of pay raises, early retirement plans or programmes for elderly workers, or other benefits that are frequently negotiated as part of a package with the use of automation. In the 1990s, for example, port automation in Rotterdam was accompanied by an agreement on better pay and early retirement programs for existing workers. Automation is far more enticing and appealing to workers if they share in the productivity gains. This has been done quite directly at Hamburg's Container Terminal Altenwerder, where worker compensation is based on both aggregate productivity increases from automation and individual productivity (ITF, 2021). Employee training is also part of the package needed to ensure that productivity gains are realized.

2.6. Policy Implications in South Africa

There exists no automatic success formula for container terminal digitalization and automation. This has significant ramifications for policymakers, as their decisions about port automation should be supported by a comprehensive grasp of how to address the societal issues brought on by technical advancements, as well as a clear identification of costs, advantages, and alternatives.

This paper acknowledges that the Comprehensive Maritime Transport Policy (CMTP), 2017 does not extensively address ports, since the Commercial Ports Policy, 2002 and National Ports Act, 2005 were deemed sufficient for advancing South African ports modernization.

The labour in port forms a wider meaning of labour under the Labour Relations Act 66 of 1995. However, in a strict sense, section 200A (1) of the Act provides for the presumption as to who is an employee. To meet the criteria, paragraph (d) of the Act provides that:

“the person has worked for that other person for an average of at least 40 hours per month over the last three months”

Taking this provision into account, it is important to note that South African port labour is casual (not placed under any employment pool) and without any guarantee of work. Through shift rotations, these workers are not able to work for a minimal average of hours required by the Act. Therefore, they lack protection as employees under the Act. This paper continues to discuss the key and specific policy and a strategic document for the purposes of ascertaining the extent to which they address the human element in ports.

2.6.1 Commercial Port Policy, 2002

This policy aims to ensure affordable, internationally competitive systems, efficient and safe port services, an increase in infrastructure investment and service delivery levels based on user needs. Section 2(2) shows that, while the plan is to invest in port infrastructure and systems which satisfy social; financial; economic or strategic investment criteria, this process must improve the safety, security, reliability, quality and speed of port operations and services. Interestingly, a very important element on this vision is the promotion of good employment practices and standards.

Section 3 of the policy advocates for the development of commercial ports. This provision clearly shows the introduction of technology for ports optimization as a key strategic element in response to the ever competitive and changing markets. It provides that:

“the National Ports Authority will provide sufficient and appropriate port infrastructure to ensure that the ports adequately respond to the market or to changes

in the market. The National Ports Authority shall avoid the unnecessary and unjustified duplication of port infrastructure that would amount to wasteful usage of scarce resources”.

On this note, the President, in his opening address to Parliament, committed to improving national competitiveness through liberalising the transport sector with the objective of lowering costs and enabling technological advances and innovation throughout industry.

Section 3(9) of the policy addresses the need for sustainable development of ports, together with sustainable benefits in socio-economic concepts. These include job creation, the promotion of Small, Medium and Micro Enterprises (SMMEs), increasing the national skills base through capacity building and training of employees. This is a critical provision, which seems to be in conflict with section 3(10), which expressly stipulates that:

“A large proportion of workers involved in port operations have low levels of skill and high levels of illiteracy. There is a high degree of reliance on casual labour. These factors limit the ability of the industry to adapt to technological change and improve efficiency and levels of service. The ability of the industry to adhere to internationally acceptable standards is also affected”.

It could be more acceptable if section 3(9) exists after section 3(10) has been solved. Some training and multi-skilling of port labour was tried before by private companies and only led to more retrenchments. Equally so, investments in training for labour that is close to retirement and not possessing any basic technological knowledge would defeat the purpose and the agenda for sustainable port labour. Therefore, new initiatives must be explored taking into account the historical and social dynamics of the current labour.

Considering section 3(9), it shows that the Government committed itself to the consideration of relevant conventions and/or recommendations of the ILO, such as the

Dock Work Convention 137 of 1973, supporting the establishment of appropriate structures with the port reform process. However, the Government, did not accept sole responsibility for human resource development. It looks to all stakeholders, including the private sector and labour itself, to assist in overcoming this challenge. Currently, there exist no strategic direction to deal with this challenge from all the parties concerned.

Adequate consultation processes regarding ports developments is a requirement by the ILO, and this policy, under Section 3(10) confirms that to enable sustainable development, it is vital to have adequate consultation and discussion on the port development with relevant stakeholders, otherwise there will always be a shift in responsibility.

2.6.2 National Ports Act, 2005

Chapter 1, paragraph 2 of this Act stipulates its main objectives as to promote the development of an effective and productive South African ports industry that is capable of contributing to the economic growth and development of our country. In addition, the Act aims to promote and improve efficiency and performance in the management and operation of ports.

Most importantly is paragraph 2(e)(ii) which aims to encourage employee participation, in order to motivate management and workers, on one hand, and sub-paragraph (iii) aiming to strengthen the State's capacity to facilitate the development of technology, information systems and managerial expertise through private sector involvement and participation, on the other. The Act, however, does not provide any direction on how to achieve paragraph 2(e)(ii) with the growing actions on paragraph (iii).

The Act realises that the precondition to the introduction of new technologies and supporting infrastructure is extensive capital private sector involvement in ports. Stratton (2003) contends that the Act's stated trend toward port privatisation has

significant implications for changes in the dock labour market and organized labour. According to the International Transport Workers Union (ITF), the dock labour market's casualization, downsizing, privatization, and deregulation of ports are all linked. Consequently, proposals for privatisation in South Africa's port industry has a possibility of not only affecting the market structure with changes in the ownership of port operations from the state to private sector, but might also affect the dock labour market.

Understanding the historical background of South Africa, Chapter 3, paragraph 11(l) gives the Port Authority powers to “promote the achievement of equality by measures designed to advance persons or categories of persons historically disadvantaged by unfair discrimination in the operation of facilities in the ports environment”. This provision has not been fully achieved because the labour is still casual (without any job security or work benefits) and there is no established control pool for labour, which makes the port labour feel more threatened with new technologies.

Paragraph 12(i) advocates for the integration of biophysical, social and economic issues in all forms of decision-making with regard to port development and operations by the Port Authority. However, the Act fails to address how the human element is to be involved in these port development plans given South Africa's social demographics. Furthermore, the Act does not give the Port Authority any duty to implement initiatives (such as training, upskilling and reskilling) aimed at preparing port labour for the world of “smart ports”.

2.6.3 Transnet Segment Strategy

Transnet's core mandate is to assist in lowering the cost of doing business in South African ports, enabling economic growth and ensuring security of supply through the provision of appropriate ports, rail and pipeline infrastructure. To carry out this mandate, Transnet needs to expand beyond its current core.

Internationally, a number of trends outline the key priorities and challenges for logistics service providers. Larger players are expanding the breadth of services they provide, often becoming deeply specialized in a small number of industry sectors and concentrating on global end-to-end logistics networks and service delivery.

Transnet is positioning itself to take advantage of trends and opportunities observed in the international transport and logistics sector. These include digitisation of operations via sensors, augmented reality, drones and robots, and autonomous vehicles. Secondly, leveraging big data and analytics to improve operational efficiencies and processes, as well as exploiting digital capabilities to offer value-added services and to lower operating costs.

The strategy mentions that its implementation is at risk due to inadequately skilled staff in operations to fully respond to 4th Industrial Revolution business models. This labour lacks scarce skills in the job market. This has the impact on value, due to delayed benefits realisation of new technologies. Under the activities to manage risk, the strategy aims to implement a compelling employer brand proposition, compile the strategic workforce plan to determine long-term and temporary skills requirements (differentiate scarce skills), develop short, medium and long-term skills development strategies, for example, creating partnerships with educational institutions to improve the supply of scarce skills. These activities might work for new labour in the port, however, the problem of how to deal with the existing labour still remain unsolved.

Chapter Three: Research Methodology

The theoretical framework and literature review from the preceding chapter served as a proper conceptual foundation for the physical research that makes up the bulk and main substance of this study. This chapter describes the methodology used for assessing of the effect of human element on the success of digitalization and automation in South African ports, and the extent to which the current policy addresses this issue. The study used a phenomenological technique, backed by qualitative research, to accomplish and achieve this aim. It includes six purposefully selected participants, which were interviewed at different levels. Furthermore, the documentary reviews, and different documents such as legislation, policy, strategies and journals were reviewed.

3.1. Research Design

McMillan (1997) defines research design as “a plan and structure of investigation to obtain evidence to answer a research question using a set of methods and procedures.” The research question itself typically determines how the research problem will be assessed or investigated. This is an essential component of other methodological considerations such as the research paradigm, method, and research context (Swanson, 2005). All of these components are combined in the research design in a way that shapes, refines, and defines the research process (Swanson, 2005). Mouton et al., (1991) also hold this position, saying that “research design helps to maximise the validity of the research findings”.

The methodology chosen is usually determined by the nature of the questions and how well the chosen methodology can be used to address the problem under investigation or being researched (Merriam & Simpson, 2000). This study adopts a qualitative research methodology. The criteria for choosing this design is primarily based on the nature of the problem. Part of the reason involves a qualified assumption that little is understood about the effect of human element on the success of digitalization and automation in South African ports, and the extent to which the laws

and policy addresses this issue. Therefore, an exploratory, diagnostic, and descriptive design was appropriate for this study (Cresswell, 2009).

3.2. Phenomenological Approach

Rahman et al., (2017) argued that the term “mixed model” is more appropriate than “mixed method” for research that involves different approaches at any or all of a number of stages throughout the process. The reasoning is that mixing frequently extends beyond the research methods. Indeed, mixing methodologies within a broad quantitative or qualitative approach can raise nearly as many issues as combining approaches (Bazeley, 2004); mixing can also occur across disciplinary traditions, such as in social history or when scientists conduct social research to assess the impact of their work. As a result, it is necessary to define what is being mixed and how it is being mixed. The "mixing" could be as simple as using different methods side by side or sequentially, or it could mean that different methods are fully integrated in a single analysis (Bazeley, 2004). The method used in this study is known as phenomenological. Moustakas, (1994) defines “phenomenology as a theoretical view that illuminate specific phenomena and accentuates the deep search of meaning from the point of view of the group or individuals”. Since the purpose of this study is to better understand the perspectives of port stakeholders, this approach is thought to be more appropriate.

3.3. Location of the Study

The study was conducted in the port of Durban, South Africa. The port of Durban is the largest in South Africa and Southern Africa, which is one of the reasons for choosing this study area. However, competitive forces have placed it after Jakarta, Santos and Melbourne on aggregate container handling. Therefore, with the ongoing technological proposals to modernise the port, it is interesting to assess if human element could hinder the process, and how the policy address this matter. Furthermore, the port’s current performance and its potential indicated a need to choose this port as the locus of enquiry.

3.4. Target Population

Govindasamy (2009) define “population as a collection of well-defined elements whether individuals, objects or events, that are known to hold similar characteristics which conform to a specific criteria and from which we intend to generalise the results of the research.” For this study, population is limited to top management of the port authority, port administration, labour representatives and the labour itself.

3.5. Sample and Sampling Techniques

According to Etikan & Bala (2017), a sample is a small unit, whereas sampling is the process of selecting a proportionate unit from a population for the study of a topic. Sampling in qualitative research is small and limited. This is due to the fact that it is based on saturation rather than representation. The size is not statistically determined, and it is less expensive and takes less time. Thus, it can be deduced that in qualitative study, sample selection is non-random, purposefully focused and very small. In contrast, quantitative research uses a larger, more random sample (Hallberg, 2013).

Purposive sampling was used in this study. According to Mujere (2016), the purposeful sampling technique is used when the researcher specifies or selects specific research participants for the sample based on their judgment, expertise, or typicality. This sample was chosen because respondents are expected to be well-informed and familiar with the topic under discussion.

3.6. Data Collection Techniques

According to Sullivan (2012), data collection is the process of collecting, gathering, evaluating and gauging information, and the most common techniques used in qualitative research are observation, interviews, and document analysis. Interviews and documentary reviews are considered appropriate data collection instruments in this study. This is due to the fact that a single method of data collection is insufficient to provide adequate and accurate research results. Triangulation, according to Cao

(2007), is not only a powerful strategy for increasing credibility and trustworthiness, but also a technique for ensuring that the content is rich, robust, comprehensive, and well-developed.

3.7. Interviews

According to Boeije (2002), an interview is a purposeful interaction between two or more people. People who are engaged in communication, conversation, or negotiation for a specific purpose related to an agreed-upon subject matter. There are three main types of interviews. Structured, unstructured, and semi-structured interviews are among them. Semi-structured and focus group interviews were used in this study. Data was collected using a semi-structured group interview process with focus group interviews. These two techniques are designed to give participants an opportunity to speak up and share their experiences, allowing the researcher to gain a better and deeper understanding and knowledge of the research topic.

An interview schedule guide was used for the purposes of this study. This interview schedule guide was a semi-structured interview with the questions listed in Annexure “A” below.

3.8. Documentary Review

Documentary reviews, in addition to interviews, are a valuable source of information (Ahmed, 2010). This method makes use of secondary data, which is data or information gathered previously by other researchers, institutions, or agencies. The approach used process tracing to effectively understand the human element in the era of digitalization and automation, as well as the policy framework governing this issue in the South African port industry. Based on the given research questions, the documentary review involved searching two different sets of data:

- i. Review of the human element in ports, digitalization and automation of port operations (documents in general);

- ii. Review of the Commercial Ports Policy, 2002, the National Ports Act, 2005, and the Labour Relations Act 66, of 1995 (official policy documents).

The two sets of information were collected to answer all the research questions. The reason for selecting these levels was to have specific information appropriate for the study topic.

3.9. Data Presentation and Analysis

Data presentation and data analysis are distinct concepts, according to McMillan and Schumacher (1997). Data presentation, according to them, is the method by which researchers summarize and organize research data and communicate information using a variety of techniques, whereas data analysis is the process of inspecting, analysing, transforming, and interpreting data collected. This study's data was transcribed and then checked for completeness and errors. Following the reading of the interview transcripts and field documents, the first stage of data analysis began. It was critical to read and comprehend the full, consolidated transcribed interviews and other sources in order to gain an understanding of the data gathered during the fieldwork. Throughout the reading process, it was also important to think about the substance of the information and its underlying meaning, and to identify significant ideas.

After reviewing some documents, a narrative analysis was carried out, which entailed making sense of the interview respondents' individual points of view. This type of analysis was used to highlight important aspects of their stories that will best achieve the study's objectives, as well as critical points discovered in other areas of the research. Similar themes and unique themes and residual matters were all considered.

Finally, these transcriptions were manually recorded and analysed in order to make sense of data interpretations. According to Henning et al. (2004), “data analysis should be rigorous, systematic, disciplined, carefully and methodologically documented.”

3.10. Ethical Issues of the Study

The study was carried out in an ethically sound and publicly acceptable manner. The study upheld respect and personal dignity, implying that it did not harass or abuse participants in any way (sex, race, socio-economic status quo, individual health conditions etc.). Informed consent, approval, and anonymity are among the ethical considerations that were taken into account.

3.11. Informed Consent

According to Wright (2012), informed consent is obtained by providing participants with information about the study and the option to withdraw at any time with no repercussions, as well as clear and complete information about any risks associated with the research. Prior to their participation, respondents were given informed consent forms, as well as an invitation letter and an information sheet. This allowed them to read, become acquainted with, and comprehend the research objectives and data collection process ahead of time.

The consent form stated the participant's willingness to participate in the study, the nature of their participation (voluntary and with the ability to withdraw at any time), how the information was to be treated (confidentially and anonymously), and data safeguarding. Before taking part in the study, participants were required to complete, sign, date, and return informed consent forms.

3.12. Anonymity

Anonymity was guaranteed and clearly stated in the invitation letter, information sheet, and informed consent form. In this context, anonymity refers to the nondisclosure of the participant's identity in any way by anyone involved in the study, including the researchers themselves. The general consensus is that identifying a respondent result in invalid data. This is because participants are less likely to cooperate if they know their names will be linked to their responses.

Anonymity is a key component emphasized in social science research to protect the rights of research participants. This will be the case, especially for high-profile individuals. In this study, steps were taken to ensure information confidentiality and anonymity. The names, positions, sections, divisions, or organizations of the participants were not mentioned. Unless participants consented to their disclosure, data and their sources remained private. Notes on observations, as well as any other data collected, were kept secure and only used for future research.

3.13. Conclusion

The qualitative research paradigm used in this chapter enabled a critical understanding of the human element in the era of digitalization and automation, as well as the legislative framework governing this issue in the South African port industry. The participants, were identified using purposeful sampling. Data was gathered through interviews and documentary review. In relation to the research questions, a narrative data analysis was conducted. The responses of participants were supplemented by reviews of policy documents, journals, papers, and relevant legislation. This chapter laid the groundwork for the subsequent chapters' data presentation and discussion, and the following chapter addresses the study's central context.

Chapter Four: Data Analysis and Interpretation of Results

This chapter seeks to unpack the effect of human element on the success of digitalization and automation in South African ports and the extent to which the Commercial Ports Policy, 2002 addresses this issue. Section 3(10) of the policy raises a key challenge which might affect the level and pace of innovation in the South African port industry. This problem seems to have not been considered alongside the proposed projects. Data gathered from interview participants was critical in identifying common themes and points of divergence. This data interrogates research questions below and address the objectives of the study. The findings also include a review of the literature in order to develop appropriate arguments and formulate an understanding of the strategic situation in South Africa.

A narrative analysis involved making sense of the interview respondents' individual perspectives. Also, while conducting the analysis, the study assesses the validity of the views raised and attempts to suggest suitable initiatives for South African port industry.

4.1. What is the effect of human element on the success of digitalization and automation in South African ports?

The Managing Executive of Transnet National Port Authority (TNPA) is responsible for the safe, effective, and economically efficient functioning of the national ports system. TNPA have accepted that South African ports are falling behind the global technological wave, which have benefited a lot of competitors, with terminal efficiency, low costs and general port attractiveness. As part of the decision to invest in customer focused infrastructure and equipment, TNPA proposes plans to attain a Smart People's Ports status.

The South African ports are developing their own response to the Fourth Industrial Revolution (4IR) and Internet of Things space. The use of drone technology is being explored, which include aquatic and aerial drones. Furthermore, the port of

Durban is piloting digital monitoring of movements of trucks and people in the port, near to real time operations monitoring. Some terminals are already looking at semi-automated terminal operations, and as the Port Authority, TNPA is not restricting the terminal operators regarding the levels of automation they would consider.

TNPA recognises that South African ports still reliant on manual labour operations. However, technological changes are surfacing at the ports, and the perspective towards manual operations will change. TNPA's submit that all their project planning is done considering the humans in ports, even though the success of these technologies demand new hard and soft skills as argued by Vaggelas & Leotta (2019). TNPA management agreed that old aged dock workers "*onyathi or buffaloes*", who does not have any basic technological background, still remain in the port. These workers rely on the experience they have gained over the years, and their experience have kept the ports in business. The rest of dock labour consists of uneducated (not able to read and write, especially in English) and low skilled workers between 30 and 45 years of age.

The South African ports employment structure shows that over the years, ports have failed to attract young and dynamic talent to work in port operations. This lack of interest is largely caused by the perceived exploitation of labour by private stevedoring companies, keeping all workers casual, without any job security, and decreased their wages by 45% from 2012.

As the ports digitalize and automate their operations, the old processes will be redundant and new skills will be required from the workers, also jobs based on low skill set such as dock work will be affected (Gurumurthy & Bharthur, 2019). The current port labour possesses long practical experience on old manual operations, so the demand for new and scarce skills based on modern computerised programmes will be very difficult to grasp. The Covid -19 pandemic period highlighted how quickly things could change within the port. It accelerated the use of some new digital systems in the ports, which was mostly operated by selective workers from private service providers. This sudden change applied pressure on office and administrative workers

who were forced to acquire new skills, qualifications, and certification in order to compete for the jobs, or otherwise they get laid off.

TNPA recognises that the challenge stated in section 3(10) of the Commercial Ports Policy, 2002 is still not resolved. As much as humans are at the centre of the ports evolution, and their capabilities being addressed in line with the introduction of technology, the human element still remains a challenge for a transition towards smart ports and migrating to “semi-automated” ports. The current Transnet Segment Strategy raise the issue of unskilled and uneducated port labour as a high risk affecting the implementation of technologies within the ports.

While accepting this challenge, recognised labour unions in South Africa put the blame on policy makers and the Government. They believe that as early as the 1970s (deployment of containers), the port should have implemented initiatives to address the human element in ports. Today, overall port labour has decreased by 75% (mostly dock workers) but there exist no justifiable technological innovations which improves the human element in the port industry. As argued by Vaggelas & Leotta (2019), the port requires greater alignment between the port strategy (including port labour) and digitalization or automation strategy. Otherwise port workers will feel as victims of port innovations, and will confront the unjustified replacement by machines and digital systems.

Port workers are off the view that a well regulated port industry would never consider the presence of humans as a barrier to innovative developments within the port. In late 1980s, labour unions tried to avoid this disjuncture by proposing a National Dock Labour Scheme (NDLS for dock labour) aimed at regulating port work, workers and compliment the regulatory framework. The NDLS was meant to reward dock workers with permanent employment (including entitlement to work benefits such as provident fund, bonuses and overtime pay) or guaranteed days of work per week. Stratton (2003) conducted an in-depth study on the NDLS for South Africa, and for the objective of this study, the author submits that with a well-supported NDLS the number and age of labour could be controlled. This would make it more practical for

the port to invest in initiatives educating and training the labour in alignment with the technological innovations. If Transnet and private stevedoring companies did not withdraw from the negotiations, and the NDLS succeeded, current “old labour” would be better trained and not feel threatened by innovations.

TNPA’s approach on upskilling and reskilling of labour for digital systems and automation, thus far seems somewhat questionable. Training and upskilling causal labour would not make business sense, especially for old and illiterate dock workers. This might work only for selective office and administrative employees. In South Africa, the re-skilling and up-skilling initiative have in the past proven to be a mechanism leading to retrenching more port workers since only a few people will be required for high skilled work after the programmes to use the digitalised and automated systems as argued by Dubbeld (2003). Therefore, considering the old and illiterate dock workers in the ports, investing money on this initiative might not be fruitful.

With this possibility, it is not clear whether the Government have any plans for alternative employment opportunities for laid off port workers. The Labour Union’s position is that TNPA is not taking any measures to avoid job losses, and it is clear that further technological innovations are driven by the maximization of profit at the expense of the people and their values. Currently, Transnet is making acceptable profits, but not much is invested back to the port workers who are at the verge of being replaced by technology.

The ITF (2021) argues that the push for automation, and whether or not automation would lead to lower overall handling costs is place-specific. It depends significantly on labour costs and on the degree to which machines replaces port labour. On the South African perspective, it is not clear why there is such a great push for automation because the cost of labour is low, and the big container terminals in the country have not reported high levels of operation incidents. What is argued by ITF (2021) holds true for South African port industry, in that, when the benefits of technological projects are ambiguous, most stakeholders will interpret any push for

technological developments as an attempt to diminish port labour or dockworkers' unions.

A critical assessment of the views above highlight that digitalization and automation is not coming to improve current labour's lives but only the selective individuals with better education and exposure to modern technology world. In developing countries, it is seldom to see ports making programmes that really improve people's lives, but they always make plans conducive for investors, and hoping that those investors will pay tax, which is misused at the end. Therefore, should the introduction of technologies fail to involve current workers as promised (Smart People's Port), innovations in South African ports are yet to face a lot of opposition. Therefore, the human element will remain a barrier to the introduction and success of digitalization and automation in South African ports.

4.2. How does the Commercial Ports Policy, 2002 address the issue of human element in the process of port digitalization and automation?

TNPA recognises the Commercial Ports Policy, 2002 as the main policy for the improvement of port efficiency and adaptability through improved technology. The planned technological innovation projects are governed by the policy, however, the policy implantation is questionable. Given the historical context of South African ports, and considering the time when the policy was passed, it is apparent that the pace of port innovation has surpassed the development of current laws and policy aimed at regulating the ports, as also argued by Stratton (2003).

The Commercial Port Policy, 2002 was drafted for the improvement of the ports and for the benefit of neighbouring cities and communities. It covers various aspects to ensure that the ports perform to their maximum capacity. This include the use of technological means to operate the ports. However, considering the assessment of the views above, it can be argued that the challenge in section 3(10) of the Policy remains a barrier towards the introduction and success of digitalization and automation in South African ports.

On the other hand, section 3(9) of the policy addresses the need for sustainable development of ports, together with sustainable benefits in socio-economic concepts. These include job creation, the promotion of Small, Medium and Micro Enterprises (SMMEs), increasing the national skills base through capacity building and training of employees. Through this provision, TNPA is mandated to upskill, reskill and train port workers in general and for various projects and sustain employment. This approach is argued to have benefited some developed ports as argued by Vaggelas & Leotta (2019). However, this mandate is challenging, specifically for technological innovation in the South African ports' environment. TNPA faces a dilemma due to these conflicting provisions, because even with these initiatives, the introduction of digitalization and automation will still result in a loss of many jobs in the ports.

Since 2002, no policy amendments have been made to address this challenge or any other complementary legal framework. The policy falls short in clearly articulating how the human element in ports can be addressed when technological developments are executed. Furthermore, the policy does not cover any specific mandate addressing how section 3(9) can be achieved while a transition to digitalization and automation is implemented.

The objectives of National Development Plan 2030 explained above further compromises the position of TNPA, with its strong position to reinforce the balance between economic and social benefits across all sectors. The Commercial Ports Policy, 2002, shall also be up to speed with this requirement. Currently, the labour unions argue that as much as this policy achieves economic transformation, it does not take cognisance of the social aspect present in ports, especially the past conditions of employment for port workers. They further argue that the policy raises a problem instead of bringing a solution to a challenge that existed for many decades.

It is clear that TNPA and the Government did not consider revisiting the demands made by the labour unions since the deployment of containerization, which was to legislate initiatives which they believed would cause harmony in the era of human-technology interaction. The strike action of the 1980s was due to failure by the

Government to adequately regulate the industry, which finally led to a wide spread industrial overview. The motive was to try make laws and policies remain relevant and practical.

More pressure was exerted on the Government by labour unions, asking the Government to regulate the employment conditions when technologies were deployed at the ports. Some of these requests were accepted in a white policy document of Transport Department at that period. The plan was to promulgate the policy and officialise it. It would include “optimal employment”, which meant that each stevedoring or private company would apply descent standards of employment and not run the company with only casual workers without any job security. However, this initiative never made it to the official policy or any legislation.

It can be argued that the port has always needed more growth in profits, and what is driven by the question of profit making far surpasses that of human element in the production system. Therefore, until today the Commercial Ports Policy, 2002 seems to have not been the solution in addressing the human element in ports when technological port developments are considered.

4.3. What is the level of cooperation between different stakeholders to address the issue of human element in the process of port digitalization and automation?

It is important to note that South African ports, especially the port of Durban, host multiple business activities which are conducted by different and independent companies. These companies (including stevedoring companies) do not have a uniform approach to labour relations space, and TNPA after awarding tenders, it does not control their decisions.

TNPA argues that for the Port Authority related plans and activities, labour unions are consulted every step of the way, so that their concerns and inputs are taken into consideration when port innovations are proposed. These consultations are done

through monthly local business council meetings that discusses port performance and how the ports can be repositioned for the changing global port environment. These meetings always encourage the exchange of ideas between port management and recognised unions.

Labour unions argue that transparent stakeholder engagement determines the fate of the port, and without it, no swift transition to technological development can take place. The importance of stakeholder engagement is emphasised by IFT (2021). In the early stages of containerization, the unionised labour in the ports, together with the stakeholders had moments of meaningful engagements. The port workers, the Government, Transnet and independent private companies operating in the port were able to establish certain forms of minimum standards in the midst of technological innovations.

Late 1980s up mid-90s symbolised some level of stability. However, today labour union feel that their power is immensely influenced and their voices somewhat suppressed. The business council meet frequently, and this is a positive change that came with Transnet in the new democratic Government.

In assessing the views, theoretically, stakeholders are consulted, however, honest and transparent articulation of the proposed plans is not clear. Also, labour unions argue that they cannot openly challenge the possible loss of jobs by port workers when digitalization and automation is introduced in the port. The challenge stated in section 3(10) of the policy is always ignored if not eliminated from the conversations, with topic of increased volumes and competition taking preference. Overall, meetings happen frequently, but comfortable and meaningful consultation lack behind, thus making the level of consultation questionable.

4.4. What are the initiatives used by technologically advanced ports to deal with the effect of human element in port digitalization and automation?

Port systems and environments differ across the globe. There exists no special initiative suitable for each and every port. However, this does not mean South Africa should not look at foreign initiatives when proposing technological innovations in ports. Rotterdam and Antwerp are considered the earliest ports to digitalize and automate port operations (Gurumurthy & Bharthur, 2019). These ports' success involved retrenchments and offering of retirement packages to workers. The port of Shanghai on the other hand moved some labour out of the port area and placed them on production zones as alternative means to create jobs.

TNPA has not mentioned retrenchments and package offering as a solution to deal with port labour when digitalization and automation surfaces. Considering this path might be against the Constitution, the National Ports Act, 2005, the National Development Plan 2030, and various strategic documents. All these documents support and promote employment creation and the wellbeing of port workers. This is the reason why TNPA considers re-skilling and up-skilling port labour as a justifiable initiative to prevent or minimize job losses, and also to keep sustainable labour.

In the mid-90s, the South African labour forces took upon themselves to study different modes of operations within modernised ports after witnessing the effect of unregulated technologies within the ports. They drew ideas such as the Dock Labour Scheme from port of Liverpool, Antwerp and all other ports leading such initiatives. The intention was to absorb methods of port modernization with the inclusion, as opposed to exclusion or substitution of human element. The aim was to avoid further conflicts within the stakeholders. Before the NDLS could be curtailed, a pilot project was up and ensured stabilised the stevedores' population in the port, accounting to about 63% of the whole working personnel in port which was similar percentage for ports of Liverpool, Antwerp and Hamburg at the time.

This initiative together with optimal employment explained above, were believed to be acceptable by all stakeholders until political instability caused key stakeholders to withdraw their support. The labour unions strongly believe that considering the South African port environment and the challenge stipulated in sections 3(10) of the Commercial Ports Policy, 2002, these initiatives are still relevant today.

Many countries have offered forced retirement packages, and port workers accepted this because these workers could be employable else in the country should they still wish to work. However, this might not be a solution for South Africa, a country with a very high unemployment rate, and little job opportunities for people holding low qualifications.

Chapter Five: Conclusion and Recommendation

This chapter considers the main objectives of the study, and illustrate how the findings, literature and critical arguments formulated thereafter meet the objectives. Finally, this chapter make recommendations addressing the issue of human element in South African ports.

5.1. Study Conclusion

This study considered the South African ports environment, the nature of port operations and the organizational changes expected from the imminent plans to introduce technological innovations. The objective of the study involved assessing the effect of human element on the success of digitalization and automation of South African ports, and also looked at the extent to which the Commercial Ports Policy, 2002 addresses this issue. Further objectives considered the assessment of consultation process between port stakeholders and planned initiatives to ensure that digitalization and automation poses no threat to port workers.

The findings provided an informed analysis on how the human element may hinder the transition from manual operations to digitalized and automated port systems. It was clear that the problem entrenched in section 3(10) of the Commercial Ports Policy, 2002, has not been considered in the current port development plans, and without proper policy and legislative amendments aligned to digital strategy, the human-technology interaction presents large friction. The technological development plans seemed ambiguous and viewed by port labour as means to lay them off and use machines to replace them.

This lack of consensus stems from the shortcomings presented by the Commercial Ports Policy, 2002, which fails to match the pace of the ever-changing and developing maritime and port industry. A further constrain involves lack of meaningful and transparent consultation between the port stakeholders. The findings illustrated that labour unions are not fully informed about the proposed plans, and

nothing is discussed on how to address the human element when digitalization and automation systems are introduced in the port. TNPA fails to address the elephant in the room and loosely mention reskilling and upskilling as the main initiatives for the Smart People's Port project to succeed.

Many developed ports experienced the tension, opposition and resistance to technological change brought by labour unions, and they decided to offer early retirement packages and retrenched most of their port workers when machines surfaced in the ports. South Africa aims to use technology to develop people and to experience the technological transition with the people. This ideology, as literature depicted, is formulated considering the South African past injustices and exploitation of the port workers, which is back-up by the supreme Constitution of South Africa and the National Development Plan 2030.

Section 3(10) of the Commercial Ports Policy, 2002, illustrates a unique South African port environment largely shaped by its historical and political dynamics. Now, the important question was whether, the initiatives applied by foreign ports may be incorporated into or implemented South African port industry. For a country plagued with high unemployment rate, low skilled and uneducated people and poverty, the aim is never to deprive people of their jobs, but to create more job opportunities. Therefore, South Africa has not mentioned any retrenchment or forced retirement initiatives, but believe in reskilling and upskilling the port labour so that they are well equipped to work with technology. However, this study raised a concern on this initiative when considering the social dynamics and age of current port workers (as raised by the section 3(10) of the Commercial Ports Policy, 2002), arguing that it will be a loss in investment if reskilling and upskilling is done for old and illiterate labour which forms the majority of dock workers. Secondly, this will not work when dock workers are still casual labour and no employment structure is implemented.

At present, it is clear that the human element will have a huge effect on the success of advanced digitalization and automation of South African ports. The South African port industry is not ready to move from current manual operations to modern

innovations, especially since the Commercial Ports Policy, 2002, does not address the human element in ports.

5.2. Recommendations

It can be accepted that a swift transition from manual port operations to digitalized and automated systems is not easy to achieve without proper regulation of the industry and clear well developed policy framework. Literature debated the challenges and the opportunities that technology brings into the port industry. The ITF (2021) strongly argue that the push for and success of technological developments depends on various factors, which are port specific. One of the factors considered was the cost of labour. South African port labour is not expensive and this shall not form part of the reason for a push to digitalization or automation, but maximization of profits.

As much as the South African ports, especially, the port of Durban is currently performing well, the technological advancement are needed to reach port maximum potential and improve port attractiveness. However, before large amounts of investments and extensive private sector involvement in port operations occur, it is recommended that TNPA and the government review the Commercial Ports Policy, 2002, with a clear aim of overcoming the challenge in section 3(10), other relevant labour legislation, and align these with the port technological development strategy. While reviewing the policy, social and economic factors of the country must be considered to avoid loss of jobs and loss of profits by the ports when labour decide to go on strikes against machines, putting port operations to a stop.

Further recommendations of this study formulate more practical means to be included in the policy review and overcoming the effect of the human element. TNPA shall reconsider the use of NDLS for the purposes of controlling the port employment structure (dock workers), the number of workers, their age etc. this will not only motivate the employees and make them feel relevant, but it might allow TNPA to effectively and strategically implement the reskilling and upskilling initiatives. Having

the NDLS in place will also attract more young and vibrant workers who in a medium term would be properly trained to work with advanced digitalized and automated systems. This method was investigated and proposed by labour unions in the 1980s, having drawn it from ports of Liverpool for example.

A third consideration would involve multiskilling of old port labour. South Africa has potential space for distribution zones. Old labour may be used for less dangerous work, involving manufacturing full PPE for port staff. Lastly, TNPA and as per “operational requirements” be transparent and offer retirement packages to those workers who prefer leaving employment. These initiatives would take time to yield results, however, they would benefit the South African port industry in the long term, remove the barrier presented by the human element, and allow the introduction of digitalization and automation to benefit the ports and people of South Africa.

References

- Ahmed, J. U. (2010). Documentary research method: New dimensions. *Indus Journal of Management & Social Sciences*, 4(1), 1-14. <http://ideas.repec.org/s/iih/journal.html>
- Bangwandeem, M. (2022). Development of smart ports in Africa. *An opportunity for Singapore to step in*. <https://www.ntu.edu.sg/cas/news-events/news/details/development-of-smart-ports-in-africa>
- Bazeley, P. (2004). Issues in mixing qualitative and quantitative approaches to research. *Applying qualitative methods to marketing management research*, 141, 156.
- Bichou, K., & Gray, R. (2005). A critical review of conventional terminology for classifying seaports. *Transportation Research Part A: Policy and Practice*, 39(1), 75-92. <https://doi.org/10.1016/j.tra.2004.11.003>
- Boeije, H. (2002). A purposeful approach to the constant comparative method in the analysis of qualitative interviews. *Quality and quantity*, 36(4), 391-409. DOI: 10.1023/A:1020909529486
- Cao, G. (2007). The pattern-matching role of systems thinking in improving research trustworthiness. *Systemic Practice and Action Research*, 20(6), 441-453.
- Chao, S. & Lin, Y. (2017). "Gate automation system evaluation; A case of a container number recognition system in port terminals", *Maritime Business Review*, Vol. 2 No. 1, 2017 pp. 21-35, <https://doi.org/10.1108/MABR-09-2016-0022>
- Chen, J., Zheng, T., Garg, A., Xu, L., Li, S., & Fei, Y. (2019). Alternative maritime power application as a green port strategy: barriers in China. *Journal of Cleaner Production*, 213, 825-837. <https://doi.org/10.1016/j.jclepro.2018.12.177>
- Chu, F. (2018). The Future of Automated Ports, Mc Kinsey Insights, Mc Kinsey & Company. <https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/the-future-of-automated-ports>.
- Commercial Ports Policy*, 2002 (SA) Section 3(10). <https://www.gov.za/documents/national-commercial-ports-policy-white-paper>
- Creswell, J. (2009). Research design: qualitative, quantitative and mixed methods approaches. 3rd ed. Thousand Oaks: SAGE Publications.

- Dubbeld, B. (2003). Breaking the buffalo: the transformation of stevedoring work in Durban between 1970 and 1990. *International Review of Social History*, 48(S11), 97-122. DOI: 10.1017/S0020859003001287
- Etikan, I., & Bala, K. (2017). Sampling and sampling methods. *Biometrics & Biostatistics International Journal*, 5(6), 00149.
- Gurumurthy, A., & Bharthur, D. (2019). Impact of Digitalisation in the Ports Sector. *Artificial Intelligence in India*, 5. <https://dx.doi.org/10.2139/ssrn.3873179>
- Hallberg, L. (2013). Quality criteria and generalization of results from qualitative studies. *International journal of qualitative studies on health and well-being*, 8. doi:10.3402/qhw.v8i0.20647
- Heilig, L., Schwarze, S., & Voss, S. (2017). An analysis of digital transformation in the history and future of modern ports. <http://hdl.handle.net/10125/41313>
- International Labour Organization, 1919, <https://www.ilo.org/>
- International Maritime Organization, March 17, 1958, <https://www.imo.org/>
- International Trade Administration. (2021). South Africa – Country Commercial Guide. <https://www.trade.gov/country-commercial-guides/south-africa-ports-and-marine>
- International Trade Administration. (2021). South Africa Ports and Marine. <https://www.trade.gov/country-commercial-guides/south-africa-ports-and-marine>
- International Trade Forum. (2013). The Competitiveness of Ports in Emerging Markets, The case of Durban, South Africa. <https://www.internationaltransportforum.org/Pub/pdf/14Durban.pdf>
- International Trade Forum. (2021). “Container Port Automation: Impacts and Implications”, International Transport Forum Policy Papers, No. 96, OECD Publishing, Paris.
- Levinson, M. (2006), *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger*, Princeton University Press.
- Logistics and Transport. (2016) <https://www.bizcommunity.com/Article/196/389/152482.html>
- Marianos, N., Lambrou, M., Nikitakos, N., & Vaggelas, G. (2011). Managing port e-services in a socio-technical context. *International Journal of Shipping*

- and Transport Logistics, 3 (1), pp. 27-56.
- Martin-Soberon, A., Monfort, A., Sapina, R., Monterde, N., Caldach D., (2014). Automation in Port Container Terminals”. *Procedia – Social and Behavioral Sciences*, 160, pp. 195-204.
- Matinlauri I., (2016), “The art of terminal automation – defining a successful deployment strategy”. Presentation delivered at the TECH TOC conference in 2016 TOC Europe, 15 June, Hamburg.
- McKinsey and Company (1967), *Containerization: the key to low-cost transport*; London, British Transport Docks Board.
- McKinsey and Company, (2018). “The future of automated ports”. Prepared by Chu F., Gailus S., Liu L. and Ni L. Available online at: <https://www.mckinsey.com/industries/travel-transport-and-logistics/our-insights/the-future-of-automated-ports>. Accessed: August 27, 2019
- McMillan, J. and Schumacher, S. (1997). *Research in education. A conceptual introduction*. 3rd ed. New York: Harper Collins College Publishers.
- Merriam, S. and Simpson, E. (2000). *A guide to research for educators and trainers of adults*. 2nd ed. Melbourne, FL: Krieger.
- Moustakas, C. (1994). *Phenomenological research methods*. Sage publications Inc.
- Mouton, J., Marais, H., Prinsloo, K., Rhoodie, N., and Mauer, K. (1991). *Basic concepts in the methodology of the social sciences*. Pretoria: Human Sciences Research Council.
- Mujere, N. (2016). Sampling in research. In *Mixed methods research for improved scientific study* (pp. 107-121). IGI Global. DOI: 10.4018/978-1-5225-0007-0.ch006
- National Planning Commission. (2012). *National Development Plan 2030 Our Future-make it work*. <https://www.gov.za/issues/national-development-plan-2030>
- National Ports Act, 2005 (SA) Chapter 1-7*. <https://www.gov.za/documents/national-ports-act>
- Notteboom, T. (2017). *Port Economics, Management and Policy. A comprehensive analysis of the port industry*. <https://porteconomicsmanagement.org/pemp/contents/part3/port-labor/>
- Oliveira, H. and R. Varela (2017), *Automation in Ports and Labour Relations in XXI*

Century,
<https://raquelcardeiravarela.files.wordpress.com/2017/07/studyautomation-2.pdf>.

- Prism Economics and Analysis. (2019). Economic Impact Study of Digitization and Automation of Marine Port Terminal Operations in British Columbia, commissioned by ILWU Canada. https://ilwu.ca/wp-content/uploads/prism-ilwu_report-a3-aug14.pdf.
- Rahman, A., Ationg, R., & Zulhaimi, N. (2017). A paradigm shift in understanding mixed method research: A Malaysian perspective. *Journal of Advanced Research in Social and Behavioural Sciences*, 9(1), 46-56.
- Roosevelt, M. (2019). Heated battle over automation and jobs at Port of L.A. moves to City Council. JUNE 20. Los Angeles Times. <https://www.latimes.com/business/la-fi-ports-automation-vote-20190620-story.html>
- Rothblum, D. A. (2000). Human Error and Marine Safety. National Safety Council Congress and Expo. Florida. Retrieved June 16, 2021. http://www.bowles-langley.com/wp-content/files_mf/humanerrorandmarinesafety26.pdf
- Satta, G., Maugeri, S., Panetti, E., and Ferretti, M. (2019). Port labour, competitiveness and drivers of change in the Mediterranean Sea: a conceptual framework. *Production Planning and Control*, 1-16.
- Schroër, H. et al. (2014), “Evaluation of inter terminal transport configurations at Rotterdam Maasvlakte using discrete event simulation”, in: Winter Simulation Conference, vol. 2014, pp. 1771–1782, <https://doi.org/10.1109/WSC.2014.7020026>.
- Smith, Matthew, and Sujaya Neupane. (2019). “Artificial Intelligence and Human Development: Toward a Research Agenda.” <http://hdl.handle.net/10625/56949>.
- Sofaer S. (1999). *Qualitative methods: what are they and why use them?* *Health Serv Res.* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1089055/>. PMID: 10591275
- Stahlbock, R. & Voss, S. (2008), “Operations research at container terminal operations: a literature update”, *OR Spectrum*, 30:1, 3-49, <https://doi.org/10.1007/s00291-007-0100-9>.
- Stratton, S. D. (2003). *Industrial relations in the port of Durban: the implementation of the National Dock Labour Scheme/Simon Stratton* (Doctoral

dissertation).

<https://digital.library.adelaide.edu.au/dspace/bitstream/2440/22063/2/02whole.pdf>

- Sullivan, J. R. (2012). Skype: An appropriate method of data collection for qualitative interviews? *The Hilltop Review*, 6(1), 10. <https://scholarworks.wmich.edu/cgi/viewcontent.cgi?article=1074&context=hilltopreview>
- Swanson, R. (2005). The challenge of research in organizations. In R. A. Swanson and E. Holton, (Eds.). *Research in organizations: foundations and methods of inquiry*. San Francisco: Berrett-Koehler, pp. 3-10.
- Tilson, D., Lyytinen, K., Sørensen, C. (2010). Research commentary—digital infrastructures: The missing IS research agenda. *Information Systems Research*, 21(4), 748–759
- Transnet Port Terminals. (2022). Innovation in South Africa's Ports. <https://innovationsoftheworld.com/transnet-port-terminals-tpt-innovation-in-south-africas-ports/>
- United Nations Conference on Trade and Development. (2018). 'Review of Maritime Transport'. http://unctad.org/en/PublicationsLibrary/rmt2017_en.pdf
- Vaggelas, G. K., & Leotta, C. (2019). Port labour in the era of automation and digitalization. What's next? *Impresa Progetto-Electronic Journal of Management*, 3, 1-15. DOI: 10.15167/1824-3576/IPEJM2019.3.1232
- Wan, C., Zhao, Y., Zhang, D., & Yip, T. L. (2021). Identifying important ports in maritime container shipping networks along the Maritime Silk Road. *Ocean & Coastal Management*, 211, 105738. <https://doi.org/10.1016/j.ocecoaman.2021.105738>
- Wright, D. (2012). Redesigning informed consent tools for specific research. *Technical Communication Quarterly*, 21(2), 145-167. <https://doi.org/10.1080/10572252.2012.641432>

ANNEXURE “A” - Semi-structured interview questions

Organisation: Transnet National Port Authority	
Interview Questions	
1.	Which policies and/or strategic documents are used as a guide to the implementation of ports development to improve efficiency?
2.	The 2002 Commercial Ports Policy makes provision for the improvement of port efficiency and adaptability through improved technology. Do these provisions apply to/cover the current and future port digitalization and automation?
3.	Do the current policies or strategic documents address the human element in ports considering current and future technological port developments?
4.	Considering these developments, are the Labour Unions structures included or consulted in the strategic directions to modern/technological port developments?
5.	What initiatives are put in place or planned to strike a balance between the need for improved port efficiency and the human element in ports?

Organisation: National Union of Metalworkers of South Africa	
Interview Questions	
6.	What kind of work is the port labour (dock workers and office workers) actively doing and how has the nature of work changed over time?
7.	How has the introduction of technologies in the port affect the employees scope of work?
8.	How inclusive is the consultative structure in all policy implementation by port management?
9.	What is the position of the Labour Unions on port digitalization and automation?
10.	What effect would privatisation of the port have on the port labour?

11.	What initiatives and recommendations put forward by Labour Unions to Terminal Operator (Transnet) regarding the prospects of port modernization?
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Organisation: Transnet Port Administration	
Interview Questions	
12.	What kind of work is the port administration actively doing and how has the nature of work changed over time?
13.	How has the introduction of technologies/digitalization and the foreseen modernisation of the port systems affect the employees scope of work?
14.	How challenging is to adapt to new skills set required by the port digitalization and automation?
15.	Does Transnet provide any training and skills development programmes in relation to port digitalization and automation?
16.	What proposals and recommendations do the employees put forward to Transnet management regarding the prospects of port modernization?