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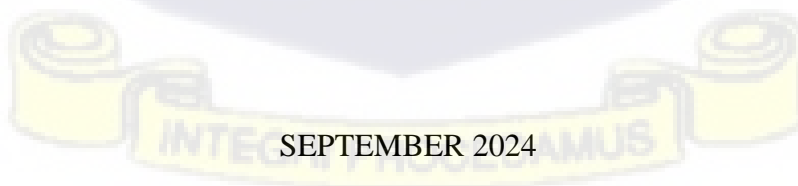
BUSINESS SCHOOL

INTELLIGENT SOFTWARE ROBOTISATION (ISR) OF WORK IN DEVELOPING
ECONOMY FIRMS: A COMPLEMENTARITY AND CONFIGURATIONAL ANALYSIS

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THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF
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DEPARTMENT OF OPERATIONS AND MANAGEMENT INFORMATION SYSTEMS



DECLARATION

I do hereby declare that this work is the result of my own research and has not been presented by anyone for any academic award in this or any other university. All references used in this work have been fully acknowledged.

I, therefore, bear responsibility for any shortcomings.



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ABSTRACT

Intelligent software robotisation (ISR) is the use of software robots with intelligent capabilities, to reduce human intervention in business processes. The level of robotisation (LOR) is the degree of robot autonomy and intervention in a process and the two levels of general interest are the high LOR (high robot autonomy) and complementary LOR (shared autonomy with human oversight control). Currently typified by two technologies namely, robotic process automation (RPA) and artificial intelligence (AI), ISR brings a number of benefits to adopting organisations. These include cost savings, error reductions (accuracy), faster delivery times and increased productivity. In spite of the role that these ISR benefits (particularly cost savings and increased productivity), could play in helping firms in developing economies navigate the post-Covid economic challenges, regions such as, Africa have been noted for a slow ISR deployment rate. Furthermore, there are reports of a high failure rate of ISR projects in general. Motivated by these two issues, and adopting a configurational analytic approach, this study set out to understand the configuration of conditions that could explain the low ISR deployment rates and high project failure rates, with the ultimate purpose of developing a framework for successful ISR deployments in developing economies. A review of extant literature revealed some knowledge gaps related to the planned purpose, which helped further elaborate and firm up the study's objectives. These were in the areas of ISR implementation approaches involving complementary LOR, employee job security concerns and coping strategies, as well as ISR theorization. Consequently, three objectives were developed to concurrently fulfill the purpose of the study while addressing these gaps.

The three research objectives which steered this study are: *(i) To examine the configurations of necessary and sufficient conditions which influence the decision to deploy intelligent software*

robotisation by a developing economy firm. (ii) To analyse the configurations of sufficient and necessary conditions which influence employees' choice of coping strategies towards the deployment of intelligent software robotisation by a developing economy firm. (iii) To identify the nature of complementarity between humans and machines in intelligent software robotisation deployments in a developing economy firm.

To address these objectives, the research efforts were guided by the critical realism paradigm, within which a parallel mixed methodology with a triangulation design was adopted. The quantitative inquiry employed a survey research method, while the case study method was used for the qualitative leg. The main consideration behind the choice of these methodological orientations, was their suitability for the research purpose which required a diverse and comprehensive set of data. Similarly, theoretical support was provided by three diverse models, on organisational technology adoption (TOE framework), IT coping behaviour and ISR complementarity. Data was collected from private sector organisations in the banking, insurance, telecommunications and business process outsourcing (BPO) sectors in Ghana. Data analysis was once again facilitated by diverse approaches namely, the Miles & Huberman (1994) approach and critical realist retrodution for the qualitative inquiry and Fuzzy-set Qualitative Comparative Analysis (FsQCA), a configurational analytic technique, for the quantitative inquiry.

Findings from the first research objective indicate that, all the eight technological, organisational and environmental conditions investigated namely, Anthropomorphism, Technology Availability, Technology Accessibility, Firm Size, Organizational Structure, Industry Characteristics, Technology Infrastructure and Regulations, are necessary and sufficient conditions in influencing the decision to deploy ISR in developing economy firms. They could thus help to explain the low adoption rate and high failure rates of ISR initiatives in developing economies, which was among

the primary motivations for this study. Conditions which emerged as requiring notable attention were the presence of technology availability, technology infrastructure (such as stable energy, broadband connectivity, data ecosystem, and cybersecurity) and industry characteristics (including labour union activities). These are valuable in explaining the low adoption rate of ISR in developing economies. Organisational structures (such as top management support, change management, skilled human resources and organisational culture) was also a notable finding, valuable in explaining the high rate of ISR project failures. The absence of regulations (such as laws on responsible & ethical AI and data privacy protection) as a core condition leading to a favorable decision to deploy ISR was a particularly noteworthy finding, in the light of recent global efforts towards regulations on the ethical and responsible deployment of AI. The finding is supported by literature which indicates that the presence of regulations could sometimes stifle the adoption of AI or other emerging technologies. This study's qualitative inquiry cited the nascency of ISR adoption and industry-led self-regulation mechanisms as the reasons for the absence of regulations in the case country. The unique contributions from this objective are : the use of technology adoption research for a specific empirical analysis of the low adoption rates and high failure rates of ISR initiatives in Africa; the test of *anthropomorphism* in *back-end software robots* and *labour union activities* as constructs or conditions influencing ISR deployment, which had not been previously tested.

Findings from the second research objective confirm the sufficiency and necessity of three conditions, Level of robotisation (LOR) of an ISR event (High or Complementary); Level of employee Control over working conditions, robots and emotions (High or Low) and the potential for self-interest fulfillment (Opportunity or Threat), in influencing employees' selection of coping

strategies towards ISR. The unique contribution from this objective was the test of LOR as a construct or condition in employees' coping strategies which had previously not been tested.

Findings from the third research objective, which were derived from the qualitative inquiry, were quite extensive (19 in all) and provided useful information on the various facets of the nature of complementarity in ISR deployments in developing economies. Some of the unique contributions from this objective included the cautionary approach adopted by firms towards the implementation of the level of intelligence in the robots and level of robotisation (LOR), fueled by concerns about internal skills maturity, system security and trust.

Findings from the integration of the mixed methods inquiries (quantitative & qualitative) yielded a synthesis of information on a number of related themes from both inquiries: technology availability was integrated with awareness of ISR; organisational structure with top management support; employment security with labour union activities; regulations, anthropomorphism and LOR with themes of the same name in the counterpart studies.

Finally, the originality of the study as a whole lies in the development of a proposed framework for successful deployment of ISR in developing economy firms, which brings together all the key findings from this study. The framework thus encapsulates this study's contribution to research, practice and policy. For practice, the proposed framework provides guidance on general, human, machine and organisational conditions which influence the successful deployment of ISR in developing economies. On the flip side, the conditions are those which if ignored, could contribute to the failure of ISR initiatives. For research, the framework provides some new constructs and variables for the development of further models on ISR deployment. For policy, the general conditions segment of the framework, serves as a useful resource for areas of policy intervention.

DEDICATION

This thesis is dedicated to my family



ACKNOWLEDGEMENT

This work would not have been possible without the grace of the Almighty and the contributions of numerous people. Thus, this work is a product of their efforts as well.

My sincerest gratitude goes foremost to my supervisor, Dr. Eric Afful-Dadzie, for his academic guidance, encouragement and immense support in countless ways. In the challenging times, he never gave up on me. He has exemplified the true definition of a mentor and I would forever be grateful.

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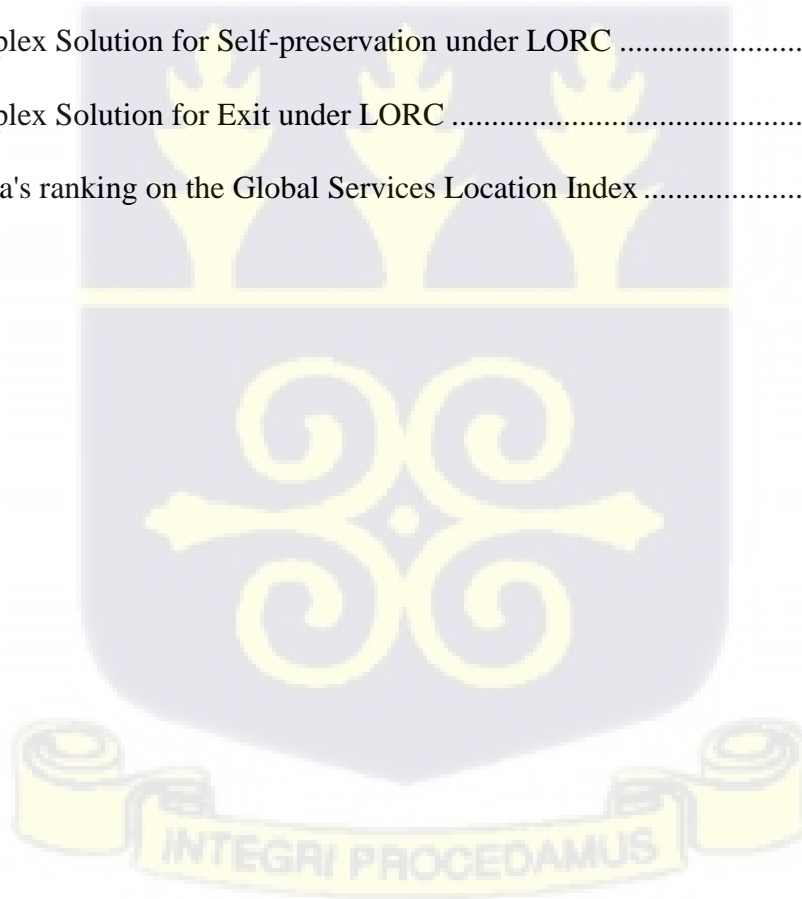
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LIST OF KEY ABBREVIATIONS

AI	Artificial Intelligence
ISR	Intelligent Software Robotisation
LOA	Level of Automation
LOR	Level of Robotisation
RPA	Robotic Process Automation



CHAPTER ONE

INTRODUCTION

1.1. RESEARCH BACKGROUND

Aside the tragic loss of about 6.7 million lives from 2020 to 2022 (World Health Organisation, 2023) and a decline of global economic growth from 5.9% in 2021 to an estimated 2.9% in 2022 (World Bank, 2023a), one prominent outcome of the COVID-19 crisis has been an accelerated adoption of digital technologies (Wibowo et al., 2022; Ofosu-Ampong & Acheampong, 2022; Lacity & Willcocks, 2021; Amankwah-Amoah et al., 2021; McKendrick, 2021). Among them is intelligent software robotisation (ISR) involving robotic process automation (RPA) and artificial intelligence (AI) tools (Wibowo et al., 2022; Lacity & Willcocks, 2021; McKendrick, 2021).

Robotisation is employed here in reference to the substitution of human labour (automation) with the use of robots (Berkers et al., 2022; Brodny & Tutak, 2021; Uskenbayeva, et al., 2019). Most definitions of robots focus on machines, either stationary or moving (Beer et al., 2022; Loh, 2019; Lin et al., 2011; Weber, 2008) and ignore recent software trends in automation. However as indicated by Uskenbayeva, et al. (2019), robotisation refers to the use of both mechanical and software robots, the sense in which the term “robot” is used in this paper. Of particular interest to this study however, is the increasing adoption of *software robots*. It must be noted here that software robots (which include chatbots, web crawlers and search engines), are not all intelligent. Currently what makes technology intelligent is the capability to learn and adapt through the AI technique of machine learning (ML) (Kaplan & Haenlein, 2019; Huang & Rust, 2018). ML is a set of methods that allow an algorithm to learn iteratively from training data to improve on its

ability to solve problems, including those for which it has not been directly programmed (Schoormann et al., 2023; Nguyen et al., 2022; Kaplan & Haenlein, 2019).

Thus, intelligent software robotisation (ISR) is described as, the use of disembodied programmable mechanisms with intelligent capabilities, to reduce human intervention in business processes characterised by both structured and unstructured data (Engel et al., 2021; Lacity & Willcocks, 2021). ISR is currently typified by two technologies, robotic process automation (RPA) and artificial intelligence (AI) tools. Artificial intelligence (AI) tools are autonomous systems driven by algorithms which replicate human cognitive abilities, such as, sensing, reasoning, learning, innovation and decision-making to solve problems (Nguyen et al., 2022; Benouda et al., 2020 & Benbya et al. 2020). RPA is an automation technology comprising software robots, usually configured to perform rules-based routine tasks involving structured data and pre-defined outcomes, but which have evolved to incorporate AI features such as machine learning (ML), natural language processing (NLP) (Filgueiras et al., 2022; Lacity & Willcocks, 2021; Ribeiro et al., 2021; Schmitz et al., 2019). The term RPA is thus used in this paper to refer to RPA tools enhanced with AI features and are thus capable of handling both rules-based and intelligent tasks. The principal benefit which drives organisations to adopt ISR with RPA is cost savings, usually realized through a streamlining of personnel costs. For example, Deutsche Telekom in Germany is reported to have made a savings of 800 FTEs (full-time equivalent employees) within three months of deploying RPA (Schmitz et al., 2019). Also, some estimates indicate that the cost of an RPA robot is about one-fifth the cost of a full-time employee (Hindel et al., 2020) and far cheaper than an employee outsourced to an offshore company (Patri, 2021; Lacity & Willcocks, 2016a). Other RPA benefits include elimination of human processing errors (Dey & Das, 2019; Moreira et al., 2023; Madakam et al., 2022; Kokina & Blanchette, 2019), improving service quality

(Waizenegger & Techatassanasoontorn, 2020; Lacity & Willcocks, 2016a), reducing delivery time (Madakam et al., 2022; Kokina & Blanchette, 2019; Lacity & Willcocks, 2016a), increased productivity (Moreira et al., 2023; Madakam et al., 2022; Lacity & Willcocks, 2016a) and freeing employees from mundane work to allow them focus more on value-added activities involving problem solving (Dey & Das, 2019).

Motivated by such benefits, ISR was growing significantly before the pandemic, with projections that by 2022, 85% of large firms with revenues of over \$1 billion would implement RPA (Gartner, 2018). During the pandemic there was still significant uptake of robotisation, as RPA vendors' revenues reached US\$ 1.4 billion in 2019, rising to US\$ 1.6 billion in 2020, with projections of US\$ 1.89 in 2021 (Gartner, 2020). In 2021 organisational spending on RPA was US\$ 2.4 billion and this was projected to reach US\$ 2.9 billion in 2022 and US\$ 3.4 billion in 2023 (Gartner, 2022).

During the COVID pandemic, cost management was a major reason for RPA adoption (Gartner, 2020), as part of a strategic business response to the economic depression caused by the pandemic. Post-Covid, an accelerated adoption of automation in general (including ISR), is still predicted as a coping strategy by businesses to stay afloat and protect investments (Chernoff and Warman, 2020; Gartner, 2020), still in response to the economic recession following the pandemic (World Bank, 2023a). Further motivations for adoption comes from advantageous features of RPA such as, its relatively moderate price tag (Desjardins, 2019; Gartner, 2020) as well as being highly adaptable and easily integrated into existing ICT systems (Tilley, 2017). ISR is not without its risks and some of the challenges includes data availability and compatibility challenges, security risks, negative appraisals about impact on jobs resulting in stakeholder resistance, difficulties with identification of processes fit for robotisation, lack of required IT skills and vendor support issues.

(Chugh et al., 2022; da Silva Costa et al., 2022). Also, between 30% to 50% of RPA projects are reportedly at risk of failure (Waizenegger & Techatassanasoontorn, 2020; Kokina & Blanchette, 2019).

In spite of the attractive benefits such as, cost savings and increased productivity, which ISR could bring to businesses in developing economies in their efforts to manage the post-Covid economic challenges, regions such as Africa have been noted for a slow adoption of RPA and AI (Fortune Business Insights, 2022; Matinde, 2021). Few empirical evidence is available to explain the reasons behind the low RPA adoption in Africa. According to an article in the *CIO magazine*, the reasons for the slow uptake of RPA in Africa are, cheaper human labor cost which may not make RPA a good business case for the replacement of humans with the robots; fear of job loss, undigitized and hence incompatible processes (prevalence of paper-based processes) and a skills gap (Matinde, 2021). Much as they seem plausible, these reasons for the slow RPA adoption in Africa are anecdotal and require empirical substantiation.

In relation to AI, some challenges have also been reported in the literature as hindering a quicker adoption pace. These include difficulties with digital infrastructure, data availability, investment funding, skills availability and regulatory frameworks (Eke et al., 2023; United Nations Conference on Trade and Development, 2023; African Union Development Agency – NEPAD, 2021). The latest Government AI Readiness Index Report 2023, released by Oxford Insights (Hankins et al., 2023) shows Sub-Saharan Africa with the lowest average readiness score globally. In addition, there is no African country among the top 50 ranked nations with the most readiness scores.

In the midst of these challenges, entrepreneurs seem not to be daunted and are still making efforts to harness the power of these emerging technologies for the continent. For instance, there is a

burgeoning AI ecosystem made up of local tech hubs named after Silicon Valley, such as, ‘Silicon Savannah’, ‘Yabacon Valley’ and ‘Sheba Valley’ in Kenya, Nigeria and Ethiopia respectively. This is in addition to centers established by tech giants such as Google, Facebook, Twitter, Amazon and Microsoft (Eke et al., 2023). These hubs have contributed to the emergence of local AI start-ups which are offering services in the financial, healthcare, agriculture and e-commerce sectors (Ade-Ibijola & Okonkwo, 2023). Other use cases are reported in the mining, manufacturing, energy and education sectors as well as, for government services and access to public resources, water management, climate change predictions (flooding, drought, desertification) and economic planning (African Union Development Agency – NEPAD, 2021; Tony Blair Institute, 2022; Moyo, 2023). Also, riding on the current wave of digitalization on the continent, coupled with post-pandemic economic pressures to stay viable, some large multinational companies in Ghana for example, have begun substantial ISR projects, spending as much as US\$2.5 million (Adombilla, 2020).

From the above, there are indications that the ISR phenomena is set to take off and grow in developing economies, yet as pointed out by Ahmed (2021), not much is known about the potential socio-technical implications of ISR adoption in developing regions such as, Africa. Similarly, there is scanty empirical literature on the slow pace of ISR adoption in Africa. There is thus the need for research to understand the various dimensions of implementing the technology within this particular business environment. This is in order to provide insights which will enable organisations within the region to maximize the value to be derived from the benefits of ISR, while addressing the organisational and socio-economic implications. Furthermore, the current concerns about an ethical and responsible deployment of intelligent automation technologies in Africa (Eke

et al. 2023), also provide a compelling reason for investigations into the ISR phenomena in the developing economy context.

1.2. STATEMENT OF PROBLEM

A review of extant literature revealed a number of contemporary themes related to ISR in general and to developing economies specifically. Five of them were considered relevant for the orientation of this study. These are, implementation and adoption issues, employment security, theorization on ISR, methodological deficits and contextual observations in respect of Africa (see section, 2.3.2). What follows is a discussion of the five themes and related problem dimensions (knowledge gaps and critical issues).

The first knowledge gap area identified in the literature relates to ISR adoption and implementation issues. In general, the widely preferred implementation approach seems to be one involving high levels of automation (LOA) with significant machine control. This approach views robotisation as a replacement of human labour and could arguably be regarded as being largely responsible for the sometimes-negative appraisals about ISR initiatives as a threat to human employment (Radhakrishnan & Gupta, 2022; Calitz et al., 2021; Eikebrokk & Olsen, 2020). Human oriented issues related to the effects of high LOA implementation such as, complacency, automation bias and situation awareness have received some attention in the ergonomics and human factors disciplines (Endsley, 2018 & 2017; Onnasch et al., 2014; Parasuraman & Manzey, 2010). However proffered solutions are usually from the orientations of these disciplines, with much focus on the design of the artefact itself as a solution, with less attention to using implementation approach as a means of addressing these problems.

In contrast is the human-machine complementarity approach, in which humans and machines are viewed as complementing each other (Sutton et al., 2018; Dahlin, 2019; Schwabbe & Castellaci, 2020; Benbya et al., 2021). Complementarity between *industrial mechanical robots* and humans has been decently researched, following the emergence of cobots (collaborative robots) on the manufacturing floor (e.g., Sorell, 2022; Cohen, 2022; Dobra & Dhir, 2020; Oyekan et al., 2019). However, complementarity in relation to *software robots* has not received commensurable coverage in the literature. Thus, though there is an appreciable amount of literature on cobots to guide their implementation, the same cannot be said for practical guidelines on the implementation of complementary ISR (Asatiani et al., 2019; Ruiz et al., 2022). Similarly, there is scanty theorization on how complementarity can reduce challenges such as, overreliance and deskilling, associated with the high LOAs characterized by high machine control (Endsley, 2017; Asatiani et al., 2019; Sutton et al., 2023). Asatiani et al. (2019) noted the paucity of research in this vein and called for more studies on the complementarity approach in software robotisation.

Furthermore, the high rate of failures of RPA implementations to meet expectations, has been red-flagged in the literature. Between 30% to 50% of RPA initiatives are reported to fail and implementation-related factors have been listed as part of the failure risk sources (Waizenegger & Techatassanasoontorn, 2020; Kokina & Blanchette, 2019; Moffitt et al., 2018; Lamberton et al., 2017). These include dimensions such as, technology selection, implementation execution, change management, stakeholder buy-in, (Moffitt et al., 2018) or not having an RPA business case; targeting RPA at the wrong processes; applying traditional delivery methodologies; automating too much of a process; not optimizing for RPA; underestimating what happens after processes have been automated and assuming RPA is all that is needed to achieve a great return-on-investment (Lamberton et al., 2017). Continued investigations of ISR implementation approaches

in general is thus important in providing knowledge for successful implementations. Given the important role of decision-making in such failures, Coombs et al. (2020) called for research to understand the decisional elements related to choices of ISR implementation elements in a firm.

The second knowledge gap area and hence potential research issue identified, concerns employees' job security anxieties in relation to ISR. Quite a lot has been written in both the mainstream media and academia on sentiments towards the human-replacement approach of automation in general, particularly regarding its implications for job security (Benbya et al., 2021; Schwabbe & Castellaci, 2020; Nam, 2019; Dahlin, 2019; Acemoglu & Restrepo, 2017; Dauth et al., 2017; Frey & Osborne, 2013). What seems to be amiss is more scholarly work to understand how employees *practically cope* with those sentiments, in this case, with the introduction of *intelligent software robots* such as, RPA & AI into their working environment. This paucity could perhaps be attributed to the comparatively recency of intelligent software robotisation. However, there is quite an old and established stream of research on how workers adapt to traditional IT systems generally, as seen in the IT resistance, technostress and other related literature (Cigdem et al., 2023; Rohwer et al., 2022; Pillai et al., 2021; Zheng & Montargot, 2021; Baillette & Barlette, 2020; Nisafani et al., 2020; Lin et al., 2018; Yin et al., 2018). In spite of this, relatively few of the coping studies focus specifically on RPA and AI and for that matter the developing economy context. Seiffer et al (2021) for instance lament on the paucity of research on *software robots* generally. Similarly, among the few studies which have examined how workers cope with RPA, Asatiani et al., (2020) and Waizenegger & Techatassanasoontorn (2020) particularly noted the sparseness of studies and called for further research in that regard. In addition, there have long been and there are still warnings about how automation in general tends to have unintended and unanticipated consequences on human activity (Wang et al., 2021; Malik et al., 2021; Parasuraman & Manzey,

2010). This is echoed by Darioshi & Lahav (2021) who in the concluding sections of their work, caution about the exposure to and consequences of biases when using automation-based technology for activities involving decision-making, some of which could be life-changing and life-threatening. On a broader level, Ing & Grossman (2023) in their introduction, note that there is still much we do not know about the effects of continued robotisation on various economies. Kokina & Blanchette (2019) call for investigations into the long-term effects of ISR on employees' job satisfaction and retention. There is thus the need for a continuous scrutiny of the effects of automation on humans and society at large.

The third knowledge gap area identified in the literature was on ISR theorization. There were two issues, theorization on the categorisation of ISR technologies and ISR adoption models. This paper addresses the latter because the scope of the former is too broad for the resources of this dissertation. Regarding ISR adoption models, a noticeable gap was the availability of few software robot-specific adoption models incorporating and testing as constructs, their unique characteristics such as, anthropomorphism and level of robotisation (LOR). The few models available on robots such as, Heerink et al.'s (2010) Almere model and others it had inspired (e.g. Wirtz et al. 2018; Ghazali et al., 2020) had as their subject, *physical service robots*, which were examined from a user's perspective (individual level analysis). Though the model by Wewerka et al. (2020) was on *software robots* and specifically on RPA, the unit of analysis was also at the individual level. All the models had leveraged existing IS models such as, TAM and UTAUT. Consequently, while using constructs such as, perceived usefulness, results demonstrability and hedonic motivation to analyse the robots, they failed to highlight the unique characteristics of the robots such as, anthropomorphism. The individual level orientation of the models made them unsuitable for this

study. This gap highlighted the need for an ISR organizational level adoption model with *software robot-specific* variables such as, anthropomorphism and LOR.

Fourthly, regarding methodology, there was a noticeable deficit of papers which had employed the FsQCA (Fuzzy Set Qualitative Comparative Analysis) approach to study software robotisation. One of the few papers which adopted FSQCA to study robotisation, Laut et al. (2021), indicates the potentially novel insights that could emanate from using such a lens. This is because, unlike traditional variance-based techniques (such as, multiple regression analysis) which aim for the *single* best-fit solution regarding the relationships between conditions that produce an outcome, FsQCA identifies and describes *different* combinations (or configurations) of those conditions that indicate the outcome (Pappas & Woodside, 2021). FsQCA is thus suited for investigating subjects such as, technology adoption, involving complex human decision factors which interact in complex ways.

Finally, a search through the literature on intelligent software robotisation studies in developing economies (with a focus on Africa), showed a minimal corpus. While there exists some work on chatbots and AI initiatives (Ade-Ibijola & Okonkwo, 2023; Essel et al., 2022; Brobbey et al., 2021; Mogaji et al., 2021; Lubbe & Ngoma, 2021; Nawaz & Saldeen, 2020), the few number of published studies on African RPA initiatives, is a telltale sign hinting at the *low adoption rate* of the technology on the continent. The papers sighted were mainly dissertations from universities in South Africa and Kenya (Tew, 2020; Mlambo, 2022; Mbiu, 2022) with a couple of mainstream publications (Iyamu & Mlambo 2022; Lakay & Iyamu 2022; Calitz et al., 2021; Ahmed, 2021). Overwhelmingly, most of these studies, both dissertations and mainstream publications, had as their study context, the financial and banking industries, leaving us with little knowledge about

software robotisation in other key socio-economic sectors in developing economies such as, health, education, telecommunications and governance. An important insight from these few studies, was the fact that, the issue of employment security and the influence of *labour unions* seem to play a key role in robotisation decisions within the African business environment, something which deserves further investigations.

In summary, the literature review on ISR revealed knowledge gaps and critical issues in relation to: (i) implementation approach, particularly the complementarity approach and the high failure rates for ISR projects; (ii) employment security and related dimension of how workers actually cope with the introduction of software robots into their working environment; (iii) theoretical shortcomings with few software robot-specific adoption models incorporating unique robot characteristics as variables; (iv) a methodological deficit in configurational analysis with FsQCA and finally and (v) contextual inadequacies in research coverage on the ISR phenomenon in Africa, reflecting a low adoption rate, as well as employment security as a major ISR concern, with corresponding labour union activities. These elements motivated the purpose and objectives of this study, with a view to making empirical contributions to addressing them.

1.3. RESEARCH PURPOSE

Considering the low adoption rate of intelligent software robotisation in developing economies, against a backdrop of a high failure rate of ISR initiatives, coupled with the general need for developing regions such as, Africa to take advantage of the benefits of emerging technologies such as, ISR to enhance their socio-economic conditions, this study seeks to generate relevant and useful insights to help address these exigencies.

Consequently, from the knowledge gaps identified, the purpose of this research is to *(a) understand the reasons behind the low adoption and high failure rates of ISR projects in developing economies and (b) to develop a framework for the deployment of intelligent software robotisation, founded on complementarity principles and integrating, machine, human and organisational dimensions.* This informed the objectives of the research and provide theoretical and methodological direction.

1.4. RESEARCH OBJECTIVES

Following the adoption of FsQCA as the analytic approach for the study, the research objectives and consequently, the research questions are framed in fulfillment of the requirements of the configurational analytic approach (Kane et al, 2014).

(i) To examine the factors and their respective configurations/combinations that influence the decision to deploy intelligent software robotisation in firms in developing economies.

The principal motivation for this objective is the need to understand the conditions influencing the low adoption rate of ISR in Africa, a critical issue identified in the literature review. Another important rationale is the fact that, implementation related issues have been cited in the literature as one of the major causes of the high RPA project failures (Waizenegger & Techatassanasoontorn, 2020; Moffit et al., 2018; Lamberton et al., 2017) leading to expensive losses to organisations. The subject thus requires continued investigations to unearth potentially fresh insights to guide organisations from avoiding such costly mistakes. Hence this study responds to Coombs et al's. (2020) call for further research to understand the elements related to ISR deployment dimensions.

The objective is addressed with a conceptual framework derived from the established organisational technology adoption model, TOE (Technology, Organisational and Environment) model (DePietro, Wiarda & Fleischer, 1990).

Robotisation-specific factors such as, anthropomorphism were added to address theoretical gaps in ISR adoption models, while labour union activities was infused to address a contextual issues from the literature on developing economies. For fresh insights and in response to the methodological gap in the literature on configurational analysis, data was analysed with FsQCA. The expected outcomes were conditions which help explain the low rates of ISR deployments and also provide insights useful for understanding the high rate of ISR project failures, ultimately contributing to the development of a framework for implementing ISR in developing economies.

(ii) To analyse the factors and their respective configurations/combinations that influence employees' choice of coping strategies towards the deployment of intelligent software robotisation by firms in developing economies.

This objective was prompted primarily by the employment security anxieties of employees in relation to ISR. Concerns have been expressed in the literature on the impact such anxieties could have *generally* on employees' psychological and social well-being, sometimes with unintended and unanticipated consequences (Wang et al., 2021; Malik et al., 2021; Parasuraman & Manzey, 2010). However, there is a gap in the literature on coping strategies *specifically in relation to software robots* which has prompted several associated calls for more research in that direction (Seiffer et al., 2021; Asatiani et al., 2020; Waizenegger & Techatassanasoontorn, 2020; Coombs et al., 2020). This is supported by calls for a closer scrutiny of the human-centered effects of automation initiatives (Wang et al., 2021; Darioshi & Lahav, 2021; Asatiani et al., 2019; Parasuraman & Manzey, 2010; Kokina & Blanchette, 2019). Waizenegger &

Techatassanasoontorn (2020) remark that, “we still know particularly little about the implications of RPA implementations on the human workforce’ (p. 11)

Beaudry & Pinsonneault’s (2005) Coping Model of User Adaption (CMUA) was used to address this objective based on the suitability of its tenets for examining one of the prominent dimensions of ISR, namely the level of robotisation (LOR). Seiffer et al. (2021) recommend further research using the CMUA to examine employees’ reactions to software robots, possibly to unearth fresh insights. Also, FsQCA was used in the data analysis as recommended by Waizenegger & Techatassanasoontorn (2020). The expected outcomes were constructs which enhance our understanding of how employees cope with back-end software robots and also contribute to the development of a framework for implementing ISR in developing economies.

(iii) To explore the nature of complementarity between humans and machines in intelligent software robotisation deployments by firms in developing economies.

This objective is a response to a gap identified in the literature on ISR implementation approaches which focused a lot on the high LOA approach and less on the complementarity approach. Authors such as, Sutton et al. (2023) and Asatiani et al. (2019) have drawn attention to the adverse effects of a high LOA on employees, namely, overreliance, complacency and deskilling and proposed complementary LOA as a solution to these concerns, as well as those related to employment security, that is, job losses from a high LOA. But the literature is sparse on complementarity as a solution to high LOA problems hence there have been related calls for increased investigations into the collaborative coupling of humans and machines (Engel et al., 2022 & Asatiani et al., 2019).

To address this objective, the implementations done by the sampled companies was analysed using an adapted framework from Asatiani et al’s (2019) study, consisting of six recommendations for complementarity implementations. The expected outcome was rich in-depth data and insights on

complementarity which could contribute to the development of a framework for implementing ISR in developing economies.

1.5. RESEARCH QUESTIONS

From the objectives were derived the following questions to guide the study:

- (i) What are the configurations of necessary and sufficient conditions which influence the decision to deploy intelligent software robotisation by a developing economy firm?
- (ii) What are the configurations of necessary and sufficient conditions which affect the choice of employees' coping strategies towards intelligent software robotisation by a developing economy firm?
- (iii) How is complementarity between humans and machines being implemented in intelligent software robotisation deployments in a developing economy firm?

1.6. RESEARCH SIGNIFICANCE

For academia the relevance of this research is threefold: Firstly, the study contributes constructs towards addressing the theorization gap on the handling of software robotisation technologies, categorized as, intelligent. Similarly, the use of FsQCA as the data analytical tool contributes to theoretical insights on different approaches to studying technology adoption. Secondly, the paper extends knowledge on the complementarity approach as a potential means for addressing the effects of high LOA, which involve minimal human labour. Furthermore, it provides contextual information about dimensions of software robotisation in developing economies, to facilitate comparative studies.

Practitioners could benefit from the derived proposed framework on intelligent software robotisation deployment to guide successful implementations. Similarly, insights from the analysis on employee coping strategies could guide in addressing human-related concerns generated by high levels of automation (LOA) in general. For policy makers in developing countries in particular, the study could be a source of useful material in designing policies for the business community to encourage more ISR deployments, in view of the positive economic impact associated with the technology.

1.7. SYNOPSIS OF CHAPTERS

Chapter One introduces the study with the research background, research problem, research purpose, research objectives, research questions, research significance and ends with an outline of the remaining sections of the study. This is followed by an exposition of the key concepts of the study and a review of relevant literature in Chapter Two. The theoretical foundations of the study are presented in Chapter Three, while Chapter Four describes the adopted research methodology, comprising the chosen research paradigm and justification, research methods, data collection approach and data analysis procedures. Chapter Five discusses findings of the configurational analysis of ISR deployment decision elements and employees' coping strategy towards ISR. The results of qualitative investigation into the nature of complementarity is deliberated upon in Chapter Six. Chapter Seven presents the proposed framework for ISR deployment in developing economies while Chapter Eight summarizes and concludes the thesis, outlining contributions, implications and recommendations.

CHAPTER TWO

CONCEPTUALISATION OF ISR AND LITERATURE REVIEW

2.1.CHAPTER OVERVIEW

The previous chapter provided the motivation, rationale, objectives and importance of this study. This chapter takes a comprehensive look at the conceptual foundations of this study, delving into various definitions and views on the concepts. In addition, the chapter also reviews the prevailing literature on ISR and related topics with a view to understanding the lay of the land and identifying gaps that are relevant to this dissertation and whose resolution contribute to knowledge in the IS discipline.

2.2. CONCEPTUALISATION OF ISR

2.2.1. Software Robotisation with RPA

Robotisation

Robotisation which is a type of *automation*, is to be understood as part of a long line of technologies which man has sought to use to address deficiencies in human physical and mental capabilities in various socio-economic enterprises, with the aim of improving performance.

Robotisation is therefore described as the use of robots to substitute humans in performing physical and cognitive tasks previously done by humans, with partial or no human intervention during the activity (Brodny & Tutak, 2021; Uskenbayeva et al., 2019; Berkers et al., 2022; Frolov et al., 2021).

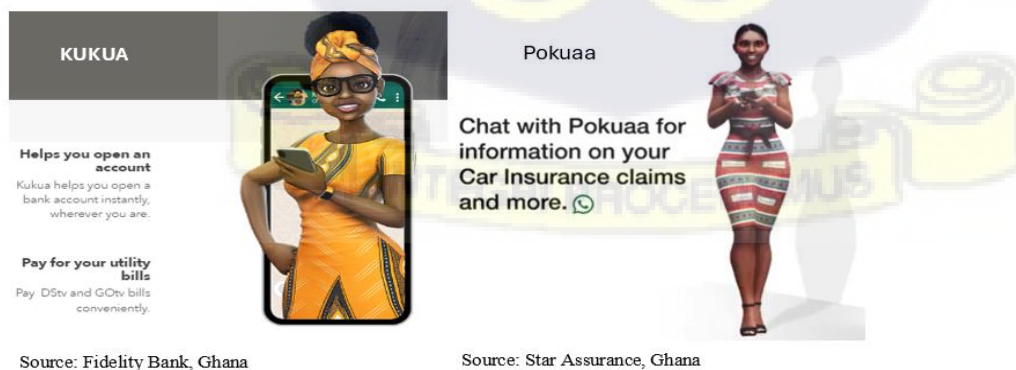
As indicated by Uskenbayeva et al. (2019) and Frolov et al. (2021) robotisation involves not only the automation of *physical manual labor* but also human *cognitive functions*. This allows for a categorisation of robotisation based on the type of robots used for these two areas of human endeavour. That is, (i) *mechanical robotisation* involving *mechanical robots* for automating physical manual activities and (ii) *software robotisation* in which *software robots* are used for automating cognitive tasks. This study focuses on software robotisation.

Software robots

Unlike their mechanical counterparts which are physically embodied, software robots (sometimes referred to as “bots”) are mainly disembodied and exist in the virtual realm or cyberspace, hosted on computers and other electronic devices.

A software robot is a computer program designed to operate either autonomously or semi-autonomously to substitute human efforts in specific predefined front-end and back-end *virtual* tasks (Omankwu et al., 2017; Baran et al., 2020; Poppovic & Sabo, 2022; Sobczak, 2022). Examples of software robots are chatbots, ChatGPT and RPA. This study focuses on robotisation with RPA. Figure 2.1 shows examples of company chatbots in Ghana.

Figure 2.1: Examples of company Chatbots in Ghana

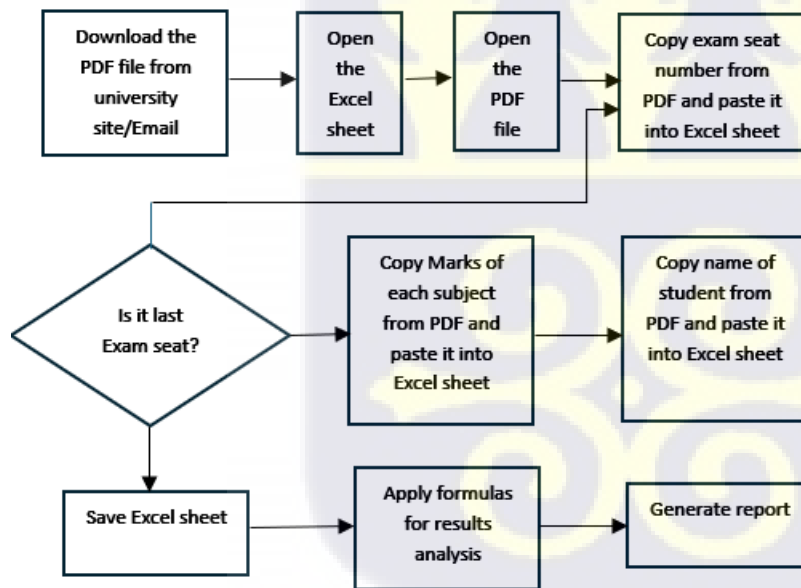


Robotic process automation (RPA)

Robotic process automation (RPA) could currently be described as, an automation technology comprising software robots, usually configured to perform rules-based routine tasks involving structured data and pre-defined outcomes, but which have also evolved to incorporate machine learning features (Schmitz et al., 2019; Lacity & Willcocks, 2021; Filgueiras et al., 2022).

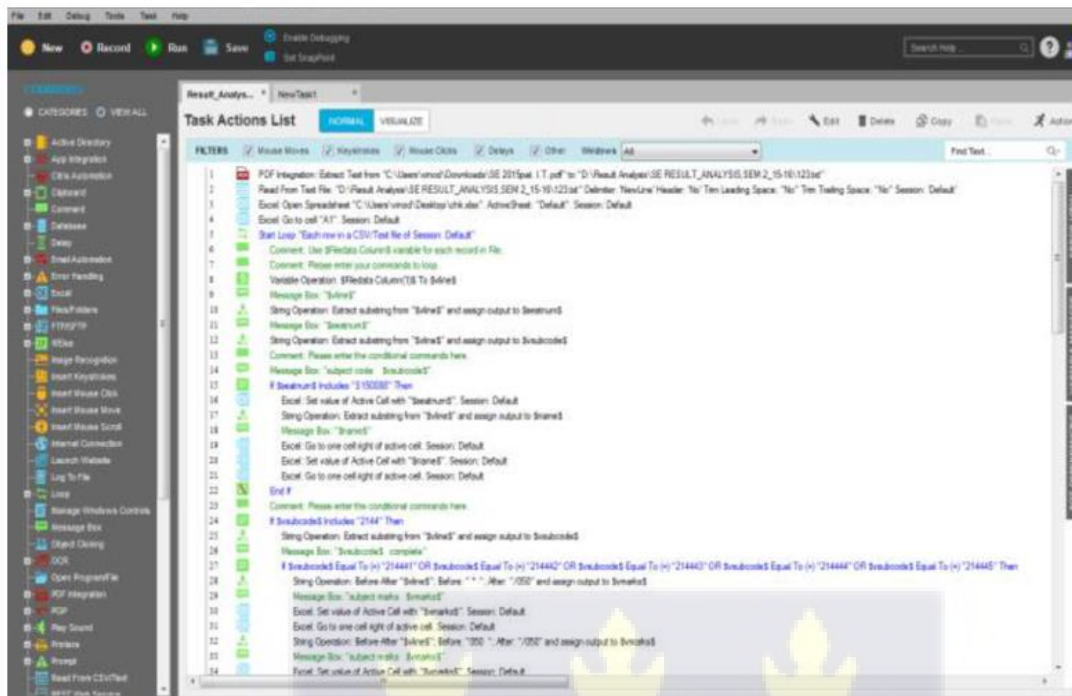
Mane et al. (2019) provide an example of an RPA robot developed to automate the analysis of a university's examination results. Figure 2.2 is the flowchart for the manual process, followed by Figure 2.3 which is the RPA robot developed to execute the process, while Figure 2.4 shows the output from the robot.

Figure 2.2: Flowchart for Manual Approach to University Exams Results analysis



Source: Mane et al. (2019)

Figure 2.3: Robot created in RPA tool for University Exams Results analysis



Source: Mane et al. (2019)

Figure 2.4: Output for University Exams Results analysis by RPA robot

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Exam Seat	Name of Students	214441								214442								214443								214444								214448								2		
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43	47	90	90	4	O	10	40	35	36	69	69	4	A	8	32	47	36	77	77	4	A+	9	36	45	21	70	70	4	A+	9	36	37	29	66	66	4	A	8	32	22	44	88		
42	38	80	80	4	O	10	40	36	25	61	61	4	A	8	32	35	24	59	59	4	B+	7	28	29	14	43	89	4	F	0	0	31	31	62	62	4	A	8	32	23	34	76		
29	35	64	64	4	A	8	32	27	28	55	55	4	B+	7	28	31	22	53	53	4	B	6	24	23	20	43	43	4	P	4	16	30	29	59	59	4	B+	7	28	21	30	72		
35	34	69	69	4	A	8	32	29	30	59	59	4	B+	7	28	29	25	54	54	4	B	6	24	28	20	46	46	4	C	5	20	29	40	69	69	4	A	8	32	22	32	72		
39	33	72	72	4	A+	9	36	40	30	70	70	4	A+	9	36	45	29	74	74	4	A+	9	36	42	16	38	80	4	F	0	0	44	38	82	82	4	O	10	40	21	40	81		
15	22	37	80	4	F	0	0	16	23	39	80	4	F	0	0	27	13	38	80	4	F	0	0	0	16	AB	18	80	4	F	0	0	14	AB	18	80	4	F	0	0	0	12	AB	80
32	35	67	87	4	A	8	32	32	29	61	61	4	A	8	32	35	27	62	62	4	A	8	32	36	20	56	56	4	B+	7	28	35	35	70	70	4	A+	9	36	32	41	84		
24	34	58	88	4	B+	7	28	27	24	51	51	4	B	6	24	28	22	50	50	4	B	6	24	22	20	42	42	4	P	4	16	33	29	62	62	4	A	8	32	32	30	69		
10088	GAJAC	23	19	36	80	4	F	0	0	24	26	50	4	B	6	24	17																											

Attributes

RPA enables the automation of business processes and tasks, through the use of software robots, that can be thought of as “digital workers”, each having their own access resources and credentials (own computer station, username, and password) and assigned roles and responsibilities, similar to a human employee (Kokina & Langmann, 2022; Kokina & Blanchette, 2019). The robots mimic humans and are capable of performing operations such as, writing emails, analysing spread sheets and transferring data from one system to another (Chugh et al., 2022; Syed et al., 2020; Lacity & Willcocks 2016a). Processes that are suitable for robotisation with RPA are characterized by high transaction volumes, interaction with several systems, high process maturity and a stable systems environment among others (Chugh et al., 2022; Syed et al., 2020; Penttinen et al., 2018, Asatiani and Penttinen, 2016; Fung 2013). Here, it must be noted that though RPA initially began with and still automates tasks with clearly defined rules (routine, rules-based, repetitive), uses structured data and produces deterministic outcomes, however in keeping with recent advances and trends, it has evolved to also include AI features such as, computer vision (optical character recognition), natural language processing and machine learning techniques; it is thus capable of handling unstructured data (Chugh et al., 2022; da Silva Costa et al., 2022; Lacity & Willcocks, 2021; Plattfaut, 2019; Schmitz et al., 2019; Romao et al., 2019). RPA is also non-invasive, that is, the robots are deployed without significant changes to existing underlying IT infrastructure and systems. Usually, they operate on the presentation layer of the IT ecosystem, namely the graphic user interfaces (Santos & Pereira, 2020; Dey & Das, 2019 and Lacity & Willcocks, 2016a).

Categorizations

Depending on the level of automation and scale of deployment, Chugh et al (2022) and Taulli (2020) report that RPA robots can be categorized into two: (i) *Attended RPA* which as the term

suggests are not fully autonomous and are operated by employees for the execution of predefined processes, such as information retrieval by a call center rep. They are deployed at the employee level on individual desktops and are therefore also called Robotic Desktop Automation (RDA). (ii) *Unattended RPA* which are highly autonomous and could be activated independently by events such as the receipt of an order, which then sets in motion the choreographed business process. They are deployed at the enterprise level on servers.

Filgueiras et al. (2022) and Chugh et al. (2022) have also distinguished between three generations or types of RPA tools. These are: (i) *Rules-based RPA*, which handle mainly structured data with predefined rules which restricts their range of actions; (ii) *Intelligent RPA*, with learning capabilities, which process unstructured data and are able to address a wider range of scenarios; (iii) *Advanced AI RPA*, which has higher cognitive capabilities such as decision-making.

In an examination of RPA tools currently on offer by six vendors including market leaders such as, UiPath and Automation Anywhere, Ribeiro et al. (2021), found that most current RPA products included AI technologies such as NLP, CV and ML, with NLP and artificial neural networks being the most prevalent. In addition to RPA, the other technology of interest to this study is AI and the next section discusses it briefly to situate it properly within the conceptualisation of ISR.

2.2.2. Artificial Intelligence

Definition

Authors such as, Berente et al. (2021), De Bruyn et al. (2020), Kaplan and Haenlein (2019) and Nguyen et al. (2022) have all discussed extensively, the challenges with defining AI which revolves around the debate on what constitutes intelligence in machines. This has made it

challenging for scholars to agree on a definition of AI. However, a feature of AI that distinguishes it from other modern ITs is AI's ability to mimic human intelligence (Kaplan and Haenlein, 2019; Benbya et al., 2021). It is therefore reasonable that such an important identity element features in a definition of AI in one form or the other.

Thus, this paper adopts the widely-held view and defines AI as *autonomous systems driven by algorithms which replicate human cognitive abilities, such as, sensing, reasoning, learning and decision-making, to solve problems* (Nguyen et al., 2022; Kaplan and Haenlein, 2019; Benbya et al., 2021)

Applications of AI

Some current uses of AI include, in the health industry: for assisted surgery, medical record analysis and medical imaging; in security operations: for facial recognition applications; in banking: for detection of fraudulent financial transactions and processing of loan applications; in agriculture: for managing crop planting, spraying & harvesting; in manufacturing: for detection of potential equipment faults for predictive maintenance; in the automobile industry: for producing driverless vehicles; in the service industry: for providing customer support via chatbots, as well as food delivery & cleaning services via robots; in the home industry: for designing smart homes; in emergency situations: for delivery of supplies such as, medicines through drones and generally in business management: for data-driven decision-making (Soori et al., 2023; Stoffels et al. 2023; Benouda et al., 2020; Benbya et al., 2020).

AI classifications

AI technologies have been variously categorized and one of the broad classifications divides AI technologies into, “Strong AI” and “Weak AI” (Benouda & Lachgar, 2020; Collins et al., 2021;

Flowers, 2019; Brynjolfsson, 2023; Liu, 2021). This classification originates from the works of American philosopher, John Searle (1980) who contributed to the debate on intelligence in machines in the early days of the AI discipline. In presenting his arguments on whether or not a machine can think and experience consciousness, he distinguishes between strong and weak AI. He uses weak AI to describe a computer that serves as a tool that represents and *simulates* the human mind, thereby enabling the formulation and testing of hypotheses about the mind. In contrast he employs strong AI to describe a computer that actually has a mind and thinks hence, experiences various cognitive states (Searle, 1980; Flowers, 2019). Searle's writings have influenced the use of the two terms in contemporary times. Thus, *weak AI* is used in reference to most current AI technologies that *emulate* human cognitive traits in helping solve everyday practical problems (Benouda & Lachgar, 2020; Collins et al., 2021; Flowers, 2019; Brynjolfsson, 2023; Liu, 2021). They are also referred to as *Artificial Narrow Intelligence (ANI)* since they are capable of performing only the specific (narrow) tasks for which they have been programmed and cannot transfer knowledge outside their application domain (Schlegel & Uenal, 2021; Abonamah et al., 2021; De Bruyn et al., 2020; Benbya et al., 2020; Kaplan & Haenlein, 2019). *Strong AI* on the other remains an ideal which AI innovators aspire to, namely an AI technology that actually thinks, feels and has consciousness (Benouda & Lachgar, 2020; Collins et al., 2021; Flowers, 2019; Brynjolfsson, 2023; Liu, 2021). Strong AI is also referred to as *Artificial General Intelligence (AGI)* because it is expected to match human-level intelligence including knowledge transfer and thus capable of performing any (general) human cognitive task (Schlegel & Uenal, 2021; Abonamah et al., 2021; De Bruyn et al., 2020; Benbya et al., 2020; Kaplan & Haenlein, 2019). A third category is *Artificial Superintelligence (ASI)* which like AGI, is also an aspiration currently not available; it is expected to exceed and outperform human intelligence in cognitive tasks.

(Schlegel & Uenal, 2021; Abonamah et al., 2021; De Bruyn et al., 2020; Benbya et al., 2020; Kaplan & Haenlein, 2019).

AI Technologies

The field of AI has progressed significantly since the Dartmouth conference in 1956. Today's AI technologies have been made possible due to significant advancement leaps in the last decade or so, in areas such as, computational power and resources; big data extraction, analysis and storage; sophisticated machine learning techniques and most recently building large language models (Raftopoulos & Hamari, 2023; Robert, 2019; Benbya et al., 2020; Collins et al, 2021; Vaswani et al., 2017). Currently AI boasts of a number of branches and associated technologies or techniques. These comprise natural language processing (NLP) including speech recognition (text and speech synthesis), computer vision (CV), expert systems and machine learning (ML) (Mukhamediev et al., 2022; Bawack et al., 2019).

Of all the AI technologies, *machine learning* is the most ubiquitous as it forms part of most of the other AI techniques and systems earlier mentioned (NLP, CV, expert systems). Machine learning therefore appears to be at the core of contemporary AI (Mukhamediev et al., 2022). ML is a set of methods that allow a computer to learn iteratively from training data to improve on its ability to solve problems, including those for which it has not been directly programmed (Schoormann et al., 2023; Nguyen et al., 2022; Kaplan & Haenlein, 2019). The numerous ML methods have been broadly grouped into, *supervised learning (SL)*, *unsupervised learning (UL)*, *reinforcement learning (RL)* and *deep learning (DL)* (Mukhamediev et al., 2022). In *supervised learning*, algorithms learn to solve problems by producing the best paired results from labeled training data in which the input and output data are paired (Schoormann et al., 2023; Nguyen et al (2022). In *unsupervised learning*, algorithms are trained on unlabeled data to identify underlying patterns and

structures (Schoormann et al., 2023; De Bruyn et al., 2020; Benbya et al., 2020). *Reinforcement learning* involves training algorithms on an output variable to be maximized in relation to allowable actions which go with rewards and penalties; learning occurs through trial and error to maximize rewards to achieve the best output (Schoormann et al., 2023; Kaplan & Haenlein, 2019; Nguyen et al., 2022). *Deep learning* is distinguished from other ML methods by its use of a specific architecture known as artificial neural networks (ANNs).

2.2.3. Current Notions of Intelligence in Machines

A significant event in the development of intelligence in machines is the first AI workshop organised by two academics, J. McCarthy, M. Minsky and two industry practitioners, N. Rochester and C. Shannon, held at Dartmouth College in the US in the summer of 1956. This event is widely held to have established in both name and objectives, the field of research and academic discipline solely devoted to automating human intelligence; it was named “artificial *intelligence*” (McCarthy et al., 1955; Bostrom, 2014). Among the objectives of the then “project” later to become a discipline were: to simulate in machines, the *human cognitive abilities* of learning, self-improvement, language, problem solving, forming abstractions and concepts and any other feature of intelligence (McCarthy et al., 1955). This provides a glimpse into what was considered to be machine intelligence, namely a replica of human cognitive abilities.

Intelligence in humans has been variously defined (Jensen 2001; Baeza-Yates & Villoslada, 2022). One of the scholars whose work on intelligence has influenced current notions is Sternberg (2018) who considers “learning” and “adaptation” as key features in human intelligence. He views intelligence as consisting of the ability to learn from experience, improve learning through self-regulation processes and adapt to different social and cultural environments. These notions of

human intelligence have had an impact on current notions of machine intelligence. Hence, Kononenko (2001), in discussing the history of machine learning, states that, “One of the basic requirements for any intelligent behaviour is learning. Most scholars today agree that there is no intelligence without learning. Therefore, machine learning (ML) is one of the major branches of artificial intelligence and indeed it is one of the most rapidly developing subfields of AI research” (p.89). This draws attention to the current dominant standard of measuring machine intelligence with ML.

Two notions of machine intelligence

Consequently, in the current era, technical systems which do not have machine learning ML features are not regarded as intelligent. For instance, Kaplan & Haenlein (2019) explain that *rules-based* expert systems are not intelligent because they “lack the ability to *learn autonomously* from external data” (p.18). On the other hand rules-based RPA combined with AI is considered intelligent (Ng et al., 2021; Shidaganti et al., 2021; Taulli, 2020; Kumar & Khanna, 2023; Mohanty & Vyas, 2018; Wewerka & Reichart, 2023). From this viewpoint, intelligence in machines is binary, that is, a machine can either learn or not and is therefore either intelligent or not.

However, in a slightly different turn, Huang and Rust (2018) view intelligence in machines as an attribute which is best appreciated on a continuum. Hence, they identify a hierarchy (or degrees) of four “intelligences” in machines, which is still based on *learning* and adaptation. The four are mechanical, analytical, intuitive and empathetic intelligence. Machines with *empathetic* intelligence (the highest level), exhibit the ability to learn from sensing human emotions and adapting their reactions accordingly based on experience; *intuitive* intelligence, the next highest level involves learning through creativity and understanding; *analytically* intelligent machines which follow next, are characterised by learning from data and information processing through

logical reasoning; *mechanical* intelligence, the lowest form of intelligence in machines, is associated with minimal learning ability as their design focuses on use in *rules-based* and repetitive functions with minimal variability and hence minimal adaptability and learning requirements. But like all the other types of intelligence, mechanically intelligent machines do still rely on observing or analysing their input to act and react, only this time their reaction is almost always the same because the input is also the same (*repetitive*) based on design (Huang & Rust, 2018).

The evolving nature of machine intelligence

Another important dimension of the notion of intelligence in machines, is its evolving or dynamic nature. Hence what was considered to be intelligent some years ago is no longer regarded as such today and this is not a new occurrence. Bostrom (2014) for instance reports the frustrations of the early AI researchers with their innovations not being accepted as “artificially intelligent”. He mentions John McCarthy, one of the conveners of the Dartmouth conference in 1956 as saying, “As soon as it works, no one calls it AI anymore.” (Vardi, 2012 cited in Bostrom, 2014; p.13). Bostrom (2014) goes on to remark that, like most technological innovations, our standards for what impresses us as intelligence in machines, keeps changing with new advances. Hence ELIZA, the first rules-based chatbot which was regarded as “intelligent” in the 1960s is today not regarded as such, due to the emergence of much more advanced and sophisticated chatbots such as, ChatGPT (King & ChatGPT, 2023; Weizenbaum, 1966; Berry, 2023).

2.2.4. Intelligent Software Robotisation

Terms such as, “intelligent process automation” (IPA), “intelligent automation” (IA), “cognitive automation”(CA) and “hyperautomation” have been used somehow ambiguously and sometimes confusingly in describing automation involving intelligent technologies.

Intelligent Process Automation (IPA) has been described as the integration of rules-based RPA with AI technologies (Kumar & Khanna 2023; Shidaganti et al., 2021; Mohanty & Vyas, 2018).

Intelligent Automation has also been similarly defined to comprise a merging of RPA and AI technologies (Ng et al., 2021; Kavitha, 2023). However, it has also been equated to cognitive automation (Ghobakhloo et al., 2023; Chugh et al., 2022; Taulli, 2020).

Cognitive automation is described by Engel et al. (2022) as using of ML (machine learning) for automation or ML-facilitated business process automation. ML is thus specified as a key component of CA while other tools such as, RPA and those for workflow management are considered as auxiliary. Lacity & Willcocks (2021) characterize CA as automation with inference-based algorithms and deep learning techniques to automate tasks with undefined rules, taking as input, both unstructured and structured data, to produce probabilistic outcomes. To add to the divergent views, Ghobakhloo et al. (2023), Chugh et al., (2022) and Taulli (2020) describe CA as being the same as IA, that is, comprising RPA merged with AI (category unspecified). Hence for them, there is no distinction between CA and IA. Further deepening the unclarity, Ghobakhloo et al. (2023) indicates that IA which is the same as CA comprises in addition to RPA & AI, also BPM tools.

Hyperautomation is yet another term used in reference to automation with intelligent technologies. Madakam et al. (2022) admit that the concept of hyperautomation is still at the early stage of development, hence much more clarity is needed to fully understand it. For now it seems to include more technologies other than RPA and AI, such as Big Data Analytics. In Kavitha (2023) which also discusses hyperautomation and includes NLP, there is no clear distinction between IPA and hyperautomation.

From the above discussion, one is left with the impression that IA, IPA, CA and hyperautomation all refer to different things but also the same phenomenon. What they all have in common is the characterisation of the underlying technology, RPA and AI together in one way or the other.

It is in avoidance of such confusion in the mind of the reader that this paper chooses another term (intelligent software robotisation - ISR) to designate the phenomenon which the terms CA, IPA, and IA attempt to describe.

In view of all the foregoing discussions, this paper follows, Lacity & Willcocks (2021) and Engel et al. (2021) to conceptualize ISR. Thus, intelligent software robotisation (ISR) is described as, *the use of disembodied programmable mechanisms with intelligent capabilities, to reduce human intervention in business processes characterised by both structured and unstructured data.*

This study focuses on ISR using RPA supported by AI technologies including ML. In recognition of the current evolution of RPA tools as having both rules-based and AI capabilities, the term ISR is thus used in this work to refer to RPA enabled with AI features.

2.2.5. Conceptualisation of Complementarity

In automation, complementarity is an *implementation approach* which is closely associated with the *level of automation*, that is, the degree of human intervention and control in an automation instance (Simmler & Frischknecht, 2021). On one end of the implementation spectrum is the High level of automation (LOA) approach where human control is either virtually absent or limited. Examples can be found in lights out manufacturing (Erdogan, 2019; Turner et al., 2021). At the other end of the automation spectrum is the Low LOA implementation approach with a dominant and pervasive human control. This is prevalent for instance, with high risk tasks such as, robot-

assisted surgery (RAS) where some surgical robots are fully operated by surgeons (Fiorini et al., 2022; Battaglia et al., 2021). Complementarity aims at a level of automation which lies between the two, with appropriate levels of both human and machine intervention and control. Hence in relation to *intelligent* robotisation (for both physical and software robots), complementarity has been variously described with terms such as “hybrid *intelligence*” (Dellermann et al., 2019), “*intelligence* augmentation” (Zhou et al., 2021), “human-AI complementarity” (Hemmer et al., 2021) and “human-robot collaboration” (Ruiz et al., 2022) and “human-AI collaboration” (Lai et al., 2021) and “human-in-the-loop” automation (Ruiz et al., 2022; Turner et al., 2021)

Definitions

Asatiani et al. (2019) define complementarity as assigning humans and machines to solve a problem collaboratively in an automation instance, where each validates the other’s actions and decisions, with the human exercising overall control.

In the context of intelligent robotisation, Dellermann et al. (2019) who characterise complementarity as hybrid intelligence, define it as, “*the ability to achieve complex goals by combining human and artificial intelligence, thereby reaching superior results to those each of them could have accomplished separately, and continuously improve by learning from each other*”, (p. 640).

Zhou et al. (2021) also in the context of intelligent robotisation, define complementarity (which they term, intelligent augmentation), as “*human-machine collaboration or human-machine symbiosis where machines perform what they do best (e.g., computing, recording, and doing routine, repetitive work) to aid humans in doing what humans do best (e.g., abstract reasoning, creating, and making in-depth discoveries about people and the world)*”, (p. 245).

Other conceptualizations include concepts such as, the “electronic colleague” (Sutton et al., 2023); “teaming” (Hemmer et al., 2021) and “human-AI collaboration” (Lai et al. 2021).

Core tenets of complementarity

The core principles of complementarity are collaboration, complementing each other’s strengths to deliver superior results, humans exercising overall control and preservation of human skills (Licklider, 1960; Grote, 1995; Asatiani et al., 2019; Dellermann et al., 2019; Sutton et al., 2023).

It must be noted that complementarity applies to robotisation in general, that is automation with both mechanical (physical) robots and software robots. This paper’s interest is in complementarity as it applies to intelligent software robotisation.

Motivations for complementarity

The impetus for the complementarity approach comes from the need to address the adverse effects of the near total human-replacement approach to automation characterized as high LOA, which involves minimal human intervention.

This approach leads to automation bias or complacency (overreliance on the machine), low situation awareness (which manifests as a slowness to detect and react to problems with an automated system) and deskilling (loss of skill by the human), all of which have been examined by a number of studies (Sutton et al., 2023; Asatiani et al., 2019; Endsley, 2017; Parasuraman & Manzey, 2010). Complementarity on the other hand serves as an effective check to avoid these sometimes costly negative effects or harmful errors which occur when either a machine or human alone controls a process (Asatiani et al., 2019; Sutton et al., 2023).

Furthermore, from a logical viewpoint, a High LOA which seeks to substitute or limit human intervention, contributes to job losses by either reducing the number of people required for a job

or halting further recruitment for the function. In contrast, by ensuring human involvement, complementarity preserves human jobs in some form or the other (Asatiani et al., 2019; Zhou et al., 2021). Additionally, a compelling motivation for complementarity is the inherent advantages of collaboration, which is the principle of two are better than one (Dellermann et al., 2019; Zhou et al., 2021; Sutton et al., 2023).

2.3. THEMES AND TRENDS IN ISR RESEARCH

2.3.1. Review Methodology

A plural methodological approach was adopted for the literature review, guided by several authors in systematicity (Levy & Ellis, 2006; Lavalley et al., 2013; Rowe, 2014; Vom Brocke et al., 2015) and iteration (Lavalley et al., 2013; Bandara et al., 2015).

The substantive literature review informing the objectives of this study, was initially undertaken in early 2021. But there were several iterations till early 2023, to keep the literature updated. The initial exercise in 2021 was driven by the following questions, (i) what do we *know and don't know* about intelligent software robotisation exemplified by RPA and AI?, (ii) what is the state-of-the-art in *research* on intelligent software robotisation using RPA and AI?

The principal objective was to obtain contemporary ISR information and current research trends as well as identify knowledge gaps in ISR in general and in developing economies, with a focus on Africa and Ghana.

Some of the electronic literature sources consulted were AISel (AIS electronic library), ACM Digital Library, Scopus, Emerald, Science Direct, EBSCO Host, Wiley Online, and Google Scholar for reasons of accessibility and repute. The following keywords were applied in various

combinations to design search strings which were used to search the literature sources: “robots”, “software robots”, “robotisation”, “automation”, “robotic process automation”, “RPA”, “intelligent process automation”, “cognitive automation”, “artificial intelligence”, “AI”, “projects”, “developing economies”, “Africa”, “Ghana”.

Being a relatively young technology, which came into prominence in 2012 (Taulli, 2020), the date range for the initial review literature search was from 2010 to 2020.

Exclusion and Inclusion Criteria

Articles were mainly targeted but with ISR being a relatively new phenomenon, Rowe’s (2014) advice was followed to widen the inclusion criteria, where there was not enough articles, to contain other materials such as, books, dissertations.

Search results were first filtered by scanning through the titles, abstracts, keywords and article sources for *relevance* in: (i) *articles’ main subjects*: which included articles with a heavy leaning towards either RPA only subjects or RPA plus AI subjects, with less on AI only subjects, all from an IS perspective; excluded were subjects on RPA variants in other field such as, Remote Pilot assistance (RPA) in engineering or Recursive Partitioning Analysis (RPA) and Replication ProteinA (RPA) in medicine (ii) *article type*: which included empirical research articles, reviews and working papers, panel discussions, but not introductory or commentary editorials, teaching notes, sponsored or commercial promotional materials, white papers, newspaper articles and technical guides; (iii) *type of source*: which included peer-reviewed journals, conference proceedings but not sources with unclear or unverifiable references and those which were inaccessible; (iv) *domain or discipline leanings of article’s content and type*: which included IS socio-technical topics and orientation but not pure economics, design and engineering content.

The final filtering activity was guided by (i) the *review questions* posed at the beginning of this section, namely what we know and do not know as well current state of research, and (ii) *quality considerations* in relation to adequacy and currency (how contemporary) of content, presentation clarity as well as, validity of claims and findings based on appropriateness of methodology, strength of argumentation and evidence (Okoli, 2015; Levy & Ellis, 2006).

With RPA plus AI being a relatively new phenomenon, the initial filtering yielded 41 potentially suitable papers in early 2021 with majority of the papers published in 2019. Out of the 41 studies, 16 were found to be relevant and useful for the objectives of the review. Subsequently, *forward and backward searches* (Levy & Ellis, 2006; Vom Brocke et al., 2015) were conducted on nine of the papers which were selected for their high quality and high number of citations. Seven (7) more suitable papers were obtained from this exercise, resulting in a total of 23 relevant papers for the preliminary review in early 2021. Later iterations over the intervening period between 2021 and early 2023 provided additional 32 papers, as the number of research studies grew significantly on the subject. Hence in all, 55 papers were employed for the review.

2.3.2. Themes Emerging from the Literature Review

Table 2.1 provides samples of selected studies which depict the dominant themes ~~which~~ that emerged from the initial reviews. Iterative searches were conducted on relevant sub-issues as they emerged.



Table 2.1: Emerging themes from the Literature review

No.	Emergent Themes	Sample papers
1	Implementation approaches (adoption issues)	Rawashdeh, et al. (2022); Eitle et al. (2022); Yang et al., (2021); Willcocks et al., 2015; Wewerka et al. (2020); Syed et al., (2020); Kokina & Blanchette (2019); Asatiani et al. (2019); Pumplun et al. (2019)
2	Employment security concerns (fear of job losses)	Radhakrishnan & Gupta (2022); Lakay & Mlambo (2022); Calitz et al. (2021); Tew (2020); Eikebrokk & Olsen (2020); Asatiani et al. (2020); Schmitz et al. (2019); Fernandez & Aman (2018); Mendling et al. (2018)
3	Impact of ISR (benefits & risks)	Meironke & Kuehnel (2022); da Silva Costa et al (2022); Kokina & Langmann (2022); Coombs et al., (2020); Vitharanage et al. (2020); Romao et al. (2019)
4	Theorizations on ISR (categorizations of ISR technology & adoption models)	Engel et al. (2022); Ulfert et al. (2022); Ribeiro et al. (2021); Wewerka et al. (2020); Kokina & Blanchette (2019); Pennttinen et al. (2018); Huang & Rust (2018); Bygstad (2017)
5	African ISR studies	Iyamu & Mlambo (2022); Calitz et al. (2021); Ahmed (2021); Tew (2020)
6	Research Methodologies	Rawashdeh et al. (2022); Laut et al (2021); Berube et al. (2021); Eikebrokk & Olsen (2020); Santos & Pereira (2020); Kokina & Blanchette (2019); Asatiani et al. (2019)

The major themes which emerged from the review were, implementation approaches, employment security concerns, impact of ISR, theorizations on categorizations of ISR technologies, African

cases of intelligent software robotisation and methodological issues. These are discussed in detailed in the sections that follow.

Implementation and adoption issues

With ISR involving RPA being a relatively new phenomenon, quite a number of studies were devoted to understanding the various dimensions of its adoption and implementation.

Hence there were studies which had examined various variables related to ISR adoption such as perceived usefulness and perceived ease of use elements including facilitating conditions, social influence, and results demonstrability as well as vendor availability (Wewerka et al. 2020); technology awareness and readiness (Yang et al., 2021); change management factors such goal setting, change champions, workforce preparation through communication and training (Tarafdar & Beath, 2018); data availability, quality and protection together with top management support (Pumplun et al., 2019).

Furthermore, various deployment facets were discussed in the literature reviewed, including: rationale for undertaking ISR, alignment with organisational goals, reliable criteria for selection of automatable task or job, development of relevant organisational structure, appropriate project management approach, customer adoption strategy, change management.

Rationale for undertaking ISR were varied such as, process optimization (Plattfaut, 2019), employee retention through freeing them from mundane tasks to enable them pursue more interesting work (Kokina & Blanchette, 2019; Lacity et al., 2021; Chiu et al., 2021), cost savings (Madakam et al., 2022) and headcount reduction (Dey & Das, 2019). *Alignment with organisational goals* came up as an important ISR adoption factor, describing the fit between organisational mission, strategy and culture on the one hand and automation expectations and

deliverables on the other, to avoid costly disappointments and failures (Rawashdeh, et al., 2022; Berube et al., 2021; Syed et al., 2020; Willcocks et al., 2015).

Reliable criteria for selection of automatable tasks was also seen as pivotal since it helped clarify what ISR can and cannot do as part of aligning organisational goals with automation expectations. It involves identifying those parts of an organisation's operations which are automatable and having a transparent and reliable criterion to get the selection right (Asatiani et al., 2019; Kokina & Blanchette, 2019; Willcocks et al., 2015 & Syed et al., 2020). *Development of relevant organisational structures* was another deployment element discussed. These include procedures governing day-to-day ISR operations, such as, onboarding procedures which assign robots to the org chart, specifying their job description, life span, the role and responsibilities of their managers and governance controls regarding accesses granted them (Kokina & Blanchette, 2019; Noppen et al., 2020; Kokina & Langmann, 2022). *Appropriate project management approaches* discussed included the Agile approach which delivers project outcomes in sprints or phases and allows for feedback to carry out iterations and corrections, has been suggested by some authors as ideal (Schmitz et al., 2019). Alternatively, controlled testing or piloting has also been suggested by Lacity & Willcocks (2016). *Customer adoption strategy* deliberations in the literature emphasized the need to get customers to accept any changes to the manner in which they engage with an organisation and its products or services, brought about by an ISR initiative (Syed, 2019). *Change management* also featured in quite a number of studies on deployment, given that ISR was a relatively new phenomenon. The papers recommended managing change in both the technical and people dimensions (Eitle et al. 2022; Lacity & Willcocks, 2016b, Osmundsen et al., 2019; Plattfaut, 2019; Tarafdar & Beath, 2018)

Also highlighted in the studies is the issue of project failures. ISR projects are reported to have recorded high failure rates of up to 50% by some estimates, (Waizenegger & Techatassanasoontorn, 2020; Kokina & Blanchette, 2019; Lamberton, et al., 2017). Implementation-related issues feature prominently in the challenges and risks which could hinder RPA delivery success (Waizenegger & Techatassanasoontorn, 2020; Moffitt et al., 2018; Lamberton et al., 2017). Some of the implementation challenges identified include dimensions such as, technology selection, implementation execution, change management, stakeholder buy-in, (Moffitt et al., 2018). Others are, having the wrong ROI expectations, project management method, type and number of processes automated, skills sourcing, evaluation of IT infrastructure; the absence of a business case, benefits realization plan, governance procedures, proper ownership of RPA program and strategy for scaling (Lamberton et al., 2017). As indicated by Osman (2019), not all processes are candidates for ISR, a view echoed by Osmundsen et al. (2019) who mention that wrong process selection is a key factor in RPA project failures. Jimenez-Ramirez et al. (2019) address the risk of using inaccurate process map documentation. Coombs et al. (2020) recommend further investigations to understand and contribute knowledge to the ISR implementation decision-making dynamics in organisations, particularly in relation to the choice of tasks to be automated and the appropriate level of robotisation for the tasks.

The major gap identified here was the observation of the dominance of research on implementation approaches which viewed software robotisation as a replacement of human labour (high LOR) with less attention on a complementarity approach. Asatiani et al. (2019) were among the few studies which highlight the advantages of a complementarity approach and provide practical guidelines in implementing it, in order to address the adverse effects of high LOR, such as, overreliance, deskilling and job retention. They call on researchers to conduct further work on

complementary ISR. Apart from the knowledge gaps, the major issue of note in relation to implementation approach, is the reported high failure rates of ISR projects, which is a significant issue requiring attention.

Employment security

Unlike traditional ICTs such as, PCs, internet and emails which aim at enabling employees in their jobs, automation technologies by their logic (replacing human intervention), on the other hand, inherently threaten jobs. Therefore, the issue of employment security in relation to ISR came up in quite a number of the papers reviewed usually in one of three dimensions.

Firstly, fear of job loss came up in some studies on ISR *adoption factors*, as a *barrier* that needed to be addressed for successful implementations (da Silva Costa et al., 2022; Radhakrishnan & Gupta, 2022; Guner et al., 2020). It worth noting that employment security was a recurring issue in the developing economy context as indicated in the studies in Kenya and South Africa (Mlambo, 2022; Lakay & Mlambo, 2022; Calitz et al., 2021; Tew, 2020).

Secondly, the issue of job security also came up in a few studies which sought to analyse *employee attitudes* to the introduction of robots in the workplace (Asatiani et al., 2020; Waizenegger & Techatassanasoontorn, 2020).

Thirdly, an important observation was the fact that the fears seem to be related to ISR *implementation dimensions*. Mendling et al. (2018) discuss employment security by examining the *types of jobs* which ISR is implemented to automate and the impact on those jobs; they believe *routine repetitive jobs* are at risk, thereby providing some justification for employment security concerns in relation to ISR. This is confirmed by Eikebrokk & Olsen (2020) who report that though RPA was being implemented to free employees from mundane tasks and ostensibly enable them

pursue more interesting work, it was also being used as a means to either layoff or halt recruitment of workers. In their study, while respondents from organisations bent on a job retention approach expressed positive sentiments towards ISR, those from organisations adopting a layoff policy, had negative sentiments. The latter group accused their employers of a lack of transparency in not revealing their full intentions about the layoffs. This contributes to employees' anxieties about their job security as confirmed by Waizenegger & Techatassanasoontorn (2020). From the employer's perspective (Kokina & Blanchette, 2019; Lacity et al. 2021), most organisations claimed that using ISR to reduce employee numbers was not a default approach or motivation as most seek to retain their staff. Rather, they reported adopting practices such as, halting or slowing down hiring together with redeploying staff (Lacity et al. 2021). That, even in cases where the layoffs do occur, efforts are first made to explore the redeployment option (Schmitz et al., 2019). But Fernandez & Aman, (2021 & 2018) report that even for employees who are not laid off, there are worries about future job security due to concerns related to their ability to learn new skills to adapt to the new roles and competition with the robots.

In sharp contrast to the implementation approaches described above, is the complementarity approach mentioned in Filgueiras et al (2022) where the robots were "inserted as co-workers". They report some favorable reactions such as an appreciation for the freed up time and seeing robots as an opportunity for career upgrade. In relation to employment security, some knowledge gaps were identified from the studies reviewed.

Firstly, what is clearly missing and not properly explored in the literature on employment security, are adequate studies on adopting complementary robotisation (where humans and software robots work together), as a means of job retention and *allaying employment security concerns*, while ensuring business profitability. The implementation approaches often preferred and adopted are

oriented towards high LOR (high replacement of human intervention). Hence not much was mentioned in these studies about collaborative work arrangements between humans and robots. It was mostly about the robots working alone (replacing human interventions) with the humans either being laid off or moving on to do something else, that is, redeployment to more value-added tasks. Secondly, how workers were *individually* coping with job security concerns *specifically* on the introduction of *software robots* into their working environment, also seem to be an under researched subject. In short, identification of fear of job loss as a consequence of ISR has been well documented. Likewise, some recommendations at the *organisational level* to help employees cope with such fears, including good change management practices such as, excellent communication protocols and reskilling opportunities (da Silva Costa et al., 2022; Plattfaut, 2019; Schmitz et al., 2019; Lacity & Willcock, 2016; Kokina & Blanchette, 2019). However, employees' own *individual* coping strategies, a very important element, requires much more attention. There is a substantial body of work on coping with technostress in relation to IT but few on ISR specifically.

Impact of software robotisation

Apart from implementation challenges (earlier discussed) and still on the trajectory of shedding light on a new phenomenon, quite a number of the studies also provided information on the benefits of ISR with few highlighting associated risks. The benefits included, cost savings, freeing employees time for more valuable work, FTE savings, error reduction or improved accuracy, increase in productivity and faster turnaround time, (Chugh et al., 2022; da Silva Costa et al., 2022; Kokina & Blanchette, 2019;).

Given the issues around employment security, a few studies also cautioned on the need not to take lightly, people's apprehension and fears about ISR. Sometimes these concerns have found

expression in perceptions of competition between workers and the robots (Fernandez & Aman, 2018 and 2021). Some recommendations for organisational efforts to help employees cope have been noted in the previous section under employment security. In relation to risk impacts (treated differently from implementation challenges), Romao et al (2019) examined ISR algorithmic risks and noted that, poorly trained bank robots pose the risk of wrong decisions which could result in more errors and less productivity for a firm. Kokina & Langmann (2022) also pointed out that, bank robots having access to confidential information are vulnerable to cybercrime, privacy and security risks. Also the failure of the robots to identify suspicious clients during onboarding, could put a bank at risk of money laundering and cause reputational damage, as well as legal costs.

The gap identified was the observation that majority of the papers discussing ISR impact elements focused on benefits and they were viewed from a perspective which, rightly so, leaned towards a financial and performance lens, heavily influenced by cost savings and productivity (Meironke & Kuehnel, 2022; Wewerka et al., 2020; Jimenez-Ramirez, 2019; Aguirre & Rodriguez, 2017; Lacity & Willcocks, 2016a). Vitharanage et al. (2020) was an exception whose investigations yielded insights on less researched benefits dimension such as, customer satisfaction and employee job satisfaction. These they called “unanticipated” benefits.

There was inadequate attention paid to the human-centered impact and implications of ISR such as, the *coping strategies* being adopted by employees to survive in their changed workplaces (Seiffer et al., 2021; Asatiani et al., 2020; Waizenegger & Techatassanasoontorn, 2020). Seiffer et al. (2021) particularly draw attention to the paucity of research on employees coping specifically with software robots and hope their work will stimulate further research interest. Coombs et al. (2020) also call for further investigations into how employees’ attitudes and actions are affected by new ISR initiatives. Waizenegger & Techatassanasoontorn (2020) remark that, “the field of

RPA is still widely under-researched; we still know particularly little about the implications of RPA implementations on the human workforce”, (p. 11).

Theorization on intelligent software robotisation

The two themes on ISR theorization that attracted attention during the review were in relation to ISR technology categorisations and ISR adoption models.

Among the few concepts sighted in the IS literature to conceptualise software robotisation technologies is the Lightweight and Heavyweight model proposed by Bygstad (2017) and its implications for generativity and innovation. It was adopted by Penttinen et al. (2018) as a lens to analyse the technology options (RPA and traditional BPM tools) available to a company which intends to undertake automation. The study was limited in the range of technologies examined and the currency of the criteria applied (e.g. invasiveness, stability of systems architecture etc.,). Huang & Rust (2018) identify four types of intelligent AI technologies (based on learning ability) in their proposed theory on AI job replacement and discuss the types of job the four could replace. Their focus however was on embodied robots in the service industry, with less attention on software robots. Ribeiro et al. (2021) provide a review of RPA technologies available at the time of their research, mainly from a practitioner’s viewpoint. The paper is insightful in revealing the evolution of RPA from a low level of intelligence (rules-based) to higher levels with advanced human-like features such as, intuition and empathy. However, the focus was more on discussing the functionalities, with no theoretical deliberations such as propositions or predictions. Recently Filgueiras et al. (2022) also identify three generations of RPA, based on their capabilities in decision-making and handling of structured or unstructured data. The objective of the paper was an empirical investigation into users’ experience with RPA hence the categorisations were intended to aid that enquiry, as descriptive background material. Engel et al. (2022) is a promising

effort which provides some foundational blocks to build on in respect of conceptualizing and categorizing ISR technologies in general.

Hence, in relation to theorization, the first knowledge gap is inadequate comprehensive theorizations on software robotisation technology categorizations for guidance on their choice and adoption. In recognition of this gap, Kokina & Blanchette (2019) for instance have called for research on organisational transitions between unintelligent and intelligent technologies. This could be valuable in guiding the choice of the two categories of technology. The second observation on ISR theorization was related to the models available to examine ISR adoption issues. Quite a number of them had leveraged the widely known IS technology adoption models such as, TAM, UTAUT and TOE.

Though considerable literature exists on *robots* in general, a noticeable gap is the limited number of models which specifically examine the unique characteristics of *software robots* such as, RPA and AI in relation to cognition, *anthropomorphism*, replacement of human intervention conceptualized as levels of automation (LOAs) and testing them as constructs in various theoretical propositions. For example, anthropomorphism has been widely studied for physical robots and customer-facing software robots such as chatbots, with rare studies on back-end software robots such as, RPA. Among the few studies which examine robot-specific constructs for instance, is Laut et al (2021) who identified “automation” and “augmentation” as distinctive characteristics of robots which they incorporated in their research framework. Also, Chiu et al. (2021) in their model, test AI’s cognitive and operational capabilities as distinctive robot features. Heerink et al. (2010) is also among the widely cited studies which have developed a robot-specific adoption model, namely the Almere model. However, the model’s focus was on individual acceptance of

both physical and software robots (“screen agents”) which provide elderly care services and not on organisational level analysis. Their work has since encouraged the development of similar models, mostly for *physical/embodied* service robots (Wirtz et al. 2018; Ghazali et al., 2020). Wewerka et al. (2020) on the other hand derived an RPA-specific adoption model but with borrowed constructs from the TAM and UTUAT models. Again, their focus was on individual user acceptance. Ulfert et al. (2022) also investigated the relationship between the level of automation (LOA) of intelligent decision software agents (DSSs) and user intentions towards them, among other elements. Their research was also at the individual level and importantly, they noted the dearth of research on the LOA of software agents and called for more studies.

The limitations of these models serve as a call for further research in developing organisational level models for ISR adoption, which incorporate *software robot-specific* variables, namely anthropomorphism and level of robotisation (LOR)

African ISR cases - the developing economy context

Nine African papers obtained from the initial review and subsequent iterations were analysed (Tew, 2020; Sitienei, 2020; Mlambo & Iyamu, 2021; Ahmed, 2021; Calitz et al., 2021; Lakay & Mlambo, 2022; Mbiu, 2022; Mlambo, 2022; Papa, 2022). The first observation from the African papers reviewed was the paucity of research from West Africa. They were mainly from South Africa (5 studies) and Kenya (3 studies) with one (1) sub-Saharan African instance (Nigeria, Ghana, South Africa and Kenyan). Almost all (8 of them) had as context, the financial sector, including banking and insurance, while one focused on the telecom industry. Furthermore, five (5) out of the nine (9) were dissertations, three (3) were journal articles, with one (1) conference paper.

Regarding their research objectives, they were mostly adoption-related and for theoretical foundations, had employed the usual models such as, TAM, TRA, UTAUT and TOE with Activity theory being the odd one. Lakay & Mlambo (2022) and Calitz et al. (2021) took a slightly different path to examine some people dimensions of ISR adoption. In respect of methodology, four papers (4) (Sitienei, 2020; Calitz et al., 2021; Mbiu, 2022; Papa, 2022) adopted a quantitative approach (surveys), with the remainder being qualitative (case studies, content analysis) (Tew, 2020; Mlambo & Iyamu, 2021; Ahmed, 2021; Lakay & Mlambo, 2022; Mlambo, 2022;)

In relation to insights, the papers indicated that ISR adoption was at the nascent stage and there was paucity of related research on the African experience (Mlambo & Iyamu, 2021; Mbiu, 2022). For instance, Mlambo & Iyamu (2021) noted the inadequacy of industrial use cases to serve as references. Research findings included adoption factors such as, relative advantage, compatibility, competitive pressure, top management support, readiness, business goal alignment, effort expectancy, facilitating conditions (Mbiu, 2022; Mlambo, 2022; Sitienei, 2020). ISR benefits were also identified, consisting of improved speed of operations, improved quality, cost savings, customer excellence (Papa, 2022).

Among the elements mentioned for preventing successful adoption were, lack of skilled personnel, poor change management, organisation culture, lack of governance processes, initial technology investment cost, difficulties with legacy applications and wrong process selection (Tew, 2020; Papa, 2022; Lakay & Mlambo, 2022). In addition, Ahmed (2021) noted regional level barriers such as, deficiencies in computing infrastructural capacities (including broadband network coverage, energy supply or electricity) and digital data ecosystem facilities (such as digitized data for AI algorithms).

Given that most of the studies were in the financial sector, the need for a regulatory regime to guide RPA deployments was also identified. It was considered necessary for consumer and data protection to forestall breach of confidentiality and leakage of sensitive information, as well as to combat cybercrime, particularly, financial crime such as, money laundering (Ahmed, 2021; Sitienei, 2020).

On the people dimension, an issue that persistently came up in interview verbatims, findings, discussions and conclusions, was the concern about employment security, expressed as a fear of job loss to ISR. This was reported in seven out of the nine papers (Tew, 2020; Sitienei, 2020; Mlambo & Iyamu, 2021; Calitz et al., 2021; Lakay & Mlambo, 2022; Mlambo, 2022; Papa, 2022). As indicated by Mlambo & Iyamu (2021) and Tew (2020), the employment security concern reflects the sensitivity around unemployment issues on the continent exemplified by the South African context. Hence to protect members' jobs, the trade unions in South Africa participate in deliberations on RPA deployments (Tew, 2020).

The major gaps in the African literature on ISR are paucity in several areas of research, namely (i) *number and breadth of studies* - nine studies mainly from 2 countries; (ii) *subject coverage* – mainly on adoption; (iii) *application domains of research context* – mainly in the financial sector; (iv) *methodologies* – mainly qualitative and quantitative. Apart from the knowledge gaps, the notable issues requiring attention were, (i) nascent or *low adoption rates* of ISR and (ii) employment security and *labour union activities* in ISR deployments on the continent.

The paucity is probably attributable to the low and nascent ISR adoption, which may have adversely impacted the range of feasible practical research instances and subjects available. Hence there is the need for more research in various context with diverse methodology, to rigorously validate the findings reported in the papers reviewed, as indicated by Calitz et al. (2021). Ahmed

(2021) also points out the fact that we know little about the potential socio-technical implication of ISR adoption in Africa.

For the purposes of this study, the findings on job security and the *activities of trade unions* is specially noted for further investigation.

Research methodologies

The methodological orientation of the 54 papers reviewed are shown in Table 2.2

Majority of the papers (38) had adopted a qualitative approach involving mainly case studies and a few content analyses. Seven (8) were quantitative studies which conducted surveys, two (2) adopted a design approach, another two (2) chose a configurational analytical leaning, three (3) were experiments, while the remaining two (2) were, Delphi and mixed methods studies.

Granted that the selection was not probabilistic and hence most likely not representative of all ISR research, the methodological breakdown is however informative for the purposes of this study.

Noticeable is the low coverage of analytical approaches which are different from the traditional qualitative and quantitative ones. Hence of interest is the low number of papers (2) using configurational analysis, compared to the qualitative approach. Configurational analysis involves framing research enquiries in a manner that allows data to be analyzed with Qualitative

Table 2.2: Distribution of Methodologies from the Literature review

Methodology	No.	Sample Papers
Qualitative	38	Engel et al. (2022); Chugh et al. (2022); Kokina & Langmann (2022); Seiffer et al. (2021); Lacity & Willcocks (2021); Coombs et al. (2020); Tew (2020); Asatiani et al. (2019); Kokina & Blanchette (2019); Fernandez & Aman (2018); Penttinen et al. (2018);

		Aguirre & Rodriguez (2017); Lacity & Willcocks (2016a)
Quantitative	8	Dey & Das (2019); Calitz et al. (2021); Mbiu (2022); Papa (2022); Sitienei (2020); Wewerka et al. (2020); Rawashdeh, et al. (2022); Chiu et al. (2021)
Design	2	Santos & Pereira (2020); Jimenez-Ramirez et al. (2019)
Configurational analysis	2	Laut et al (2021); Waizenegger & Techatassanasoontorn (2020)
Experimental	3	Ghazali et al. (2021); Ulfert et al. (2022); Heerink et al. (2010)
Delphi	1	Berube et al. (2021)
Mixed method	1	Eikebrokk & Olsen (2020)
TOTAL	55	

Comparative Analysis (QCA) tools. Traditional multivariate analysis such as regression analysis, look for a *single* best fit solution to explain the relationship between variables. QCA on the other looks for more in a dataset by unearthing the *combinations* of conditions that contribute to an outcome. Laut et al. (2021) and Waizenegger & Techatassanasoontorn (2020) who used configurational analysis in studying dimensions of ISR, point out the potential for this approach to contribute diverse and rich insights to enquiries on IS phenomena and encourage more use of the approach.

2.3.3. Summary of Identified Gaps

The knowledge gaps identified from the emergent themes in the literature reviewed and discussed in the foregoing deliberations, have been organised, following Muller-Bloch & Kranz (2015) and are presented in Table 2.3.

Table 2.3: Summary of Gaps identified from the Literature review

Category	Theme	Gap	Significance of the gap	Call for relevant research
Issue gaps	1. Implementation approach towards for software robots	Dominance of studies on high LOR (level of robotisation) which fail to address its adverse effects and few on complementary robotisation	(i) High LOR has adverse effects (e.g. overreliance, deskilling and job losses) (Asatiani et al., 2019); (ii) 30%-50% ISR project failure due to implementation related risks (Waizenegger & Techatassanasoontorn, 2020)	On complementary ISR as a means to address adverse effects of high LOR (Asatiani et al., 2019)
	2. Employment security	More focus on identification of job loss as an issue and less on solutions and employees' coping strategies towards anxieties related to software robots	Employment security is a matter of socio-economic concern with adverse implications (Mlambo & Iyamu, 2021 & Tew, 2020)	On (i) addressing job loss using complementary IS (Asatiani et al., 2019) (ii) coping with software robots (Seiffer et al., 2021; Coombs et al., (2020)
	3. Impact	Adequate attention to financial benefits and less on human-centered impacts	Automation has unintended & unanticipated consequences,	On human-centered impact of ISR (Seiffer et al., 2021; Waizenegger &

		(e.g. workers' reactions)	hence human-centered impact studies is critical (Wang et al., 2021; Malik et al., 2021; Parasuraman & Manzey, 2010)	Techatassanasoontorn, 2020; Coombs et al., 2020)
Theoretical gaps	4. Theorizations on ISR	a) Inadequate theorization on categorisations of ISR technologies to guide appropriate choice	Selection of inappropriate robotisation technology is cited as part of reasons for ISR project failures (Moffitt et al., 2018)	On theorization on the choice of intelligent versus unintelligent robotisation (Kokina & Blanchette, 2019)
		b) More of traditional IS adoption models (e.g. TAM, UTAUT) and less on software robot-specific adoption models; robot models focused on individual level analysis	A broader and deeper understanding of ISR's unique characteristics (e.g. anthropomorphism, LOR) as model constructs and organisational level dimensions	On more models on software robotisation (Ulfert et al., 2022)
Contextual gaps	5. African ISR studies	Few studies, mainly from two countries and about the financial sector	Broader understanding required on ISR phenomenon dimensions in Africa	On diverse studies on ISR deployment in Africa (Calitz et al., 2021; Ahmed, 2021)

Methodological gap	6. Analytical approaches	Dominance of qualitative analysis and variance-based analysis for the quantitative studies, with less of configurational analysis such as FsQCA	Diverse analytical methods could provide novel insights	On more use of QCA in IS research (Laut et al., 2021; Waizenegger & Techatassanasoontorn, 2020)
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Gaps and issues to be addressed by this Doctoral research

As a response to the gaps, most of them will be addressed by this doctoral research, with the exception of the gap on the theorization of the categorisations of ISR technologies and the adoption of intelligent and unintelligent robotisation. The scope of work required to address that, is beyond the resources of this dissertation and is noted as a research endeavour for the future. Also, there was overlapping in the gap identifications on complementary ISR and employees’ coping strategies. Hence a synthesis was performed and the “impact” theme was merged with “employment security” on the issue of coping strategies. “Complementarity” which was identified under both “implementation approach” and employment security was assigned to implementation approach. Furthermore, three issues were identified from the literature as requiring further investigations, namely reported high failure rates of ISR projects, the low rate of ISR adoption in developing economies as well as the activities of labour unions in relation to employment security in the developing economies. Table 2.4 summarizes the gaps and issues to be addressed.

Table 2.4: Summary of Gaps & Issues to be addressed by this thesis

Category	Emergent Theme	Gaps to be addressed	Issues to be addressed
Issue gap	1. Implementation and adoption issues	complementary ISR	High rate of ISR project failures
	2. Employment security	employee coping strategies	
Theoretical gap	3. Theorization on ISR	robot-specific variables (e.g. anthropomorphism, levels of robotisation, LOR) as constructs to be investigated	
Contextual gap	4. African ISR studies	limitations in number of studies, coverage breadth (subject & industry) and research methodology	(i) low ISR adoption rate; (ii) labour union activities in response to employment security
Methodological gap	5. Configurational analysis	configurational analysis using FsQCA	

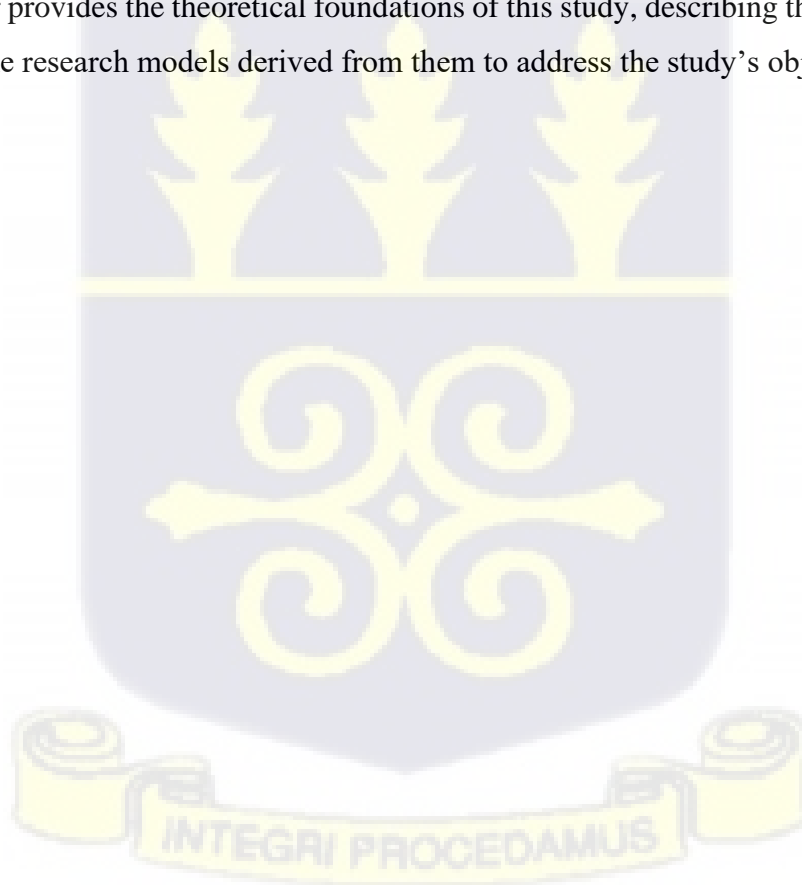
2.4. CHAPTER SUMMARY

The chapter discussed the key concepts of the thesis, namely intelligent software robotisation and its primary technologies, artificial intelligence and robotic process automation. It also looked at the notions of intelligence in machines and the concept of complementarity as applied to humans and robots working collaboratively.

Regarding what we know and do not know about the current state of ISR research, a review of the literature indicated that there is appreciable research on ISR adoption, benefits and risks, as well as employment security as a major concern, particularly in the developing economies.

The review however also exposed knowledge gaps in the areas of implementation and adoption, employee coping strategies, theorization on ISR technologies, adoption models, methodological approaches as well as a research deficit in developing economies in the number and breadth of subject coverage, application domains and methodologies. Also missing was a healthy number of configurational analysis. Apart from the gaps, important issues such as high rate of ISR project failures, the low rate of ISR adoption in developing economies as well as the activities of labour unions, were also identified as requiring attention. These gaps and critical issues guided the formulation of the research problems, objectives and purpose.

The next chapter provides the theoretical foundations of this study, describing the various theories employed and the research models derived from them to address the study's objectives.



CHAPTER THREE

THEORETICAL FOUNDATIONS

3.1. CHAPTER OVERVIEW

The previous chapter discussed key concepts of the study and provided a survey of the literature on ISR and related topics together with identified gaps which informed the development of the research objectives for this study.

This chapter discusses the theories and models providing the theoretical foundations for this research, interspersed with the conceptual framework derived specifically to address the principal objectives of the study. They are presented in the order of the objectives.

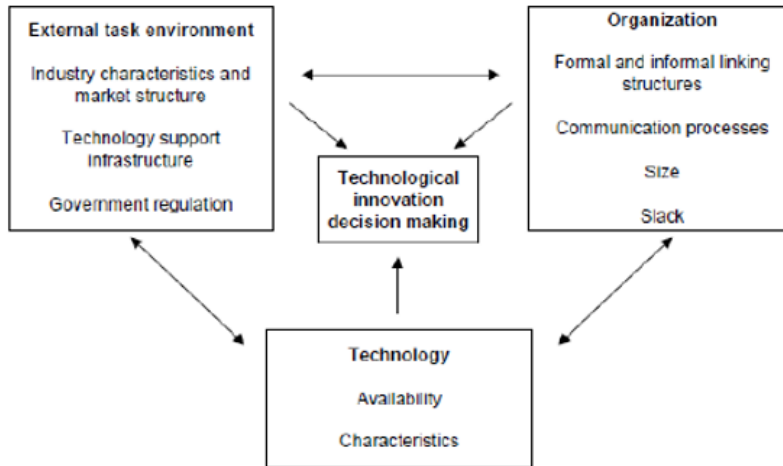
3.2. MODELS FOR ISR DEPLOYMENT

3.2.1. Technology-Organisation-Environment (Toe) Framework

The TOE framework (DePietro et al., 1990) broadly classifies the elements that influence a firm's decision to implement a given technological innovation, into three groups, namely, Technology, Organisation and Environment, each category in turn comprising a number of variables. The contention is that together, these elements interact to determine technological implementation decisions for a firm. This is shown in Figure 3.1.



Figure 3.1: The TOE Framework



Adapted from: DePietro, Wiarda & Fleischer (1990)

The technology elements of the framework include the availability and characteristics of the technology accessible to the organisation, both internally and externally. Processes and equipment also form part of the technological characteristics. The organisational elements comprise the size, organisational structures, communication processes together with slack (IT resources available to handle any internal or external pressures). The environmental elements describe the general setting and conditions within which the organisation operates including competition, available technology infrastructure and support, as well as regulatory arrangements.

Application of the TOE framework in IS research

Two of the widely cited papers which have reviewed how the TOE framework has been applied in IS research are, Baker (2012) and Oliveira & Martins (2011). A recent addition is Thomas & Yao (2023), which is a meta-review that includes a review of the earlier two articles as well. From all three reviews, it emerges that the TOE framework has been employed extensively in IS research and in diverse ways, thereby contributing to knowledge generation in the discipline.

According to Thomas & Yao (2023), the framework has been used to investigate decisional and behavioral elements at various stages of technology adoption at the organisational level, such as, the technology evaluation, actual usage and post-adoption stages (to analyze value achievement).

The authors also found that, the TOE framework has been adapted with the incorporation of constructs from other adoption models such as, TAM, DOI, UTUAT and Institutional theory. Regarding research methods used in conjunction with the TOE framework, they identified surveys, case studies, Delphi and longitudinal studies. The least tested TOE constructs are those related to communication and linking structures, due to difficulties in their measurement (Thomas & Yao, 2023).

The review indicates that the TOE framework has been used to study a wide range of ICTs across diverse sectors, including, e-healthcare, e-banking, e-commerce, e-governance, e-procurement, blockchain, cloud computing, enterprise architecture, industrial collaborative robots, social media marketing, augmented reality and big data analytics. Example of papers which have used the TOE framework to study intelligent software robotisation (ISR) adoption include, Marrucci et al. (2023), Radhakrishnan et al. (2022), Hoffmann & Mehler, 2023; Laut et al. (2021), Berhold et al. (2021) and Yang et al. (2021). Its wide and continued usage in diverse dimensions of IS investigations, suggests the continued relevance of the model to IS research as mentioned by Radhakrishnan et al. (2022).

Strengths and limitations of the TOE framework

The major strengths of the TOE framework are its broad coverage of variables and flexibility. Firstly, compared to models such as, DOI, the TOE model covers a much broader range of variables. As indicated by Thomas & Yao (2023), “While some theories and frameworks cover aspects of organizational technology innovation, none provides a *comprehensive* approach

elaborating all necessary and *sufficient contextual factors* other than Organization- Technology- Environment (O-T-E, later re-ordered in IS literature and referenced as T-O-E)” (p.5811). This is explained further in the next section. The second strength of the TOE framework is its flexible and generic nature. The TOE framework offers a general proposition on the nature of the elements that influence technology adoption, without its own *specifically* stated theoretical predictions or postulates. This allows researchers to adapt the framework in various ways to suit their research purposes, including the addition of relevant variables and theoretical predictions from other theories (Thomas & Yao, 2023).

Within these strengths are also the seeds for the framework’s limitations. The TOE framework has been criticized for not being a well-developed theory, leading to a characterisation of the model as a categorisation of variables (Awa et al., 2017; Gangwar et al., 2014). Issues have also been raised with the adequacy of the model to explain the adoption of technology in certain circumstances such as, the differences in the adoption of the same technology by different organisations within a similar context (Nagy et al., 2014); or the adoption of technological arrangements with unique features such as cybersecurity characterised by unknown and intangible threats (Wallace et al, 2020). In response to the criticisms, the recommendation is for researchers to strengthen the TOE framework with extensions for adequate robustness and rigour (Thomas & Yao, 2023; Hoffmann & Mehler, 2023; Wallace et al., 2020; Awa, et al., 2016)

Justification for the choice of the TOE framework

Compared to other well used IS adoption models such as The Technology Acceptance Model (TAM) (Davis, 1989), Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), Theory of Planned Behaviour (TPB) (Ajzen, 1991), Diffusion of Innovations (DOI) (Rogers, 1983), Unified

Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003), the TOE was considered suitable for this study for several reasons.

Most of the models listed earlier, with the exception of the DOI, analyse individual level adoption, while TOE and DOI focus on organisational level adoption, which is the thrust of this study. However the DOI lacks environmental factors, thereby making the TOE framework a much more *broader model* with more variables to cover a wider range of possible adoption factors. Furthermore, the developing economy environment which is different socio-economically from the developed world where most IS theories emanated from, also presents a different research context where environmental factors cannot be ignored as noted by various scholars (Adamu & Benachour, 2020; Asiaei & Rahim, 2019; Andoh-Baidoo, 2017; Hong et al., 2014; Thatcher & Ndabeni, 2013; Musa, 2006). The TOE thus allows for an analysis of relevant *contextual* factors. To support the choice of the TOE framework as being appropriate for this study's subject and objectives, the author turned to some studies which have used the model in a similar manner with encouraging outcomes. The studies include Marrucci et al. (2023) and Laut et al. (2021) who adopted both the TOE framework and a configurational analysis to study ISR. Radhakrishnan et al. (2022) also used the TOE framework to discuss the current wave and trend towards *intelligent process automation*.

Application of the TOE framework in the study

The TOE framework was adapted for this study with the inclusion of two elements to allow for a rigorous investigation of the study's objectives. The addition of the two variables also responds to the recommendations proffered as part of addressing the weaknesses of the model, which is to include other variables for adequate robustness and rigor. Firstly, from the literature review one of the unique characteristic of robots namely, their human-likeness (anthropomorphism), often came

up as a factor in adoption decisions. This has been investigated in situations where *software* robots (e.g. chatbots) interact with humans, mainly customers, in *frontline* service encounters (Vladova et al., 2022; Li & Suh, 2021 and Cui et al., 2020). However, more studies are required to understand fully, the influence of anthropomorphism in adoption decisions in situations where the robots operate at the *backend* and interact mainly with employees. This is thus tested in the Technology category. Secondly, Another important insight from the review of the few African studies conducted on the adoption of software robotisation on the continent, indicated a dimension which could be significant within the African context. This relates to job security and employee job protection activities, especially from union activities (Tew, 2020; Mlambo, 2022; Calitz et al., 2021; Lakay & Mlambo, 2022; Sauders & Rutkowski, 2019). Labour union activities was thus tested in the Environment category, under Industry structure.

The resulting research framework, shown in Figure 3.2, was used to investigate the first objective of the study which is to examine why a firm chooses to implement intelligent software robotisation. The research framework guided the design of a questionnaire to collect data on the constructs from the selected sample, which was analysed with FsQCA.

3.2.2. The ISR Deployment Model

Constructs definition and Development of Propositions

Table 3.1 provides a detailed description of the TOE dimensions used in this study. It describes the variables together with their measures or sub-variables as well as the literature sources supporting the measures.

The constructs of the theoretical framework for ISR adoption were derived from a review and synthesis of the literature on technology adoption in general (diverse technologies), adoption of ISR involving the use of RPA and AI and adoption in the developing economy context. This

approach was adopted because of how relatively young the ISR phenomenon is and hence the low depth of research stream to choose from. The approach adopted thus provides a much broader and more solid support for the propositions proffered than a narrow focus on the scanty ISR literature alone.

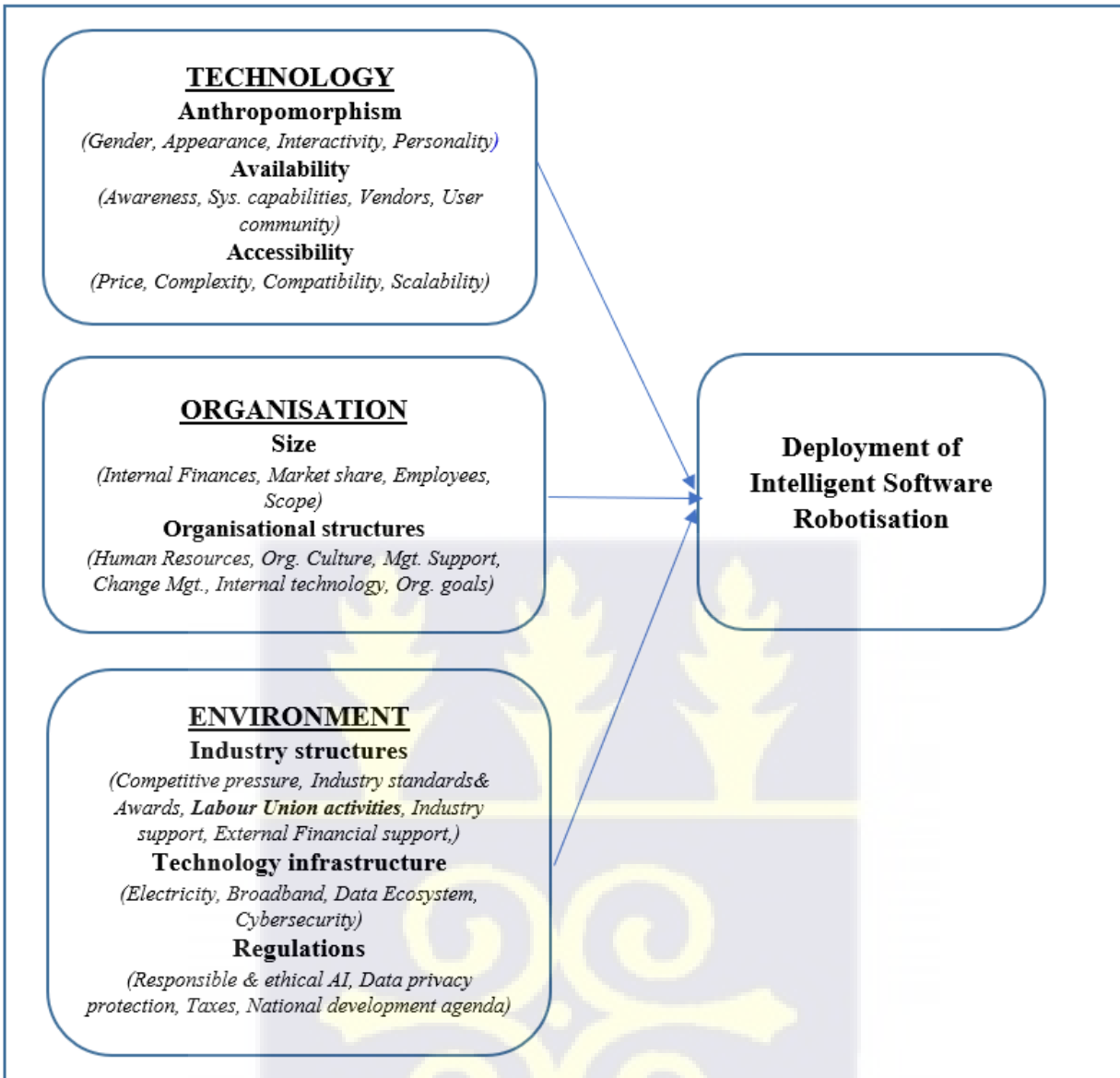
Technology Dimension

The technology dimension in the TOE framework (DePietro et al., 1990) refers to the availability and characteristics of the technology accessible to the organisation, both internally and externally. Processes and equipment also form part of the technological dimension. This study assesses technology *availability*, technology *accessibility*, *anthropomorphism* (a tendency to attribute human-like traits such as names to non-human objects), as part of the technology characteristics dimension. The definitions of the constructs, their measurement scales and sources of empirical support for their efficacy are provided in the constructs definition table (Table 3.1)

Several studies indicate the influential role of factors such as, *anthropomorphism* (Vladova et al., 2022; Makkonen et al., 2022; Li & Suh, 2021; Seiffer et al., 2021; Go & Sundar, 2019; Pfeuffer et al., 2019; Kim et al., 2019); *technology availability* (Sayem et al., 2022; Alzaabi & Shuhaiber, 2022; Zuchowski, 2022; Marett & Xiao, 2022; Almarashda et al., 2021; Gomez-Gonzalez et al. 2020; Asiaei & Rahim, 2019;) and *accessibility* (Cheng & Parker, 2023; Manning et al., 2022; Marett & Xiao, 2022; Atawneh et al., 2022; Zuchowski, 2022; Sayem et al., 2022; Setiawan, 2019; Zhang et al., 2017) in technology adoption decisions in relation to ISR.

The above empirical evidence, was thus valuable in supporting the technology dimension of this study's proposition on ISR deployment, which is stated at the end of this section.

Figure 3.2: ISR Deployment Model



Adapted from, DePietro, Wiarda & Fleischer, 1990

Organisational Dimension

The organisation dimension in the TOE framework describes elements such as, firm size, organisational structures, communication processes together with slack (IT resources available to handle any internal or external pressures) (DePietro, Wiarda & Fleischer, 1990). This study examines *firm size* and *organisational structures* under various sub-variables.

Table 3.1 provides the definitions of the constructs, their measurement scales and sources of empirical support for their efficacy and importance.

From the literature, a number of studies were found to have provided evidential material on the important role of *firm size* (Afsay et al., 2023; Zoll et al., 2022; Pai & Chandra, 2022; Chittipaka et al., 2022; Laar & Seymour, 2022; Berhold et al., 2021; Moker et al., 2020; Pumplun et al., 2019; Awa et al., 2017; Sabi et al., 2018) and *organisational structures* (Henderson & Salado, 2023; Mohiuddin et al., 2023; Leppala & Huhtamaki, 2022; Ali et al., 2022; Chen et al., 2022; Sayem et al., 2022; Low et al., 2022; Lewandoski et al., 2021; Hamm & Klesel, 2021; Smit et al., 2018; Wolverton & Thomas, 2018) in general technology and ISR adoption decisions.

The above empirical evidence, provided support for the organisational elements in this study's proposition on ISR deployment, which is stated at the end of this section.

Environmental Dimension

The environmental dimension of the TOE framework (DePietro, Wiarda & Fleischer, 1990), describes the general setting and conditions within which an organisation operates, which includes specific industry characteristics and market structures, available technology infrastructure and support, competition, and regulatory arrangements (DePietro, Wiarda & Fleischer, 1990; Oliveira & Martins, 2011). This study examines the environmental dimension under three broad categories of elements namely, industry characteristics, technology infrastructure and regulatory regime which are further distilled into various sub-variables as shown in Table 3.1, depicting the definitions of the constructs, their measurement scales and sources of empirical support for their efficacy and importance. A note is made here of the inclusion of the labour union variable identified in the literature review; it is employed here as a measurement scale for industry characteristics.

Table 3.1: Constructs Definitions for ISR Deployment Model

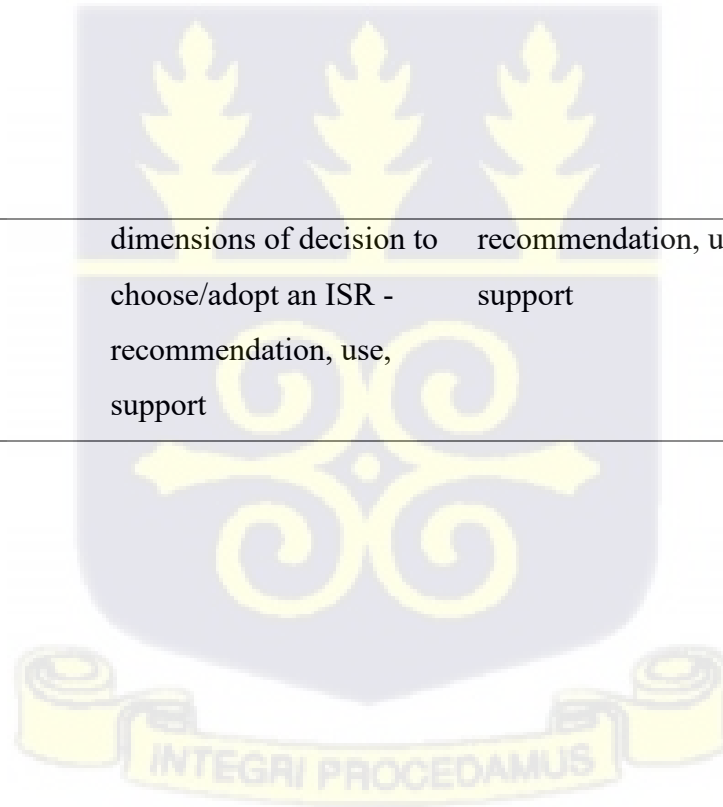
Dimension	Variable	Operational Definition	Measurement	Sample Sources
TECHNOLOGY		The technological elements that influence the decision to deploy AI-RPA robots in a developing economy firm	anthropomorphism, availability, accessibility	DePietro et al. (1990)
	Anthropomorphism	the human-likeness of AI-RPA robots	gender, human-like image, interactivity, personality	Vladova et al. (2022); Makkonen et al. (2022); Li & Suh (2021); Seiffer et al. (2021); Go & Sundar (2019); Pfeuffer et al. (2019); Kim et al. (2019)
	Availability	the ease of finding a suitable AI-RPA robot	awareness, system characteristics, vendor availability, user community network	Sayem et al. (2022); Alzaabi & Shuhaiber (2022); Zuchowski (2022); Marett & Xiao (2022); Almarashda et al. (2021); Gomez-Gonzalez et al. (2020); Asiaei & Rahim (2019)



Accessibility	the ease of actually acquiring AI-RPA robots	price, ease of use (complexity), compatibility, scalability	Cheng & Parker (2023); Manning et al. (2022); Marett & Xiao (2022); Atawneh et al. (2022); Zuchowski (2022); Sayem et al. (2022); Setiawan (2019)
ORGANISATION	The organisational elements that influence the decision to deploy AI-RPA robots in a developing economy firm	size, organisational structures	DePietro et al. (1990)
Size	the extent of the volume and value of a firm's operations	internal financial strength, market share, number of employees, scope	Afsay et al. (2023); Zoll et al. (2022); Pai & Chandra (2022); Chittipaka et al. (2022); Laar & Seymour (2022); Berhold et al. (2021); Moker et al. (2020); Pumplun et al. (2019)
Organizational Structures	the internal characteristics of a firm	skilled human resources, organisational culture, management support,	Henderson & Salado (2023); Mohiuddin et al. (2023); Leppala & Huhtamaki

		change management structures, internal technology infrastructure, alignment with organisational goals	(2022); Ali et al. (2022); Chen et al. (2022); Sayem et al. (2022); Low et al. (2022); Lewandoski et al. (2021); Hamm & Klesel (2021)
ENVIRONMENT	The environmental elements that influence the decision to deploy AI-RPA robots in a developing economy firm	industry structures, technology infrastructure, regulations	DePietro et al. (1990)
Industry Structures	features of the industry in which the firm operates	competitive pressure, industry standards & awards, industry associations, external financial support, <i>labour union activities</i>	Islam et al. (2023); Zhao & Xu (2023); Gomez et al. (2022); Gupta et al. (2022); Calitz et al. (2021); Simoes et al. (2020); Jacobsson et al. (2017); Calitz et al. (2017)
Technology infrastructure	the physical technological systems in a firm's location	stable energy, broadband connectivity, data ecosystem, cybersecurity	Ade-Ibijola & Okonkwo (2023); Okolo et al. (2023); Tuffour & Nsiah (2023); Sharma et al. (2022); Dinrifo et al. (2022); Daramola &

			Etim (2022); Chen et al. (2022); Kalusopa (2021); Smith & Neupane (2018)
Regulations	the various legal requirements governing business operations in a firm's location	laws on responsible & ethical AI, data privacy protection, taxes on robots, national development agenda	Mohiuddin et al. (2023); Kumar et al. (2023); Bwalya (2023); Ghobakhloo et al. (2022); Radhakrishnan et al. (2022); Tuffaha & Perello-Marin (2022); Dinrifo et al. (2022); Sharma et al. (2021); Rahman et al. (2021); Morley et al. (2023)
DEPLOYMENT	dimensions of decision to choose/adopt an ISR - recommendation, use, support	recommendation, use & support	DePietro et al. (1990)



There is also ample evidence in the literature for the importance of environmental factors such as, *industry characteristics* (Islam et al., 2023; Zhao & Xu, 2023; Gomez et al., 2022; Gupta et al., 2022; Calitz et al., 2021; Simoes et al., 2020; Jacobsson et al., 2017; Calitz et al., 2017), *technology infrastructure* (Ade-Ibijola & Okonkwo, 2023; Okolo et al., 2023; Tuffour & Nsiah, 2023; Sharma et al., 2022; Dinrifo et al., 2022; Daramola & Etim, 2022; Chen et al., 2022; Kalusopa, 2021; Smith & Neupane, 2018) and *regulatory regime* (Mohiuddin et al., 2023; Kumar et al., 2023; Bwalya, 2023; Ghobakhloo et al., 2022; Radhakrishnan et al., 2022; Tuffaha & Perello-Marin, 2022; Dinrifo et al., 2022; Sharma et al., 2021; Rahman et al., 2023; Morley et al., 2023; Chen et al., 2021; Basu et al., 2020; Alsheibani et al., 2020; Kovacev, 2020; Pumplun et al., 2019; Abbott & Bogenschneider, 2018) in decisions related to technology adoption generally and ISR in particular. The above empirical evidence, was therefore valuable in supporting the environmental elements in this study's proposition on ISR deployment, which is presented below.

Propositions

Following all the empirical evidence gathered on the various elements of the TOE framework, this study makes the following proposition on the deployment of ISR in developing economy firms, from a *configurational* frame:

Proposition : Anthropomorphic traits in ISR robots, technology availability, technology accessibility, firm size, organisational structures, industry characteristics, technology infrastructure, regulatory regime are sufficient and necessary conditions which influence the decision by developing economy firms to deploy ISR.

3.3. MODELS FOR EMPLOYEES' ISR COPING STRATEGIES

3.3.1 Coping Model of User Adaptation (CMUA)

The Coping Model of User Adaptation (CMUA) (Beaudry & Pinsonneault, 2005) examines user reactions to the introduction of a new technological event to the working environment. It could be regarded as an alternative approach to other known models on user responses towards new technology, such as, the TAM-Technology Adoption Model (Davis, 1989) and IDF-Innovation Diffusion Theory (Taylor & Todd, 1995) on adoption. It is built on coping theory in psychology and particularly the works of Lazarus & Folkman (e.g. 1984, 1985) and Folkman et al., (1986) among others.

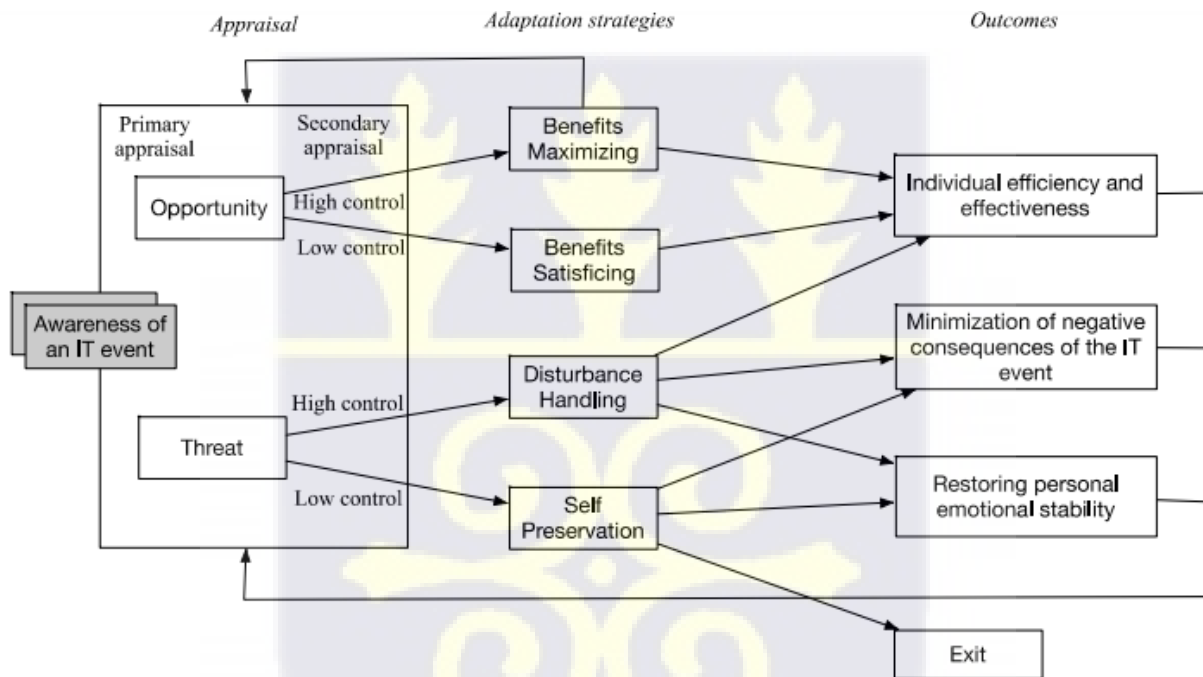
The fundamental premise of CMUA is that the introduction of a new technology or the modification of an existing one brings about changes or disruptions in various elements of an organization. The basic assumption of the model is that IT usage becomes an integral part of work, hence users are compelled to adapt to the disruptions.

The CMUA describes such adaptations as a *phased process* (shown in Figure 3.3) where one activity follows the other in a sequential manner in stages. Thus adaptation begins with the Appraisal stage comprising the primary and secondary appraisals. With primary appraisal, an IT event is evaluated as either an *opportunity or threat* to personal and professional life, followed by the secondary appraisal where the user evaluates their own level of control over the IT event as high or low. Next is the selection of the Adaptation which is dictated by a combination of the results of the primary and secondary appraisals leading to a choice of one of the following: *benefit maximizing, benefit satisfying, disturbance handling, self-preservation*. The final step is the Outcome stage where the adaptation strategies are expected to end up in efficiency & effectiveness, minimization of negative consequences, restoring personal and emotional stability and *exit*. A

summary of the definitions of the coping strategies are provided in Table 3.2 where they are operationalized.

The adaptation process is however, highly *iterative* and continually evolves as a result of the ongoing changes that occur in the interactions between the user and the IT event. Appraisal and adaptation constantly influence each other. Thus appraisal influences the adaptation efforts that are likely to be undertaken, which in turn leads to a reappraisal of the situation. Furthermore coping can occur at any of the deployment stages, that is the pre-, during and post-implementation.

Figure 3.3: Coping Model of User Adaptation (CMUA)



Source: Beaudry & Pinsonneault (2005)

Application of the CMUA model in IS research

When the model first emerged, some authors set out to validate its propositions (Elie-Dit-Cosaque & Straub, 2011), while others extended it by adding some variables (Fadel, 2012; Stein et al.,

2015). Some scholars have also leveraged it to derive their own similar coping models (Bala & Venkatesh, 2016; Bhattacharjee et al., 2018 & Paluch et al., 2022).

Furthermore, it has been used for theoretical support and hypothesis development (Chiu et al., 2022; Afzal & Panagiotopoulos, 2022); referenced in discussing research findings (Asatiani et al., 2020; Waizenegger & Techatassanasoontorn, 2020) and recommended for use in further research (Seiffer et al., 2021; Kashefi et al., 2015).

The theory's explanatory power has been validated through its extensive use in investigating user adaptation to a wide range of IT issues and in various sectors. These include AI across multiple organisations (Chiu et al., 2022), RPA in the accounting and financial sectors respectively (Asatiani et al., 2020); smart policing (Afzal & Panagiotopoulos, 2022); bring your own device (BOYD) across multiple sectors (Baillette & Barlette et al., 2021); technology-enabled (PC-based) assessments in education (Pillai et al., 2021); mobile ICTs across multiple sectors (Yin et al., 2018); digitalisation of health care delivery (Kashefi et al., 2018) and ERP in manufacturing (Bala & Venkatesh, 2016).

Strengths and limitations of the CMUA model

The major strength of the CMUA is that, while other theories and models such as, TAM, TPB, TRA that explain how users engage with IT events mainly focus on pre-adoption behavior, the CMUA embraces a much broader and dynamic scope which includes, pre-, during and post-adoption (Beaudry & Pinsonneault, 2005; Kashefi et al., 2018). For instance, unlike the others, the CMUA addresses *user adaptation* (Elie-dit-Cosaque & Straub, 2010). In addition, the CMUA goes beyond the prevalent analysis of intentions to use and acceptance of a new technology to examine the “black box” of underlying cognitive and behavioral facets which drive such reactions, as well as the outcomes of these behaviors (Elie-dit-Cosaque & Straub, 2010). The CMUA thus provides

a much *more nuanced description* of user reactions to new IT events compared to other models (Kashefi et al., 2015).

In addition, the CMUA compared to the other models, identifies the continuous and *iterative* nature of adaptation to a new technology (Beaudry & Pinsonneault, 2005; Ng et al. 2021; Kashefi et al., 2018). It acknowledges that adaptation is the result of ongoing interactions between the user and their environment, including the technology. The model thus makes provision for feedback loops and reappraisals.

Regarding its limitations, the authors of the model themselves provided a number of suggestions to strengthen their model, some of which have been discussed by researchers who have either validated or extended the model (Elie-Dit-Cosaque & Straub, 2011; Fadel, 2012; Bala & Venkatesh, 2016; Kashefi et al., 2018). One such remedial suggestion, is the issue of measurement scales; since the CMUA was developed from a qualitative study, it has been noted by the authors and Elie-dit-Cosaque & Straub (2010), that the model does not provide measurement scales which could be used to test its propositions quantitatively. Bala & Venkatesh (2016) also indicate that the CMUA does not theorize on the weights attached to the appraisal and coping elements (that is, which of the two is more influential?) and their sequencing (does one *always* follow the other?), another gap noticed by the authors.

Acknowledging that the coping strategies they outline may have failed to discuss other important strategies such as, sabotage, the authors called for more studies to build a comprehensive typology of adaptation strategies. Fadel (2012) responded with an extension incorporating a third appraisal type, *challenge*, while Kashefi et al. (2018) also introduced two typologies of adaptation, *approach* versus *avoidance*.

In all the CMUA has stood the test of time and continues to be used in contemporary IS research to explain users coping strategies towards IT events as demonstrated by the papers cited in the previous section

Justification for the choice of the CMUA model

The CMUA looks beyond technology adoption and goes further to provide insights into the different ways in which people might *adapt* to a technology, such as, benefit maximizing, threat minimization and adjustment of work (Kahsefi et al., 2015). More specifically in relation to this study, the CMUA analyses how users cope with *disruptive* IT-related events. Intelligent software robotisation, the subject of this study, is one such disruptive event, especially considering its potential to create anxiety about job security while also offering other career opportunities. Thus, the theory was considered appropriate for investigating employees' coping strategy towards intelligent software robotisation.

Furthermore, the model was originally developed with knowledge workers as research participants. The participants for this study are predominantly from industries which could be regarded as knowledge work industries (e.g. banking, insurance, telecommunications)

Application of the CMUA model in the study

Appraisal and adaptation elements from the CMUA model were used for this study owing to their suitability for the purposes and objectives of the study. The IT event part of the model was the first item to be adopted since it is at the core of the CMUA model. In the research framework, it was represented by a dimension of the ISR implementation which could cause employees to pursue a coping strategy, namely the *level of robotisation*. This was derived from Parasuraman et al. (2000)

& Asatiani et al. (2019) and was adapted for assessing the level of human and robot involvement in the robotisation initiative.

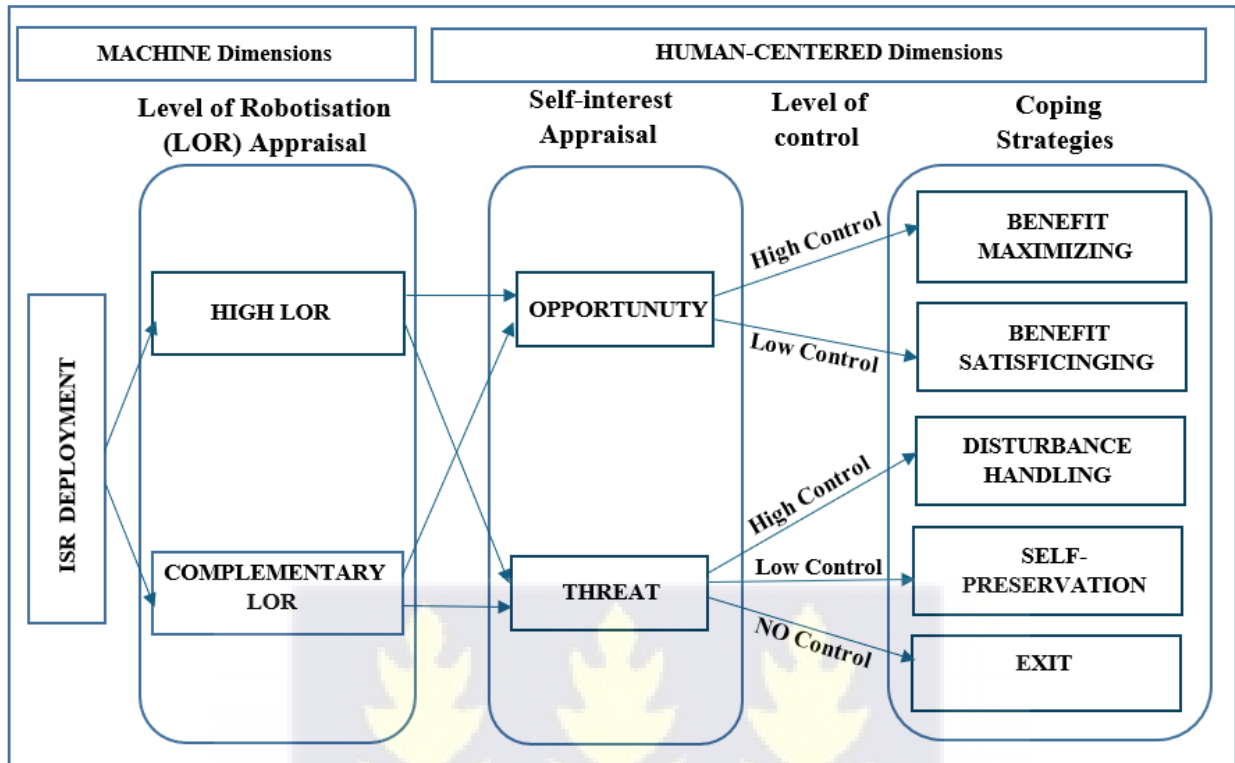
Next to be adopted from the CMUA was the primary appraisal of an event as being either an *opportunity or threat*. It was adapted for assessing the level of robotisation from a self-interest lens. Also adopted was the individual's *level of control* over their working conditions, their emotions and the technology, which was incorporated as a moderator. Finally, given that a key objective of this study is to understand worker's *coping strategies* towards ISR, the five coping strategies of the CMUA were also adopted to examine the various ways in which employees might adapt to ISR.

In summary, due to their suitability for the objectives of this study, the following specific elements of the model were adapted: (i) the IT event; (ii) primary appraisal dimension namely, *opportunities and threats*; (iii) secondary appraisal dimension of *high control* and *low control*; (iv) adaptation elements namely, coping strategies for opportunities (*benefit maximization & benefit satisficing*) or threats (*disturbance handling, self-preservation & exit*). The resultant model, shown in Figure 3.4, was used to address the third objective of the study, which is, to analyse employees' coping strategies towards the implementation of software robotisation in a firm.

3.3.2. Employees' ISR Coping Strategies Model

The research framework for Research Objective 2 mainly derived from the CMUA, is shown in Figure 3.4 while the corresponding constructs definitions are provided in Table 3.2.

Figure 3.4: Employees’ ISR Coping Strategies Model



Adapted from Beaudry & Pinsonneault (2005), Parasuraman et al. (2000) & Asatiani et al. (2019)

Constructs Definitions and development of Propositions

The main constructs in the Employees’ ISR Coping Strategies Model are briefly defined in Table 3.2, together with the literature sources for the definitions.

Constructs Definitions for ISR Coping Model

Table 3.2: Constructs Definitions for ISR Coping Model

Construct	Operational Definition	Sources
LOR	The degree to which an ISR robot has control, independent of human action, over ISR operations	Parasuraman et al. (2000); Kaber & Endsley (2004)

High LOR	Where an ISR robot has a higher level of control than the human in ISR operations	Parasuraman et al. (2000); Kaber & Endsley (2004)
Complementary LOR	Where control of robotisation operations is shared between the ISR robot and human	Parasuraman et al. (2000); Kaber & Endsley (2004)
Threat	Where a user appraises the LOR of an ISR deployment as having a potentially adverse effect on their professional or personal life	Presbitero & Teng-Calleja, (2023); Ulfert et al. (2022); Zhang et al., (2022); Brougham & Haar (2018); Beaudry & Pinsonneault (2005)
Opportunity	Where a user appraises the LOR of an ISR deployment as having a potentially beneficial effect on their professional or personal life	Xu et al. (2023); Filgueiras et al. (2022); Asatiani et al. (2020); Hemmer et al (2022); Beaudry & Pinsonneault (2005)
Level of control	The control which employees believe they have over their emotions, work procedures and the robots	Beaudry & Pinsonneault (2005); Elie-Dit-Cosaque & Straub (2011); Fadel (2012) Stein et al. (2015)
Coping strategies	The behavioral adaptation mechanism adopted by a user to address the outcome of their appraisal of an ISR deployment as (i) either an opportunity or threat and (ii) whether or not they have control over the situation (their emotions, work and the robots)	Xu et al. (2023); Barlette & Baillette (2020); Pillai et al. (2021); Bhattacharjee et al. (2018); Yin et al. (2018); Bala & Venkatesh (2016); Beaudry & Pinsonneault (2005)
Disturbance handling	The behavioral adaptation mechanism adopted by a user in response to the appraisal of the LOR of an ISR deployment as (i) a <i>threat</i> and (ii) they	Waizenegger & Techatassanasoontorn (2022); Zhang et al. (2022); Wang et al. (2022); Asatiani et al. (2020); Beaudry & Pinsonneault (2005)

	have <i>high control</i> over their emotions, work and the technology	
Self-preservation	The behavioral adaptation mechanism adopted by a user in response to the appraisal of an ISR deployment as (i) a <i>threat</i> and (ii) they have limited control over their emotions, work and the technology	Yang et al. (2023); Zhang et al. (2022); Ulfert et al. (2022) Asatiani et al. (2020); Beaudry & Pinsonneault (2005)
Exit	The behavioral adaptation mechanism adopted by a user in response to the appraisal of an ISR deployment as (i) a <i>threat</i> and (ii) they have <i>no control</i> over their emotions, work and the technology. Hence they find the situation to be optionless, too demanding and overwhelming to cope with emotionally.	Presbitero & Teng-Calleja (2023); Brougham & Haar (2018); Li et al. (2019); Beaudry & Pinsonneault (2005)
Benefit Maximizing	The behavioral adaptation mechanism adopted by a user in response to the appraisal of an ISR as (i) an <i>opportunity</i> and (ii) they have <i>high control</i> over their emotions, work and the technology	Xu et al. (2023); Filgueiras et al. (2022); Waizenegger & Techatassanasoontorn (2022); Asatiani et al. (2020); Beaudry & Pinsonneault (2005)
Benefit Satisficing	The behavioral adaptation mechanism adopted by a user in response to the appraisal of an ISR as (i) an <i>opportunity</i> and (ii) they have <i>limited control</i> over their emotions, works and the technology	Sutton et al (2023); Waizenegger & Techatassanasoontorn (2022); Chiu et al. (2021); Hemmer et al (2023); Beaudry & Pinsonneault (2005)

Next is a more detailed description of the constructs, which provide their foundations and empirical support for their significance in influencing employees' choice of ISR coping strategies. This is followed by a number of propositions on coping which formed the basis for the data collection and analysis efforts to address Research Objective 2.

Level of Robotisation (LOR)

In automation initiatives generally, the extent of automation is closely associated with human-machine task allocation and the issue of autonomy (Asatiani et al., 2019). Hence with robotisation, the level of robotisation (LOR) describes the degree of independence of a robot and its level of interaction with humans, in performing the functions previously undertaken by humans (Parasuraman et al., 2000; Kaber & Endsley, 2004). LOR is among the critical dimensions to be addressed in any robotisation endeavor, because in addition to deciding which tasks will be robotized, it also determines how much of those tasks will be robotised.

A couple of measurement schemes are available to determine the LOR in a robotisation tool. For instance, Parasuraman et al. (2000) and Kaber & Endsley (2004) provide a ten-point scale with which to assess LOR, based on machine autonomy. Table 3.3 shows the scheme adopted by Endsley (2004). For the highest LOR of 10, the machine acts without human intervention, 'ignoring' human input; at level 7 - 9, the user still has no input but this time the machine communicates its actions when it chooses to, when asked or when necessary. At the intermediate levels of 4-6, autonomy is shared while the user exercises approval oversight on the actions of the machine. At levels 2-3 the machine offers assistance, with some involvement. At the lowest LOR of 1, the machine offers no assistance and all work is done by the human.

Table 3.3: Sheridan & Verplank's Hierarchy of LORs

(1) Human does the whole job up to the point of turning it over to the computer implement,

- (2) Computer helps by determining the options,
- (3) Computer helps to determine options and suggests one, which human need not follow,
- (4) Computer selects action and human may or may not do it,
- (5) Computer selects action and implements it if human approves,
- (6) Computer selects action, informs human in plenty of time to stop it,
- (7) Computer does whole job and necessarily tells human what it did,
- (8) Computer does whole job and tells human what it did only if human explicitly asks,
- (9) Computer does whole job and decides what the human should be told, and
- (10) Computer does the whole job if it decides it should be done and, if so, tells human, if it decides that the human should be told.

Source: Kaber & Endsley (2004)

Significance of LOR in the research model

The level of robotisation is the strongest measure of the extent of human replacement in an automation instance, since it describes the levels of robot and human involvement, interactions and control. Consequently, it is also a strong means through which an employee can assess the threat (or otherwise) posed by an automation initiative to their self-interest, be it professional or personal.

Dimensions of LOR in the research model

The hierarchy of LORs (Table 3.3) was useful in determining the LOR elements for this study, namely a High LOR and Complementary LOR. The nature of the capabilities and functions of an automation tool is an important consideration when contemplating the use of the Kaber & Endsley (2004) scheme. Hence, for the purposes of this study, a *High LOR* is located from levels 8-10 on the scheme, indicating high robot independence with limited or no human intervention. A *Complementary LOR* on the other hand is located from levels 2-6 where autonomy is shared between humans and machines, with the human having oversight responsibility.

Appraisal of a High LOR: In the research model, an appraisal of an ISR deployment by an employee as a *high LOR* with high robot independence and little or no human intervention, is associated with possible job losses according to the literature (Frey & Osborne, 2013; Acemoglu & Restrepo, 2017). It could thus be regarded as a *threatening* event (Beaudry & Pinsonneault, 2005). The CMUA posits that where employees appraise an IT event as a threat, they are likely to adopt a threat-related coping strategies such as disturbance handling, self-preservation or exit (in extreme cases). On the other hand a high LOR initiative frees employees from repetitive, mundane and tedious work, allowing them to engage in more interesting, creative and value added work and offers job upgrade prospects (Ulfert et al., 2022; Lacity et al. 2021; Chiu et al., 2021; Asatiani et al., 2020; Kokina & Blanchette, 2019). Therefore an appraisal as a High LOR could also be seen as an *opportunity* for professional development. Once again, the CMUA indicates that, such a favorable appraisal is likely to result in opportunity-related coping strategies (benefit maximizing and benefit satisficing).

Appraisal of a Complementary LOR: In the research model, an appraisal of an ISR initiative as a complementary LOR with partial robot independence and humans exercising general oversight, has several implications. On the positive side (*opportunities*), it inherently preserves job and hence reduces anxieties about employment security (Asatiani et al., 2019). However, since human intervention here is comparatively higher than in High LOR, (e.g., reviewing robot tasks in addition to continuing with part of their old jobs), the situation of freeing up time for other professional pursuits could be lesser and could therefore be a source of grievance (*threat*). Similarly, depending on the employees' appraisal of the complementary LOR, they could opt for either an opportunity or threat related coping strategy, moderated by the level of control.

Studies indicating the relevance of LOR or robot autonomy as a factor to be considered in ISR coping research include, Ulfert et al. (2022), Seiffert et al. (2021) and Zhang et al. (2022). The two dimensions of LOR and their role in determining employees' coping strategies towards ISR is shown on Figure 3.4.

Opportunity and Threat appraisals

Opportunity and threat appraisals of an ISR initiative, are constructs from the CMUA (Beaudry & Pinsonneault, 2005). While *opportunity* relates to beneficial appraisals to an employee's professional and personal life such as, promotions, improvement of job quality, reduction of workload and personal status enhancement, *threats* include adverse appraisals such as, job loss and loss of personal status. The efficacy of these two constructs as influential factors in determining IT coping strategies have been demonstrated by CMUA validation studies (Elie-Dit-Cosaque & Straub, 2011; Fadel, 2012; Stein et al., 2015). Other related studies, specifically on coping with ISR are, Seiffert et al. (2021); Waizenegger & Techatassanasoontorn (2022); Asatiani et al. (2020); Chiu et al. (2021) and Afzal & Panagiotopoulos (2022).

Level of control

The level of control is adapted from the CMUA (Beaudry & Pinsonneault, 2005) and refers to the control employees believe they have over an ISR initiative as a whole, broken down into control over their emotions, work procedures and the technology. In the research model for coping, namely the Employees' ISR Coping Strategies Model (Figure 3.4), a cue is taken from the CMUA, hence the level of control is regarded as *moderating factor*. It is thus analysed and treated as a derivative of the coping strategy ultimately chosen by the employee, that is, *High control* for Benefit Maximising and Disturbance Handling); *Low control* for Benefit Satisficing and Self-preservation and *No control* for Exit. The significance of the level of control in the choice of coping strategies

is shown by CMUA validation studies (Elie-Dit-Cosaque & Straub, 2011; Fadel, 2012; Stein et al., 2015).

Coping Strategies

Coping strategies are the behavioral mechanisms used by employees to address their appraisals of an ISR initiative as a threat or opportunity, moderated by their level of control over the situation. The CMUA (Beaudry & Pinsonneault, 2005), indicates that these strategies aim at either restoring emotional stability or dealing directly with the consequences of the ISR initiative, with a focus on the areas over which employees believe they have control, namely, their emotions, work and the technology. Emotion-focused strategies include passive acceptance, minimization of consequences, self-deception, avoidance, apathy and selective attention. Work-focused strategies include modification of work procedures and habits as well as, skills adjustments such as training. Technology-focused strategies leverage customization of robot functionalities and features where available.

The CMUA provides five coping strategies which are, (A) *Threat-related*: (i) ***Disturbance Handling*** (adjusting emotions, taking minimum training, adjusting work procedures & technology where possible); (ii) ***Self-preservation*** (adjusting emotions e.g. self-deception, avoidance, apathy, selective attention) and (iii) ***Exit*** (leaving the organisation); (B) *Opportunity-related*: (iv) ***Benefit Maximising*** (making maximum efforts to maximize benefits such as promotions, through taking extra training and advanced usage to become an expert); (v) ***Benefit Satisficing*** (making minimum effort to be in good standing e.g. taking only mandatory training and maintaining competence). In the research model for coping, namely the Employees' ISR Coping Strategies Model (Figure 3.4), the choice of a strategy depends on appraisals of the LOR and self-interest appraisal (opportunity- or threat-related), moderated by level of control. This is also specified in Table 3.2. Studies which

confirm the choice of coping strategies to handle disruptive IT events generally include, Bala & Venkatesh (2016); Bhattacharjee et al. (2018) and Paluch et al. (2022).

Propositions

Following the empirical evidence and support from CMUA-related studies, as well as other relevant coping literature cited in the foregoing discussion, the propositions below are proffered in relation to coping with ISR using a *configurational* frame:

*Proposition 1: Appraisals of the **level of robotisation** and **self-interest** potentials of an ISR deployment by an employee, moderated by their **level of control**, are all necessary and sufficient conditions for employees' choice of an **ISR coping strategy**.*

*Proposition 2: Appraisals of an ISR deployment by an employee as either a **high** or **complementary level of robotisation**, as well as an **opportunity** to advance their self-interests, in an organisational environment where they also have a **high level of control** over their emotions, work procedures and the robots, are all necessary and sufficient conditions for adopting a **Benefit Maximizing** coping strategy.*

*Proposition 3: Appraisals of an ISR deployment by an employee as either a **high** or **complementary level of robotisation**, as well as an **opportunity** to advance their self-interests, in an organisational environment where they also have a **low level of control** over their emotions, work procedures and the robots, are all necessary and sufficient conditions for adopting a **Benefit Satisficing** coping strategy.*

*Proposition 4: Appraisals of an ISR deployment by an employee as either a **high** or **complementary level of robotisation**, as well as a **threat** to the advancement of their self-interests, in an organisational environment where they also have a **high level of control** over their emotions,*

*work procedures and the robots, are all necessary and sufficient conditions for adopting a **Disturbance Handling** coping strategy.*

*Proposition 5: Appraisals of an ISR deployment by an employee as either a **high** or **complementary level of robotisation**, as well as a **threat** to the advancement of their self-interests, in an organisational environment where they also have a **low level of control** over their emotions, work procedures and the robots, are all necessary and sufficient conditions for adopting a **Self-preservation** coping strategy.*

*Proposition 6: Appraisals of an ISR deployment by an employee as either a **high** or **complementary level of robotisation**, as well as a **threat** to the advancement of their self-interests, in an organisational environment where they also have a **no control** over their emotions, work procedures and the robots, are all necessary and sufficient conditions for adopting an **Exit** coping strategy*

These propositions were investigated with the aid of the FsQCA configurational analysis procedure.

3.4. COMPLEMENTARY ISR IMPLEMENTATION MODELS

3.4.1. Recommendations for Automation in Knowledge Work Organisations (RAKWO)

Asatiani et al.'s (2019) Recommendations for Automation in Knowledge Work Organisations (RAKWO) examines ways to address two adverse effects of a high level of automation (LOA) namely, overreliance and deskilling and strongly advocates for complementarity as a possible solution. Complementarity involves assigning humans and machines to solve a problem collaboratively in an automation instance, with the two complementing each other's strengths and

validating each other’s actions and decisions, while the human exercises overall control (Asatiani et al., 2019; Zhou et al., 2021; Lai et al., 2021; Sutton et al., 2023). *A detailed discussion on complementarity is found in Chapter 2.*

Using the Distributed Cognition Theory (Hutchins, 1995; Hollan, Hutchins & Kirsch, 1995) as a lens, Asatiani et al. (2019), proposed a framework for the implementation of intelligent software robotisation. This consists of six recommendations, based on a synthesis of findings from several studies conducted by the authors on software robotisation with RPA. The recommendations are outlined in Table 3.4 and shown in Figure 3.5.

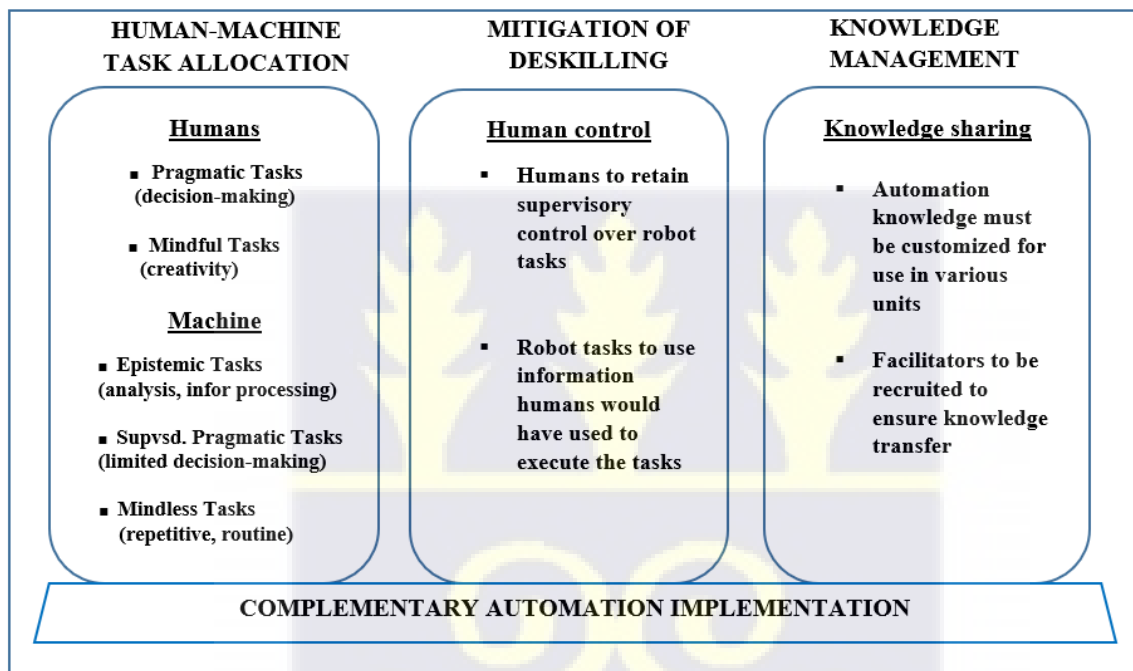
Table 3.4: Recommendations for Automation in Knowledge Work Organizations (RAKWO)

AUTOMATION DIMENSIONS	RECOMMENDATIONS
Human-Automation Task Allocation	Recommendation 1: Be careful when assigning <i>pragmatic</i> tasks to automation but seek for opportunities to find uses for automation in <i>epistemic</i> tasks.
	Recommendation 2: Divide tasks into their <i>mindful</i> and <i>mindless</i> components and offload the mindless part to automation while keeping the mindfulness-requiring part to humans.
Mitigating the risk of Deskilling	Recommendation 3: Implement automation to execute <i>pragmatic tasks</i> but make sure human workers retain the control of those tasks in order to sustain their skill level.
	Recommendation 4: To retain task control, organize automated operations’ inner workings so that they use the same information representations that also human workers will use in their supervisory control roles.

Managing Collective Knowledge	Recommendation 5: Make sure that the distributed knowledge can be re-contextualized into a local, actionable form in remote units.
	Recommendation 6: Recruit knowledge facilitators to facilitate knowledge transfer across local contexts.

Source: Adapted from Asatiani et al., (2019)

Figure 3.5: Recommendations for Automation in Knowledge Work Organizations



Source: Adapted from Asatiani, Penttinen, Rinta-Kahila & Salovaara (2019)

Some of the key assumptions of the RAKWO framework are:

- (i) robotisation initiatives involve distributed cognition, which consists of intricate interactions between humans, automation tools and environmental elements, and becomes an integral part of an organisation's work processes such that employees are exposed to it and are expected to use it;
- (ii) humans and machines have different strengths and weaknesses and both parties can complement each other in addressing their shortcomings and consolidating their robustness in three areas: human-machine task allocation, mitigation of deskilling and knowledge management.

Task allocation among humans and machines is a critical part of any robotisation initiative and to aid in doing this effectively, the authors define and categorize various task regimes. *Pragmatic* tasks are action-oriented decisions and executions while *epistemic* tasks analyze and produce information. *Mindful* tasks are those that require creativity or out-of-the-box thinking, while *mindless* tasks are repetitive information processing and routine tasks that do not require cognitively demanding processes.

The RAKWO framework aims to guide in building an automation system based on a complementary allocation of tasks to humans and machines with resilient checks and balances, while retaining human supervisory control. It also serves as means of preserving the loss in the organisation of the human skills related to the automated tasks handed over to the robots.

Application of the RAKWO framework in IS research

The RAKWO framework has been cited and referenced by several articles for the value of the recommendations.

For instance, the recommendations on dividing tasks between humans and computers have been noted by Arnold et al. (2023), as providing a viable solution to the problem of technology dominance, automation bias and deskilling. Similarly, the recommendations on human-robot task allocation have been mentioned as best practice for sequencing tasks in successful implementations of RPA (Krakau et al., 2023). Also, while eschewing the tensions created by fully-automated decision-making systems in BPM initiatives, Sadiq et al. (2023) recommended the framework's complementary approach which leverages the strengths of both humans and machines in different tasks, as a value creation mechanism. This is echoed by Koreff et al., (2021) who cited the RAKWO framework as reference when they recommended the coupling of human input such as brainstorming, with data analytic tools for effective fraud management in the

healthcare sector. Furthermore, the framework has been used for support in theorizing on human engagement in decision-making tools (Schemmer et al., 2021). It has also been cited by Sutton et al. (2023) as one of the works that contributed to the revision of their Theory of Technology Dominance (Arnold & Sutton, 1995), a theory on how overreliance on intelligent systems can result in deskilling.

Strengths and Limitations of the RAKWO framework

To properly situate a critique of the Asatiani et al. (2019) framework, it is necessary to first survey similar literature for a comparative analysis.

There is some appreciable research in implementing what is termed hybrid automation in general, particularly from a systems design and engineering orientation. Quite a number of such efforts have been directed towards *mechanical robots* with limited attention to *software robots*, especially *intelligent software robots*. Of the few hybrid intelligence literature considered relevant for this study (Dellermann et al., 2018; Dellermann et al., 2019; van der Aalst, 2021; Wallace et al., 2021; Ruiz et al., 2022; Klippenstein et al., 2023), there is limited practical guidance on implementing complementarity *specifically for ISR using RPA*. Most of the guidance in these studies are either conceptual or theoretical (Dellermann et al., 2019; van der Aalst, 2021), design-focused (Dellermann et al., 2018; Klippenstein et al., 2023) or unclear procedures (Wallace et al., 2021). Among the papers, Ruiz et al. (2022) is the study most similar to Asatiani et al. (2019), since it also focuses on RPA and offers some practical implementation guidelines.

Compared to all the afore-mentioned studies, there are a number of laudable features of the RAKWO framework which could be regarded as constituting its relative strength. These include, firstly its ease of application derived from the simplicity, clarity and feasibility of the guidelines. The second is the human-centered approach of the RAKWO framework, with a focus on

addressing the adverse effects of a high LOA on humans such as, deskilling. Consequently it advocates for transparency of algorithms to ensure humans are engaged in the process and do not lose their skill to take over manually if there is a system outage. Ruiz et al. (2022) seem to emphasize technical efficiency and robustness as the principal goal of complementarity, thereby missing the human element with no significant recommendations in that direction. Thirdly, Asatiani et al. (2019) provide guidelines at a granular task allocation level, indicating which specific tasks to assign to humans and robots. This is not detailed in Ruiz et al. (2022), thereby creating an implementation challenge.

In relation to weaknesses, the obvious one as pointed out by Sutton et al. (2023) is the fact that, the framework, not being a full-fledged theory, lacks theoretical propositions to explain some of the complementarity tenets it espouses.

Justification for the choice of the RAKWO framework

The RAKWO framework was chosen because it was the most appropriate guide since it addresses the main subjects of this study, namely intelligent software robotisation and complementarity. Furthermore, models for evaluating and analysing complementarity implementations in general and for software robotisations such as, RPA or AI specifically, are rare in the literature. In addition, the propositions in the RAKWO framework are well researched, based on several published peer-reviewed case studies conducted by the authors at various times. Also Asatiani et al. (2019) focus on a key pillar of software robotisation namely, task allocation while at the same time addressing a key risk namely, deskilling. Lastly, for contextual fit in relation to Africa, the RAKWO framework seeks to encourage job security, which is a significant issue in this region, as revealed in the literature. In all, the RAKWO framework is suited for addressing the second objective of

this study, which is to identify the nature of complementarity between humans and machines in intelligent software robotisation implementations in a firm.

Application of the RAKWO framework in the study

The first four recommendations of the RAKWO framework, which address human-robot task allocation and deskilling, were adopted for this study as they were considered ideal for understanding the nature of complementarity in a firm’s ISR implementation (the second objective of this study). The remaining two recommendations were related to knowledge management which is outside the scope of this study. The resulting adapted framework for this study is shown in Table 3.5 and Figure 3.6.

3.4.2. The Complementary ISR Deployment Framework

The Complementary ISR Deployment Framework, shown in Table 3.5 and Figure 3.6, was used as a guide in designing participant observation and the *interview schedules* to understand the nature of complementarity in the selected organisations. The data collected was also analysed with the aid of the Complementary ISR Deployment framework to understand the nature of complementarity in the selected organisations.

Table 3.5: The Complementary ISR Deployment Framework

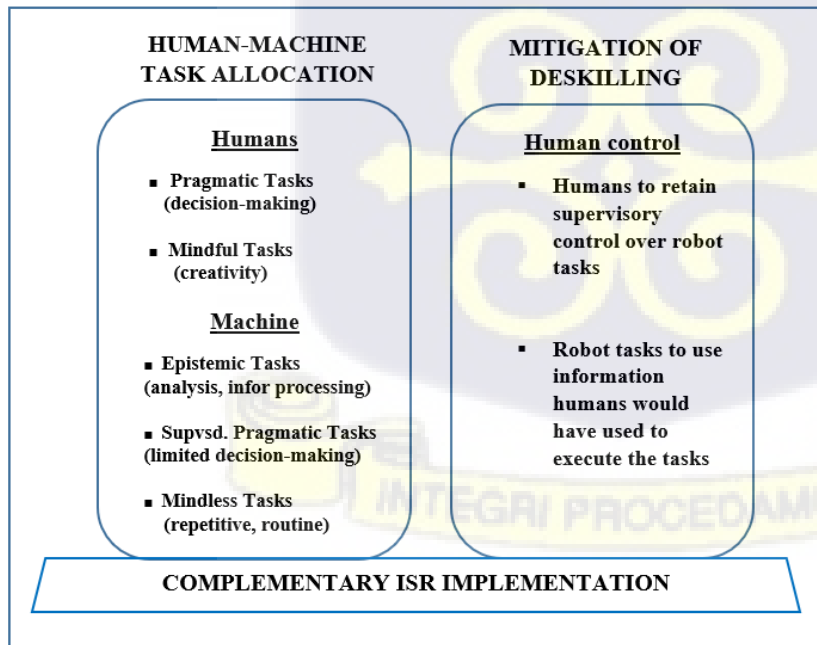
ROBOTISATION DIMENSIONS	RECOMMENDATION
Human-Robot Task Allocation	<p><i>Recommendation 1:</i> - <u>Decision-making dimensions of tasks</u></p> <p>i/ <i>Epistemic</i> tasks (predominantly analysis & information processing) are recommended for AI-RPA robots</p> <p>ii/ <i>Pragmatic</i> tasks (predominantly decision-making & execution) are recommended for humans but AI-RPA robots could also handle decision-making tasks with low-level risks</p>
	<p><i>Recommendation 2:</i> - <u>Cognitive demands dimensions of tasks</u></p>

	<p>Divide a particular task into mindful & mindless components and share as follows:</p> <p>ii/ AI-RPA robots to handle the <i>mindless</i> components (mainly <i>repetitive & routine</i> with less cognitive demands)</p> <p>i/ humans to handle the <i>mindful</i> components (mainly creative & out-of-the box thinking)</p>
Controlling & Mitigating the risk of Deskilling	<p>Recommendation 3: - <u>Control dimensions (pragmatic tasks)</u></p> <p>Humans must supervise decision-making tasks assigned to AI-RPA robots, to ensure task control & skills maintenance on the task</p>
	<p>Recommendation 4: - <u>Control dimensions (system configurations)</u></p> <p>AI-RPA robots must be configured with the same information representations human workers will use in their supervisory control roles. This is to ensure task control & skills maintenance on the task</p>

Adapted from Asatiani et al., (2019)

Given its relative novelty, the framework presents an opportunity for this study to contribute to theorization on complementarity.

Figure 3.6: The Complementary ISR Deployment Framework



Source: Adapted from Asatiani, Penttinen, Rinta-Kahila & Salovaara (2019)

3.5. CHAPTER SUMMARY

This chapter discussed the three main models that provided theoretical guidance in this study, namely the Technology-Organisation-Environment Model (TOE) (DePietro, Wiarda & Fleischer, 1990), Coping Model of User Adaptation (CMUA) (Beaudry & Pinsonneault, 2005) and Recommendations for Automation in Knowledge Work Organizations (RAKWO) (Asatiani et al., 2019).

The strengths and weaknesses of these models, justification for their choices, how they have been applied in IS research and how they were applied in this study were all outlined. Finally, the three separate research frameworks used in addressing the three research objectives, which were all derived from the aforementioned foundational models, were also described. These were, The ISR Deployment Model for Research Objective 1, the Employees' ISR Coping Strategies Model for Research Objective 2 and the Complementary ISR Deployment Framework for Research Objective 3.

The next chapter discusses the philosophical and methodological orientations of this study with an exposition of the research methods adopted to collect data to address the research objectives.



CHAPTER FOUR

METHODOLOGY

4.1. CHAPTER OVERVIEW

The previous chapter discussed the theoretical foundations girding this study, with a detailed look at the theories and emergent models that guided the data collection and analytical activities of the study, their strengths and weaknesses and the justification for their choice.

This chapter discusses the philosophical foundations of the study beginning with the various paradigms prevalent in IS research and ending with the research procedures and activities undertaken to address the study's objectives.

4.2. PHILOSOPHICAL TRADITIONS IN IS RESEARCH

A paradigm is a set of assumptions shared by a professional community, about knowledge and its acquisition (Hirschheim & Klein 1989) or the shared beliefs that guide their actions (Guba, 1990). Similarly, Kuhn (1970), in *The Structure of Scientific Revolutions*, indicates that paradigms offer a community of practitioners, guidance on model problems and solutions to pursue. Neuman (2006) explains further by describing a paradigm as “a general organizing framework for theory and research that includes basic assumptions, key issues, models of quality research, and methods for seeking answers” (p.81)

Four philosophical assumptions gird a paradigm namely, *ontology*, *epistemology*, *methodology* and *axiology*. While ontology refers to the forms of reality, epistemology distinguishes valid knowledge from opinion or beliefs. Methodology on the other hand deals with the methods of

acquiring valid knowledge; axiology describes the purposes, values and ethical limits of science (Mingers, 2008)

Among IS scholars, the dominant research paradigms are positivism, interpretivism and the critical philosophies (Orlikowski & Baroudi, 1991; Cecez-Kecmanovic, 2011a). Two prominent strands of the critical traditions are identified in the literature. The first is the “emancipatory” *critical* research philosophy which questions and challenges established social conditions with the aim of creating social transformation (Myers & Klein, 2011; Cecez-Kecmanovic, 2011b). This is distinguished from the second, the *critical realist* tradition, which espouses a multi-layered view of reality and aims at unearthing and explaining the underlying structures and mechanisms of this reality (Bhaskar, 1979; Dobson et al., 2007; Easton, 2010). The latter is of interest to this study, hence the discussion that follows, focuses on positivism, interpretivism and critical realism (rather than the critical approach).

Positivism

A positivist ontology assumes that reality is objective and exists on its own, independent of an observer’s ability to perceive it or not (Dube & Pare, 2003; Straub et al., 2004;). Epistemologically, positivism holds that valid knowledge is that which is acquired only from observable or identifiable and measurable data (Straub et al., 2004; Dube & Pare, 2003). Such data is to be obtained in a value-free manner in which the researcher’s role is neutral, passive and non-interventionist and avoids the involvement of their values and beliefs in examining the research phenomenon (Dube & Pare, 2003). Also in this tradition, there is a strong interest in determining causality and generating law-like generalizations to explain social phenomenon; thus, hypothesis and theory testing as well as, deductive reasoning are features of this paradigm (Dube & Pare, 2003; Lee, 1989). A quantitative methodology is preferred and data is typically collected from

surveys, laboratory experiments and field studies through the use of highly structured instruments, which are then usually analysed statistically (Weber, 2004; Lee and Hubona, 2009).

Interpretivism

In Interpretivist ontology, reality is viewed to be a consequence of human actions, experiences and perceptions and thus becomes meaningful *only* when seen in the light of those elements that create them. Therefore, to interpretivists, reality is socially constructed and exists mainly in the experiences of the humans who give meaning to them (Klein & Myers, 1999; Harvey & Myers, 1995; Walsham, 2006; Walsham, 1995). Thus, epistemologically, legitimate knowledge in this tradition is believed to be acquired only through the perspective of the actors in a phenomenon, particularly through the interpretations of the subjective meanings ascribed to their actions (Walsham, 2006; Walsham, 1995; Klein & Myers, 1999; Harvey & Myers, 1995). Research using this paradigm is value-laden, acknowledging the influence of a researcher's values and beliefs in the knowledge acquisition process, as they engage with the research phenomenon and become involved in the life and work contexts of the research participants (Walsham, 1995; Walsham, 2006). The qualitative methodology is usually associated with the interpretivist paradigm (Harvey & Myers, 1995; Klein & Myers, 1999), the preferred data collection instruments being interviews yielding unstructured data which are "thick" descriptive narratives (Walsham, 1995; Walsham, 2006;), in contrast to the numerical and statistical data usually associated with positivists studies. Interpretivists usually employ induction (as opposed to deduction in positivism) to either draw specific implications or construct plausible explanations from observed data as exemplified by the "grounded theory" approach (Walsham, 1995). Hermeneutics, ethnography and phenomenology are among the well-known interpretivists research approaches usually within a case study or field study milieu (Walsham, 1995; Walsham, 2006; Klein & Myers, 1999; Harvey & Myers, 1995)

Critical Realism

Critical realism, which derives its roots from the works of Bhaskar (1978), straddles the two aforementioned paradigms (positivism and interpretivism), having emerged as a criticism and alternative to both (Morton, 2006; Easton, 2010). Maintaining a plural view of reality, ontologically, critical realists acknowledge the existence of an objective reality independent of the observer but unlike positivists, they admit that there are other dimensions to this reality, namely it being stratified into three dimensions, the real, actual and empirical (Mingers et al., 2013; Wynn & Williams, 2020; Dobson et al., 2007). The real comprises *structures, mechanisms* and the *events* that emerge from them. The *actual* is made up of the observable and non-observable events caused by the mechanisms, while the *empirical*, which is a subset of the actual, refers to only the observable or experienced *events*. (Mingers et al., 2013; Wynn & Williams, 2020; Easton, 2010; Dobson et al., 2007).

Structures in critical realism are related objects and conditions which could have diverse forms such as physical, social, cognitive and may be complex or simple, structured or unstructured. They constitute the environment of a phenomenon of interest and include for instance, organisations, technology, ideas, concepts, feelings, languages, meanings, norms, rules and practices (Easton, 2010; Mingers et al., 2013; Wynn & Williams, 2020). Mechanisms are the *ways of acting* or *causal powers* and *tendencies* emanating from or inherent in particular structures, which define, constrain and enable what a given structure can do (Dobson et al., 2007; Mingers et al., 2013; Wynn & Williams, 2020; Easton, 2010). While powers are innate abilities signaling possible actions, tendencies on the other hand are characteristic actions from those abilities; thus though all men have the power to steal, thieves have the tendency to actually steal often (Wynn & Williams, 2012).

In summary, structures give rise to a set of mechanisms which in turn create particular events (Mingers et al., 2013; Wynn & Williams, 2020).

Reality in critical realism, is also described in relation to its transitive and intransitive nature (Mingers et al., 2013; Dobson, 2002). Thus the intransitive dimension of reality refers to the enduring, independent and not directly observable, underlying structures and mechanisms together with their generative powers. The transitive dimension on the other hand is the evolving, observable, events, experiences, theories, laws, conjectures, models, interpretations and anomalies (Mingers et al., 2013).

Epistemologically, critical realists regard legitimate knowledge about reality as that which is acquired through observations of an independent reality in the empirical realm, as well as interpretations of socially constructed meanings (Morton, 2006). Hence the critical realist approach to knowledge acquisition is to identify the set of *structures* related to a phenomenon as well as, the *mechanisms* emerging from these structures together with the observed *events* created, in order to explain various dimensions of the phenomenon, such as, how and why it occurred (Volkoff & Strong, 2013; Wynn & Williams, 2020). In relation to knowledge generation, Critical realism in essence, has a strong focus on explanations (Dobson et al., 2007; Bhaskar, 1979; Easton, 2010;)

Furthermore, in critical realism acquiring knowledge about reality is regarded as a social process in which the transitive elements of reality (such as observations, theories, conjectures) are used to generate and improve knowledge about the intransitive elements of a phenomenon (such as its underlying structures and mechanisms) (Mingers et al., 2013; Morton, 2006). Hence knowledge is considered to be historically and socially derived (Wynn & Williams, 2020; Dobson et al., 2007; Dobson, 2002).

Critical realism also admits the fallibility of human knowledge given that it is limited by our perceptions and extent of our chosen theories (Mingers et al., 2013; Dobson et al., 2007; Easton, 2010). Hence this philosophical tradition believes that the entirety of reality cannot be fully comprehended by human knowledge and consequently, there may be potential alternatives to the assertions we derive to explain reality (Dobson et al., 2007; Easton, 2010; Mingers et al., 2013; Wynn & Williams, 2020; Morton, 2006).

In respect of the methodology for acquiring knowledge, CR employs *retroduction* or *abduction* which is in contrast to deduction in positivism and induction in interpretivism (Mingers et al., 2013). *Retroduction* involves taking observations about a phenomenon and *working backward* to theorize about them by uncovering the underlying mechanisms that could have created the observations (Volkoff & Strong, 2013; Mingers et al., 2013). Hence the researcher moves backwards from observations in the *empirical* domain to structures and mechanisms in the *real* domain (Volkoff & Strong, 2013; Mingers et al., 2013).

Since CR acknowledges different dimensions of reality which require a range of different research methods and methodologies to study them, CR accommodates a “multi-methodological” approach (Mingers et al., 2013; Venkatesh et al. 2013; Zachariadis et al., 2010).

Axiologically, research informed by critical realism is value-laden given the view that our knowledge of reality is shaped by our social conditioning (Dobson, 2002). Hence one cannot discount a researcher’s values from their knowledge acquisition processes. However, that should not be mistaken for the interpretivist view that *reality itself* is a construction of individuals’ experiences *alone*. Far from it; in the critical realist view, it is *our knowledge* of reality that is conditioned by our experiences and continuously changing, but the *reality itself*, particularly its

underlying structures and mechanisms, are “relatively stable” and not dependent on our views of it (Dobson, 2002).

4.2.1. Choice Of Critical Realism and Justification

Choice: Critical Realism was chosen as the guiding paradigm for this study

A number of authors have provided some guidelines on the selection of a philosophical tradition for a research initiative (Brown & Duenas, 2020; Kankam, 2019; Kivunja & Kuyini, 2017; Chilisa & Kawulich, 2012; Krauss, 2005). Among the items recommended for consideration are, the nature of the phenomenon or problem being investigated (is it objective in nature such as, being technically oriented or related to individuals’ cognitions and experiences?) (Kankam, 2019; Kivunja & Kuyini, 2017; Chilisa & Kawulich, 2012; Krauss, 2005); the research purpose and questions (Brown & Duenas, 2020; Kankam, 2019; Kivunja & Kuyini, 2017); the researcher’s philosophical beliefs or paradigmatic preferences in relation to reality and knowledge (Brown & Duenas, 2020; Kivunja & Kuyini, 2017) as well as the researcher’s values and ethical orientation particularly in respect of working with human participants and disclosures of conflicting interests (e.g. funding) (Brown & Duenas, 2020; Kivunja & Kuyini, 2017).

A combination of all these considerations influenced the choice of critical realism (CR) as the paradigm for this study.

While acknowledging the merits and usefulness of the positivist and interpretivists traditions, the philosophical beliefs of this author, from training and life experiences, gravitates towards the views espoused by the critical realist paradigm.

Given that the subject of this study, complementary intelligent software robotisation (ISR) involves human-machine collaboration, it is a socio-technical phenomenon with both inherent human experiences and technical dimensions, thereby creating a multi-layered phenomenon. Such a phenomenon is ideally suited for the multi-faceted views of reality advocated by the critical realist paradigm. Choosing a positivist or interpretivist paradigm alone, with their respective leanings towards an objective or subjective reality *alone*, would have been limiting in addressing the research objectives.

Finally, this author is highly interested in human-centered research involving interactions with people, to know their perceptions, experiences and behaviour in relation to a phenomenon, which is in alignment with the epistemology of CR.

Application of Critical Realism in this research

There are several ways in which CR has been applied in this study, namely ontologically, epistemologically and methodologically. Ontologically, adopting CR's multi-dimensional view of reality (Dobson et al., 2007; Easton, 2010; Mingers et al., 2013) supported the formulation of the study's objectives of examining the broad *socio-technical* facets of the ISR phenomenon. The CR orientation was thus helpful in adopting and maintaining a holistic focus (human, machine, organisational) in the study's objective as against taking a narrow stance.

In line with the CR epistemological tenet of explaining the various dimensions of a phenomenon (Volkoff & Strong, 2013; Wynn & Williams, 2020), the research questions of this study aimed at not only, explaining the causal elements involved in the ISR implementation decisions but also how the implementation was done, together with employees' reactions and coping strategies. Hence the CR principle of identifying the underlying structures related to a phenomenon and

unearthing their mechanisms or generative powers and tendencies (Mingers et al., 2013; Morton, 2006) was applied in this study.

In this regard, the CR *retroduction* approach was employed. As indicated by Wynn & Williams (2020, 2012), several framework exist for operationalizing the retrodution process and they all have in common some essential activities that can be summarized as: (i) *describing* from observations, the phenomenon of interest and its components; (ii) theorizing about the *structures* related to the phenomenon that is, the social elements (people, organisations and their relationships); material artifacts (IT and other technologies); as well as rules and practices governing the relationships between the social and material objects; (iii) theorizing about the *mechanisms* engendered by the structures with the capabilities of generating the observed events; (iv) empirical assessment of the causal and explanatory powers of the proposed mechanisms as theorized. The ISR phenomenon was first described with a conceptualisation in Chapter 2 and exposition of related problems in Chapter 1. This was followed by theoretical frameworks in Chapter 4 on various structures and mechanisms related to various facets of the ISR phenomenon which require explanations. For instance, on the issue of the low adoption of ISR in developing economies, the TOE model was used to theorize about the underlying technological, organisational and environmental *structures* such as, change management policies, management support & availability of skilled human resources (organisational structures) as well as, their proposed *mechanisms* such as, project management actions, which could possibly cause the low adoption rates. Finally the appropriate data collection and analytical arrangements were initiated, as described in this chapter, to assess the efficacy of the theoretical frameworks.

In respect of data analysis, CR was used to derive insights on the nature of complementary ISR as described in Chapter Six.

4.3. METHODOLOGICAL TRADITIONS IN IS RESEARCH

Research methodology refers to the overall strategy adopted for a given research initiative, comprising the research design, research methods and related activities undertaken to generate credible knowledge (Cecez-Kecmanovic, 2011a; Mingers, 2001). It has also been termed, research “strategy” (Cavaye, 1996) and research “approach” (Galliers, 1991).

There are varied views and sometimes confusion on specific examples of what constitutes a methodology, with methods (e.g. case study, experiments) sometimes being used interchangeably with methodology (e.g. Benbasat et al., 1987, Galliers, 1991). However, in consistency with the examples provided during the paradigmatic (philosophical traditions) discussions, this paper adopts the qualitative and quantitative approaches as examples of methodology.

The three methodological approaches often reported in IS research, are the quantitative, qualitative and mixed-methodologies (Zwanenburg et al., 2023; Venkatesh et al., 2013; Creswell, 2003).

Quantitative

The quantitative methodology which is derived from the empirical methods of enquiry in the natural sciences is closely associated with the positivist philosophical tradition (Lee & Hubona, 2009; Creswell, 2003; Kroeze, 2011; Gable, 1994). It aims to predict causal relationships, identify patterns as well as describe the characteristics of a population, and does this through highly structured research methods such as surveys and experiments and the use of data collection tools such as, questionnaires (Boateng, 2020; Creswell, 2003; Chen & Hirschheim, 2004; Yilmaz, 2013).

A quantitative methodology advocates the use of evidence or data collected through quantifiable measurements, to test theories and confirm hypotheses as well as, draw conclusions typically from

deductive reasoning (Boateng, 2020; Creswell, 2003; Yilmaz, 2013; Kroeze, 2011). Numerical data and statistical analysis are prominent features of this tradition (Boateng, 2020; Lee & Hubona, 2009; Creswell, 2003).

In summary, a quantitative methodology is “concerned with outcomes, generalizations, prediction, and cause-effect relationships through deductive reasoning” (Yilmaz, 2013, p.313).

Qualitative

On the other hand, the qualitative methodology is closely associated with the interpretivist philosophical tradition (Kroeze, 2011; Cecez-Kecmanovic, 2011a; Gable, 1994). It aims to describe and explain phenomena and relationships, as well as understand patterns, through semi-structured research methods such as ethnographies and case studies together with data-collection tools such as, in-depth interviews and participant observations (Boateng, 2020; Creswell, 2003; Yilmaz, 2013).

A qualitative methodology relies on data derived from the interpretation of the experiences of individuals and the meanings they make of a phenomenon, collected through interactions with and observations of a study’s subjects, to inductively arrive at conclusions as well as develop grounded theories (Boateng, 2020; Creswell, 2003; Yilmaz, 2013; Urquhart & Fernandez, 2006).

It involves the use of non-numerical data in the form of text, audio and video records of various facets of the phenomena studied including people’s experiences (Boateng, 2020; Yilmaz, 2013).

In summary, a qualitative methodology is “concerned with process, context, interpretation, meaning or understanding through inductive reasoning” (Yilmaz, 2013, pp.313).

4.3.1. Choice of the Mixed-Methodology and Justification

Choice: *A parallel mixed methodology with a triangulation design was chosen for this study. Within that framework, Research Questions 1 and 2 were addressed with a Quantitative methodology while a Qualitative methodology was employed for Research Question 3.*

The mixed methodology approach combines both the quantitative and qualitative methods in a single study thereby harnessing the strengths of the two methods (Reiss et al., 2022; Jokonya, 2016). The advantage of a mixed methodology over the other two approaches individually include, enabling a much broader examination of a phenomenon with varied data types and analysis (Jokonya, 2016; Plano Clark et al., 2010) which potentially offers varied and richer insights than is possible with the other two approaches separately (Mingers, 2001). Also, within the same study, a mixed methodology facilitates several research efforts at the same time such as, pursuing both theory generation (qualitatively) and theory testing (quantitatively) (Venkatesh et al., 2013).

The first justification for the choice of the mixed methodology relates to its quantitative-qualitative dimensions and rests on the fact that, the three objectives of the study together have *both* quantitative and qualitative oriented elements which are best served by a mixed methodology.

On the quantitative dimension, Research Questions 1 and 2 examine the ISR deployment decisional elements and employees' ISR coping strategies respectively. Two theories (TOE and CMUA) were leveraged in a theory testing and confirmation vein to address these two objectives. For such a theory testing thrust, a quantitative approach is the general norm and practice in IS research as well (Creswell, 2003; Zachariadis et al., 2010).

On the qualitative facet, Research Question 3 is founded on the nascency of the ISR phenomenon and thus seeks to understand the nature of the ISR implementation undertaken by the selected firms. This is an exploratory endeavour requiring an *in-depth* examination and explanation of

various facets of the phenomenon. Such intensive inquiries into nascent phenomena in IS research are typically associated with a qualitative approach (Boateng, 2020; Venkatesh et al., 2013). In addition, the ultimate purpose of the study, which is to generate a framework for implementing ISR in developing economies, is a *theory development* effort, which is also closely associated with a qualitative approach (Creswell, 2003; Urquhart & Fernandez, 2006).

The choice of *the triangulation design* was informed by the overall purpose of this study which is to provide a framework for the implementation of ISR in developing economies, incorporating complementarity principles and integrating, machine, human and organisational dimensions. For such a multi-faceted objective, comprehensive data was required. Hence a triangulation design which aims at completeness or comprehensiveness of information, through an integration of data from varied sources and methods (Plano Clark et al., 2010) was considered appropriate in generating the relevant data and insights for a useful framework.

Finally, from a philosophical viewpoint, a mixed methodology aligns with the chosen paradigm for this study, namely critical realism, which embraces a multi-methodological approach in studying the plural dimensions of reality espoused by the tradition (Wynn & Williams, 2020; Mingers et al., 2013; Venkatesh et al. 2013; Zachariadis et al., 2010). Such an alignment was considered essential in avoiding contradictions in the philosophical and methodological foundations of the study, in order to minimize potential challenges with the study's validity and reliability.

Application of the Mixed-methodology approach in the study

Regarding how the mixed methodology was applied practically in this study, Table 8.1 in Chapter Eight demonstrates how insights from the qualitative and quantitative inquiries were integrated to

provide comprehensive understanding of the phenomenon. This subsequently fed into the study's proposed framework for deploying ISR in developing economies described in Chapter Seven

4.4. RESEARCH METHODS

Research methods are the specific techniques, processes and procedures such as, surveys, case studies, experiments and ethnographies, which are used to acquire and process data to address a research's objectives (Cecez-Kecmanovic, 2011a; Mingers, 2001).

Conventionally, research methods and their related data collection tools are usually associated with a given methodology. Hence the quantitative methodology has a strong preference for research methods such as, surveys and experiments together with data collection tools such as questionnaires (Boateng, 2020; Creswell, 2003; Yilmaz, 2013). On the other hand, case studies, ethnographies, grounded theory are often regarded and chosen as qualitative research methods, accompanied by in-depth interviews, focus-group discussions and participant observations as examples of data collection tools (Cecez-Kecmanovic, 2011a; Stockemer, 2019; Boateng, 2020; Creswell, 2003). A mixed methodology involves a combination of both quantitative and qualitative research methods and hence blends techniques such as, surveys and interviews, experiments and focus groups, ethnographies and questionnaires or surveys and observations (Mingers, 2001; Venkatesh et al., 2013; Creswell, 2003). The research methods chosen for this study are the *survey* and *case study* which will be discussed under the approaches selected for the three research questions.

4.4.1. Choice of the Survey Method and Justification

Choice: *Two explanatory cross-sectional surveys were conducted to address Research Questions 1 and 2*

A survey is a quantitative research method, which involves the collection of information from a sample of a group of people, using structured question formats delivered in a standard manner, with aim of generalizing the findings to the population (Malhotra & Grover, 1998; Stockemer, 2019). Alternatively, based on its dominant data collection instrument, some authors have described a survey as a research method that uses a questionnaire to capture data from individuals (Palvia et al., 2006; Chen & Hirschheim, 2004).

An *explanatory (or confirmatory)* survey aims at finding causal relationships about a phenomenon through the testing of developed concepts and theories in relation to the phenomenon (Malhotra & Martin, 2008; Forza, 2002). A *cross-sectional survey* collects data on a phenomenon at a given moment in time and is ideal for testing theories about relationships, as against the longitudinal survey which collects data from the same group over several different periods and is ideal for studying changes in a phenomenon over a given period (Stockemer, 2019; Malhotra & Grover, 2019).

There are several reasons for the choice of the survey research method for the above two research questions. Firstly, Yin (2003) indicates that a survey is ideal for addressing research questions such as, the above two, which are framed in the “what” mode.

Secondly, the choice followed the *quantitative* methodology and theory-testing approach that had already been chosen for these two questions as indicated above. A survey is recommended for *quantitatively* testing a theory (in contrast to qualitative testing) (Abareshi & Martin, 2008; Newsted et al., 1998; Malhotra & Grover, 1998). Given that the overall purpose of this study is to

develop a framework for the implementation of ISR in developing economies, findings that are robustly *confirmed* from theory was considered very useful. The nascency of the ISR phenomenon though could pose challenges in respect of obtaining a large population and sample for generalisations to the population. Therefore theoretical generalisations was preferred to generalisations to the population. The second justification is the fact that surveys are among the most widely used quantitative tools in IS research in general and thus have a history of being a widely tested and validated method (Sivo et al., 2006; Kosch et al., 2023). Considering the above reasons, a cross-sectional and explanatory survey design was thus chosen to address research questions 1 and 2.

Application of the survey method in the study

The survey method influenced the choice of the data collection instruments for Research Questions 1 & 2, namely the questionnaire, which in turn influenced the choice of analytical methods for the data generated for the two research questions. These are discussed in the respective sections for data collection and analysis.

4.4.2. Choice of the Case Study Method and Justification

Choice: *An explanatory multiple case study method was used in addressing Research Question 3*

A case study as a research method, refers to the in-depth inquiry into a single or ~~few~~ several instances of a contemporary phenomenon in its real-life settings, often using multiple data collection media (Boateng, 2020; Yin, 2003; Benbasat et al., 1987).

Yin (2003) provides some guidance on the selection of research methods for a study and this comprises, the nature of research questions asked (e.g., how, why, what, how much/how many)

the degree of control the researcher has over the study's subjects or events and how contemporary the research topic is. In his view, "how" and "why" questions about a contemporary phenomenon over which the researcher has little or no control are best addressed by a case study.

This third objective (Objective 3) of the study, on the nature of complementary robotisation, has an exploratory leaning since it seeks to unearth insights about the phenomenon. The software robotisation technologies to be studied, namely RPA combined with AI, are a relatively recent phenomena which require some exploratory and in-depth analysis. Such investigations are best suited for the qualitative approach which provides an opportunity for an open-ended inquiry (as against a hypothesized one). This allows for the examination of various facets of a phenomenon "to understand the nature and complexity of the processes taking place" (Benbasat et al., 1987; p. 370) and also for discovery (Cavaye, 1996).

The *explanatory* case study seeks to enable an understanding of the nature and complexities of a phenomenon especially in relation to its causal dimensions (the "why") and operative processes (the "how") (Boateng, 2020; Yin, 2003; Benbasat et al., 1987). Furthermore, *multiple case studies* investigate several instances of a phenomenon to allow for data analysis across cases, which provides a robust verification, suitable for theory development, explanation and replications (Boateng, 2020; Cavaye, 1996). The above reasons provided enough grounds to choose the case study method to address Research Question 3

Application of the case study method in the study

From the choice of the case study method, was derived other choices such as the selection of the data collection instruments for Research Questions 3, namely the interview, which consequently influenced the analytical methods chosen for the qualitative data collected. These are discussed in the respective sections for data collection and analysis.

4.5. SAMPLING AND CASE SELECTIONS

The sampling for the study was done at two levels given that a multiple case study was planned. Thus there was sampling to select case organisations and sampling for individual participants.

Case selections

For selection of the companies, a combination of *snowball* and *convenience* sampling, which are both non-probability sampling techniques, were used. In *snowball sampling*, a researcher first identifies an initial group of members, usually a small number, who then go on to identify or refer other members (Stockemer, 2019). *Convenience sampling*, involves the selection of members due to their availability (Stockemer, 2019). Hence, through vendors and various contacts, a number of companies were initially identified. Some of the companies then suggested other organisations likely to have deployed ISR. From the extensive search using these methods (vendors, industry & company contacts) it turned out that not many companies had deployed ISR at the time, hence there was a very small population of 9.

Inclusion & Exclusion criteria

As a content validity check to ensure that relevant data was collected from the companies identified, some inclusion and exclusion criteria were developed. Given that the theoretical framework for research Q1 had as the dependent variable, *actual deployment* (and not intention) and research Q2 had *actual coping strategies* as the dependent variable, the following considerations were taken into account in developing the selection criteria for the theory-based sampling for the organisations: (i) the companies should have implemented an ISR initiative within the last five years to ensure that the initiatives had the latest ISR technology and capabilities; (ii) the ISR implementation should be at least at the testing phase as at the time of data collection to

ensure at least some experience with decisional and implementation elements; (iii) the ISR implementation should have at least two employees using it as part of their regular job routine, to ensure appreciable coping experience. Exclusion criteria included: (i) companies with ISR initiatives at the planning or project kick-off phase and yet to reach prototype and testing; (ii) live ISR implementation whose usage was restricted to only one person.

All 9 companies met the inclusion and exclusion criteria. With such small populations, Leedy & Ormrod (2015) recommend a census, where the whole population is surveyed, instead of sampling them. Consequently, all 9 companies were approached because at the time, they were the only ones available, hence the *convenience sampling*. Only 5 out of the 9, agreed to participate, a response rate of 56%. The distribution of invited and respondent companies together with their industries are shown in Table 4.1

Table 4.1: Industries of Sampled Companies

Industry	Number of organisations	Number of organisations
	invited	who responded
Banking	4	2
Insurance	2	1
Telecommunications	2	1
Business process outsourcing	1	1
TOTAL	9	5

Source: Author

It must be noted that given the small population, the sampling procedures discussed above were for both the quantitative (survey) and qualitative (interviews) inquiries, though sampling is not usually associated with qualitative studies. Thus the same companies that participated in the survey also took part in the case studies. Further information on the companies and their industries are provided in

Individual participant selections

A form of *purposive sampling*, that is, theory-based sampling was chosen for the individual participant sampling. In purposive sampling members are selected because of their possession of some appropriate characteristics deemed essential for a study (Stockemer, 2019). With theory-based sampling the selection criteria is specifically related to members' close association with the theoretical framework and constructs of a study (Boateng, 2020). Hence the inclusion criteria was that members should have knowledge and experience on the constructs from the three research models. The exclusion criteria was the absence of knowledge and experience in these three areas.

The choice of a theory-based sampling was mainly motivated by the study's purpose of developing a framework for ISR deployment in developing economies, which is a theory generation activity. The theory-based sampling was thus to facilitate data collection to confirm the models used for research questions 1 & 2 (quantitative phase) and also obtain rich in-depth data (qualitative phase) which will ultimately enable the creation of a framework for ISR deployment in developing economies, the major output of this study.

Details of the outcome of the participant sampling and response is provided during the discussion on the administration of the various data collection instruments, where the response rates are provided.

4.6. DATA COLLECTION PROCEDURES

Collection of relevant data to answer the research questions comprised various activities namely, identification of data types and sources, choice and development of data collection instruments,

followed by validation and administration of the instruments. Table 4.2 provides a summary of the general methodology for the study which includes the data collection arrangements.

Table 4.2: Summary of the Study’s General Methodology

Research Objective	Objective 1 & 2	Objective 3
Paradigm	Critical Realism	
Methodology	Mixed Methodology	
	Quantitative	Qualitative
Research Methods	Survey	Case Study
Data Source	Primary & Secondary	
Sampling	1/ For companies - Snowball and Convenience sampling 2/For Individual participants – Purposive sampling (theory-based)	
Data Collection Instruments	Questionnaire, observations, documents, news media, websites	Interviews, news media, documents, company websites, observations
Data Analysis	Configurational (FsQCA)	Miles & Huberman; Critical realism Retroduction

Data Sources

For the *survey* both primary and secondary data sources were used to address research questions 1 and 2. The primary data was mainly collected from a questionnaire, supplemented by observations from site visits, while the secondary data came from documents, publicly available organisational reports, company websites and news media items.

The *case study* for research question 3 also, generated both primary and secondary data. The primary data was collected through interviews, supported by participant observation, while the secondary data was obtained from publicly available company reports and announcements in the news media and information from company websites.

4.6.1. Questionnaire as Instrument

Development & Validation of instrument

From the choice of the quantitative methodology and the survey method for Research Questions 1 & 2, the questionnaire was chosen as the data collection instrument for these two research questions. Consequently, general guidance on the process of instrument development was provided by established social science sources such as Churchill (1979) and Dillman et al. (2014) as well as, other recent sources such as Stockemer (2019), with support from IS research emulations (Recker & Roseman, 2010; Lewis et al., 2005; Schmitz & Storey, 2020).

Two different instruments were developed, one for research Question 1 on ISR deployment (QQ1) and another for research Question 2 on coping strategies (QQ2). The questions were open-ended and responses were graded on a five-point Likert scale (“Strongly agree”, “Agree”, “Neutral”, “Disagree” and “Strongly Disagree”) (Churchill, 1979). Regarding content, the critical realist research guidelines (Wynn & Willam, 2020 & 2012) was followed. It indicates that empirical assessments and data collection should follow the theorizations on mechanisms and structures, which implicitly associates instrument development with any theoretical framework if there is one. Consequently, the contents of both questionnaires were primarily informed by the respective theoretical frameworks for ISR deployment and worker’s coping strategies.

The resultant questionnaires were validated mainly through expert judgment, as recommended in established guidelines (Straub et al., 2004; Schmitz & Storey, 2020) and IS research practice (Boudreau et al., 2001 and Recker & Roseman, 2010). They were first reviewed mainly for reliability and content validity by my supervisor and an MIS Masters graduate skilled in research methods. This led to some amendments and the instruments were tested with three colleagues also pursuing PhD in my department and later, some respondents from the field (a manager, supervisor

and junior level staff). Further amendments were made following comments received resulting in the validated instrument used finally for the study, which is shown in Appendices E and F.

Administration

The two questionnaires were administered online through Google forms. The online format was chosen because of the several advantages it has over the paper, post mail and face-to-face delivery modes. These include their low cost (e.g. no expenditure on paper printing and physical delivery); ease and speed of access to questionnaires; flexibility and convenience in answering (respondents can adjust responses unlike the paper format); better data processing since the digital format minimizes errors from manual coding and facilitates convenient data analysis with digital survey resources (McCoy & Marks, 2001). The links to the questionnaire were distributed by emails from the researcher and by managers in situations where respondents did not want to share their email addresses.

Table 4.3: Survey Response rate

Questionnaire Type	Invited	Responded	Response Rate
ISR Deployment (QQ1)	27	20	74%
Coping Strategies (QQ2)	31	22	71%

Table 4.3 shows the response rate for the survey, indicating that 74% of those invited for the ISR Deployment survey (Research Question 1) and 71% of those invited for the Coping strategy survey (Research Question 2) responded. The small sample emanates from the low population of companies who have implemented ISR as it is new. The sample is nevertheless adequate for the chosen analytical method, configurational analysis (FsQCA) which was designed for such small samples, typically from 12 to 50 (Greckhamer et al., 2015).

4.6.2. Interview Schedule as Instrument

Development & Validation of instrument

From the choice of the qualitative methodology and the case study method for Research Questions 3, the interview schedule was chosen as the data collection instrument for this research question. A semi-structured interview schedule was prepared following guidelines from several sources. The questions were guided by the critical realist tenet of seeking explanations to understand the underlying mechanisms of a phenomenon. The literature review on complementary ISR implementation provided content subjects and the objectives of the study gave overall guidance. Yin (2003) recommends open-ended questions, which are non-threatening. A cue was also taken from Stockemer (2019) on number of questions, length and wording, with recommendations for simplicity and clarity. The target duration was 45 minutes to 1 hour considering the busy schedule of the respondents.

The instrument was validated through expert judgement by my supervisor, course colleagues in the OMIS department and one industry contact. Amendments were made following the comments submitted and the final instrument administered can be found in Appendix G.

Administration

Fourteen (14) individuals were interviewed in 12 sessions because two pairs of individuals requested to be interviewed together as one person may not have all the information on the interview schedule. In all cases, the interview schedule was shared ahead of time. The interviews took place within the same period as the survey and were both face-to-face as well as via Zoom. The sessions lasted between 45 minutes to 1 hour. They were all recorded either with a smartphone or the recording feature in Zoom and later transcribed.

Table 4.4: Interview Response rate

Data collection activity	Invited	Responded	Response Rate
Interview	18	14	78%

Table 4.4 reports the response rate for the interview, showing that of the 18 persons invited, 14 agreed to participate, a response rate of 78%.

4.8. DATA ANALYSIS

A number of analytical methods were employed in this study to analyse the quantitative and qualitative data. Configurational analysis was used for the quantitative data, while the qualitative data was analysed with the Miles & Huberman's (1994) approach, as well as critical realism retrodution.

4.8.1. Configurational Analysis (FsQCA)

For research objectives 1 and 2, the configurational analytical method was employed with the aim of eliciting fresh insights which could be different from those obtained by using the traditional variance-based multivariate techniques.

FSQCA is a variant of the qualitative comparative analysis (QCA) method developed by Ragin (1987) as an alternative analytic method to multivariate statistics (such as regressions), with the goal of facilitating a quantitative analysis of smaller samples/cases than was allowed by traditional multivariate analysis. Among its distinguishing features is the fact, while traditional variance-based statistical analysis rely on null hypothesis significance testing (NHST) to look for a single best solution linking conditions and their outcome, QCA techniques such as, FsQCA rely on set

theory and Boolean algebra, to look for the different combinations of conditions (configurations) that lead to a given outcome.

Detailed information on FSQCA is provided in Appendix A.

FSQCA Procedure for Data Analysis

Table 4.5 gives a synopsis of the FSQCA procedures for data analysis. This is also described in detail in Chapter Five during the discussion of the results of the configurational analysis.

Table 4.5: FsQCA Procedures for the Data analysis

	Step	Activity	Expected outcome	This Study's Outcome
1	Development of Configurational Model	Developing a research model founded on configurational principles and includes conditions and outcomes based on theory	Research Model	2 research models for ISR Deployment & Employees' Coping Strategies
2	Data Collection and Validation	Collecting data based on the research model and in a manner that can be used for configurational analysis	Data translatable into set and Boolean language	Survey data from questionnaire using predefined Likert scales in numerical format
3	Calibration of Data	Coding of data in quantitative format and assigning of set membership	Coded data	Excel sheet of coded data fed into fsQCA software
4	Analysis of conditions	Analyzing data with the help of truth tables, to identify necessary and sufficient conditions as well as the configurations	Set of solutions	Solutions from fsQCA software

5	Determination of solutions	Analyzing of solutions using coverage and consistency scores to determine relevance	Relevant solutions identified	Relevant solutions from fsQCA software
6	Interpretation of findings	Relevant solutions interpreted in the light of study's objectives	Report on findings	Findings explained in Chapter Five

In preparation for the analysis of the data in fsQCA software, coding was done on the Likert Scale responses. Responses were coded from 1 to 5 where strongly disagree was coded as 1, while that for strongly agree were coded as 5. The data responses were then summarized under each construct by finding the average of the respondents' responses on each of the constructs. Based on the summarized data, the minimum, maximum and average values for each of the summarized constructs were obtained; these served as the full non-membership, full membership, and cut-off points respectively for the FsQCA analysis. The data was then loaded into the FsQCA software 3.0 where the individual responses under the constructs were calibrated into fuzzy scores that represents the degree of membership. The test for the solutions were done by setting the causal variables against the outcome variable to develop a truth table of the solutions. The logical minimization was done by setting the number of cases to 1 (which means the configurations must be present in at least 1 case within the responses) and the consistency set to 0.80. The standard analysis was run which returned the sufficient and core conditions for each of the outcomes under investigation.

In configurational analysis a number of measures are employed to extract relevant and useful solutions. Key among them are the measures of *necessity* and *sufficiency* of conditions (and their combinations or configurations), to cause an outcome. This principle guided the framing of the research questions. Configurational analysis considers the effect of both the presence and absence

of a condition on the occurrence of an outcome. Thus, sufficient conditions are those which are required for the occurrence of an outcome and their presence will almost definitely lead to the outcome; hence in their absence, the outcome will not occur. Necessary conditions are also required for the outcome occurrence however, their presence does not definitely guarantee the occurrence of the outcome; their absence will also lead to non-occurrence (Kane et al. (2014). Given the emphasis of configurational analysis on addressing complexity, the two measures are considered in covering all possible configurations that contribute to a solution. They also reflect the level of the relationships (low or high) as occurs in traditional multivariate statistics.

Necessity and sufficiency are determined with a number of measures. The first is *consistency* which measures the degree of reliability of a combination of conditions in causing the outcome under investigation, somehow similar to the significance level in traditional multivariate statistics (Park et al., 2017). It also refers to the extent to which a condition or configuration is *necessary* (Mattke et al., 2022). The second measure in relation to necessity and sufficiency is *coverage* which generally refers to the extent to which *cases* with the same conditions also show the same outcome (Mattke et al., 2022). There are several other measures related to these two, however the widely used ones from the fsQCA software and their thresholds are presented in Table 5.3 in Chapter 5. Also See Appendix A for background information on FSQCA.

4.8.2. The Miles & Huberman approach

For the qualitative inquiry on the nature of complementarity in ISR Deployments (research question 3) the Miles and Huberman's (1994) data analysis approach, shown in Figure 4.1, was adopted to analyze the interview data. The framework which is an iterative process, logically begins with Data collection, but also allows for the researcher to commence the second step, Data

Condensation, concurrently (Boateng, 2020). Condensation mainly involves summarization and includes activities such as paraphrasing, coding and extraction of themes, abstract concepts and patterns. Data Display follows data condensation and here, various tools such as charts, tables, graphs and other diagrams are employed to show the results of the condensation stage. The Conclusion stage involves drawing firm inferences from the initial results using techniques such as seeing plausibility, noting patterns and relationships, making comparison and contrasts, and building a logical chain of evidence. The conclusions also need to be verified with methods such as, triangulating data sources, checking out rival explanations, following up on surprising data and outliers and ruling out spurious relations (Boateng, 2020) . It must be noted that the iterative nature of the framework means the researchers can go back to any stage if required, in the course of the analysis.

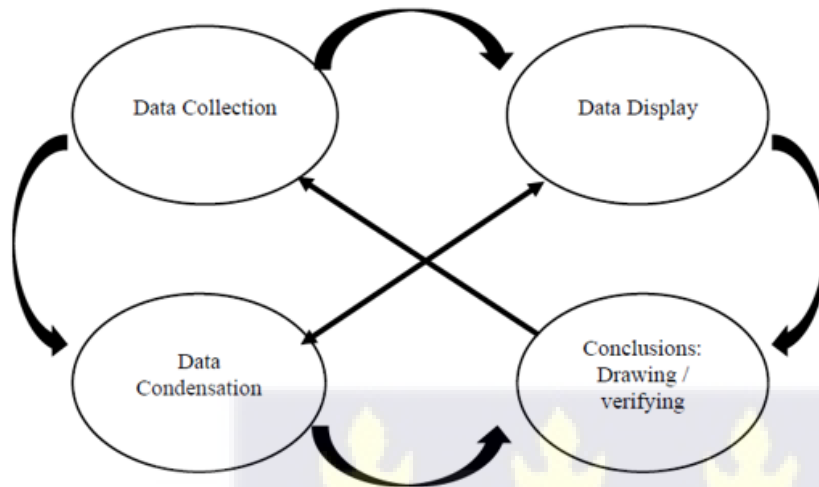
Table 4.6: Application of Miles & Huberman data analysis approach

Steps	Activities
Data Collection	Through semi-structured interviews
Data Condensation	(i) Summarized quotes or interview verbatims through paraphrasing; (ii) Open coded the summarized data with labels derived from literature and theory (deductively) and also from the verbatims themselves (inductively)
Data Display	Used tables mainly
Conclusions	(i) Inferences from the codes & themes in relation to the research objective; (ii) triangulated the results with findings from the quantitative enquiry

Table 4.6 summarizes how the Miles & Huberman approach was used in this study. Further details on the application of the approach can be found in the discussion of the results of the qualitative

inquiry in Chapter Six, where it is described and demonstrated for the various individual findings appropriately.

Figure 4.1: Miles and Huberman Data Analysis approach



Source: Miles & Huberman (1994)

4.8.3. Critical Realism Retrodution

Another analytical approach used was the Critical realism retrodution procedure (Wynn & Willam, 2020 & 2012; Boateng, 2020).

Table 4.7: Application of Critical Realism Retrodution

Step	Retrodution activity	Activities	Outcome
Step 1	Description of event of interest	Description of events to which CR analysis is to be applied: (i) Level of intelligence; (ii) Anthropomorphism; (iii) Level of robotisation	Exposition of all relevant details of the events

Step 2	Identification of related structures	Analysis of the events' environment, for instance the social elements (e.g. people, org.), material artifacts (e.g. technology), rules & practices related to the event	Structures identified (Chapter Six)
Step 3	Identification of related mechanisms	Analysis of generative powers & tendencies engendered by the structures and capable of causing dimensions of the event	Mechanisms identified (Chapter Six)
Step 4	Conclusions	Analysis of relationships between the identified structures & mechanisms to explain the causing of the event	Reported findings (Chapter Six findings 6, 8 & 11)

Table 4.7 outlines the various steps for the Critical Realist Retrodution analysis accompanied by a synopsis of activities and outcomes. Instances on on how it was actually used can be found in Chapter Six, where the CR retrodution analysis are described in full. Table 4.8 summarizes the research approach adopted for all three research objectives.



Table 4.8: Summary of Research Approaches for the Research Objectives

	Research Approach	Choices	Activities	Outcome
Research Objectives 1 & 2 (Quantitative Inquiry)	Research Methodology	Quantitative	Appropriate selection of research methods	Selection of survey method
	Research Method	Survey	Appropriate selection of data collection strategy (sampling & instrument development)	Respondents identified; questionnaire designed
	Data Collection Instrument	Questionnaire	Data collection strategy executed	Relevant data collected
	Data Analysis	Configurational analysis (FsQCA)	Activities	Outcome
	Step 1	Development of Configurational Model	Developed a research model founded on configurational principles and includes conditions and outcomes based on theory	Research Model: 2 research models for ISR Deployment & Employees' Coping Strategies developed (in Chapter Three)
	Step 2	Data Collection and Validation	Collected data based on the research model and in a manner that can be used for configurational analysis	Data translatable into set and Boolean language: Survey data from questionnaire using predefined Likert scales in numerical format derived

	Step 3	Calibration of Data	Coded data in quantitative format and assigning of set membership	Coded data: Excel sheet of coded data fed into fsQCA software
	Step 4	Analysis of conditions	Analyzed data with the help of truth tables, to identify necessary and sufficient conditions as well as the configurations	Set of solutions: Solutions from fsQCA software derived
	Step 5	Determination of solutions	Analyzing of solutions using coverage and consistency scores to determine relevance	Relevant solutions identified from fsQCA software
	Step 6	Interpretation of findings	Relevant solutions interpreted in the light of study's objectives	Report on findings - provided in detail in Chapter Five
Research Objectives 3 (Qualitative Inquiry)	Research Approach	Choices	Activities	Outcome
	Research Methodology	Qualitative	Appropriate selection of research methods	Selection of case study method
	Research Method	Case Study	Appropriate selection of data collection strategy (case selection, respondents selection, instrument development)	Respondents identified; interview schedule designed
	Data Collection Instrument	Interviews	Data collection strategy executed	Relevant data collected
	Data Analysis (method 1)	Miles & Huberman (1994)	Activities	Outcome

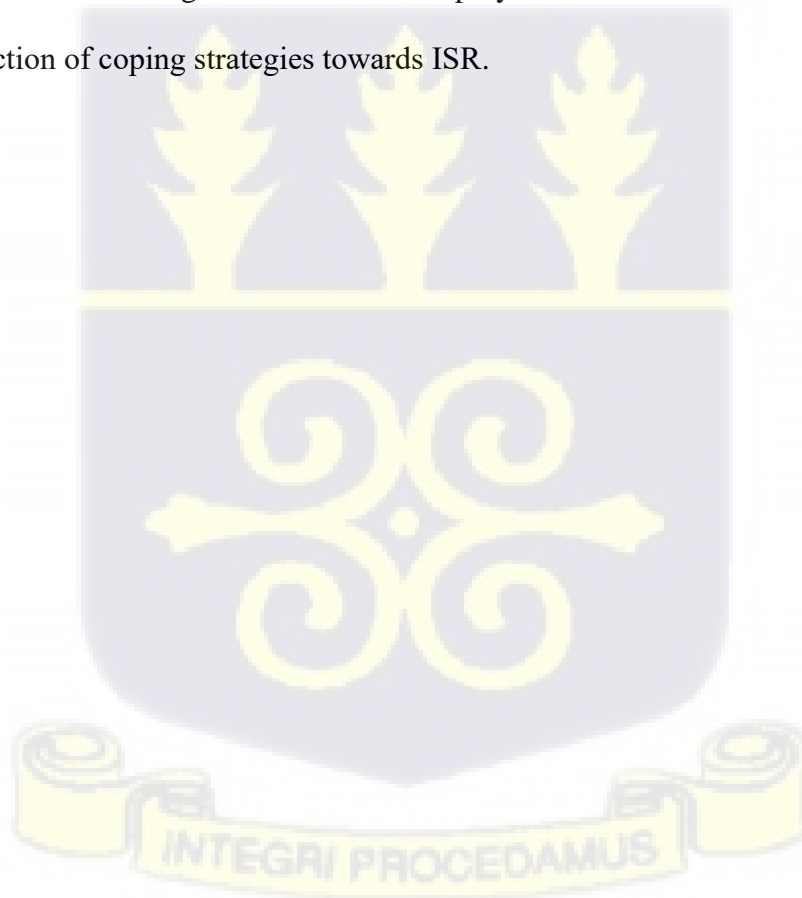
Step 1	Data Collection	Collected data through semi-structured interviews	Transcripts containing verbatims of interview responses
Step 2	Data Condensation	(i) Summarized quotes or interview verbatims through paraphrasing; (ii) Open coded the summarized data with labels derived from literature and theory (deductively) and also from the verbatims themselves (inductively)	Codes and themes related to the data and research objectives (in Chapter Six)
Step 3	Data Display	Used Tables mainly to display result	Accessible format of results of data condensation (in Chapter Six)
Step 4	Conclusions	Inferred from the codes & themes in relation to the research objective	Report on findings in Chapter Six
Data Analysis (method 2)	Critical Realism	Activities	Outcome
Step 1	Description of event of interest	Description of events to which CR analysis is to be applied: (i) Level of intelligence; (ii) Anthropomorphism; (iii) Level of robotisation	Exposition of all relevant details of the events

Step 2	Identification of related structures	Analysis of the events' environment, for instance the social elements (e.g. people, org.), material artifacts (e.g technology), rules & practices related to the event	Structures identified (Chapter Six
Step 3	Identification of related mechanisms	Analysis of generative powers & tendencies engendered by the structures and capable of causing dimensions of the event	Mechanisms identified (Chapter Six)
Step 4	Conclusions	Analyse relationships between the identified structures & mechanisms to explain the causing of the event	Report Findings (Chapter Six, findings 6, 8, 11)



4.9. CHAPTER SUMMARY

This chapter looked at the philosophical orientation which guided the methodology for the study, with justification for the various choices made. The critical realist paradigm with a multi-layered view of reality was appropriate for the multi-faceted 3 research objectives. This allowed the choice of a mixed methodology to gather rich comprehensive data from both qualitative and quantitative methods such as a survey and case study. Again in line with the pluralism of approaches, diverse data analytical approaches, comprising FsQCA, Miles & Huberman (1994) and Retroduction from critical realism were adopted. The next chapter discusses the findings of the quantitative inquiries into the conditions influencing the decision to deploy ISR as well as conditions influencing employees' selection of coping strategies towards ISR.



CHAPTER FIVE

FINDINGS AND DISCUSSIONS FROM THE CONFIGURATIONAL ANALYSIS

5.1. CHAPTER OVERVIEW

The previous chapter provided an insight into the research methods and procedures used to gather data for this study, accompanied by a justification of the choices made. This chapter provides the findings of the configurational analysis of the decisional elements involved in deploying ISR in developing economy firms (research Question 1), as well as the conditions influencing employee's choice of coping strategies towards ISR (research Question 2).

5.2. CONFIGURATIONS FOR DECISIONAL ELEMENTS IN ISR DEPLOYMENT

Research Question 1: What are the configurations of necessary and sufficient conditions which influence the decision to deploy intelligent software robotisation by a developing economy firm?

Here the analysis underlying the configurations of necessary and sufficient conditions are presented together with the solutions.

5.2.1. Respondents' Profile

Table 5.1 gives a summary of the respondents' age, gender, number of years they have worked with the company and their roles.

Table 5.1: ISR Deployment Survey Respondent's Profile

Age	Number	%
18 -24	2	10%
25 – 34	8	40%
35 – 44	6	30%
45 – 54	4	20%
TOTAL	20	100%

Gender		
Male	18	90%
Female	2	10%
TOTAL	20	100%
Years with the company		
1 – 4	11	55%
5 – 9	1	5%
10 -14	4	20%
15 – 19	3	15%
20+	1	5%
TOTAL	20	100%
Roles		
IT & Engineering	13	65%
Project Management	2	10%
Operations management	5	25%
TOTAL	20	100%

5.2.2. FSQCA Thresholds

See section Appendix A for background information on FSQCA and section 4.8.1 for information on FSQCA analysis procedures and measures. Here, the widely used measures from the fsQCA software and their thresholds are presented in Table 5.2. They help in interpreting the results to determine the necessity and sufficiency of conditions and their configurations (combinations) in causing an outcome of interest.

Table 5.2: Key FsQCA Measures, Definitions and Thresholds

Measure	Description	Threshold	Sources
Consistency	the degree of reliability (consistency) of a configuration in causing the outcome under investigation (Park et al., 2017);	0.75 - 1	Ragin (2008a); Mattke et al (2022); Fiss (2011); Mezei et al (2020); Greckhamer et al., (2015)

Raw coverage	the proportion of cases that have a given configuration as a cause of the outcome, in the midst or existence of other causal configurations in those cases as well (Fiss, 2011; Mattke et al., 2022)	0.25 - 0.65	Woodhouse (2013); Uruena & Hidalgo (2016); Mattke et al (2022)
Unique coverage	the proportion of cases which have a given configuration as the sole or exclusive cause of the outcome, with no other configurations in those cases (Mattke et al., 2022)	>0 or 0.25 - 0.65	Woodhouse (2013); Alves & Lourenco (2023); Schneider et al. (2010); Uruena & Hidalgo (2016);
Solution coverage	the extent to which all the configurations together, cover or explain the causes of the outcome (Pappas & Woodside, 2021)	0.25 - 0.65	Woodhouse (2013); Uruena & Hidalgo (2016); Alves & Lourenco (2023)
Solution consistency	the degree to which all configurations together consistently result in the outcome (Park et al., 2017)	0.75 - 0.8	Park et al. (2017); Pappas & Woodside (2021); Alves & Lourenco (2023)
Frequency cut-off	the minimum number of cases in which a given configuration should be found, to be considered sufficient (Mattke et al., 2022)	Small-N sample (1 or 2) / Large-N sample (≥ 3)	Ragin (2008a); Mattke et al (2022); Pappas & Woodside (2021)

5.2.3. Configurations for ISR Deployment

The results reveal interesting insights into the factors influencing the deployment of intelligent software robots in the firms under investigation. The analysis presents seven (7) configurations of

conditions that lead to the outcome of interest, which in this case is the deployment of ISR. Together they depict the complex solution shown in Table 5.3.

Table 5.3: Configurations for ISR Deployment decisions

Configuration	Complex Solution						
	1	2	3	4	5	6	7
Anthropomorphism	•	⊗	⊗	⊗	•	⊗	•
Technology Availability	●	⊗	●	⊗	●	●	●
Technology Accessibility		⊗	⊗	•	⊗	•	•
Firm Size	•	⊗	⊗	⊗	⊗	•	•
Organizational Structure	•	•	⊗	⊗	•	•	⊗
Industry Characteristics	•	⊗	•	•	⊗	•	•
Technology Infrastructure	•	⊗	•	•	•	•	⊗
Regulations	•	⊗	⊗	⊗	⊗	⊗	•
Consistency	1.00	1.00	0.97	1.00	0.99	0.91	1.00
Raw Coverage	0.29	0.27	0.18	0.20	0.25	0.22	0.21
Unique Coverage	0.06	0.08	0.03	0.05	0.05	0.04	0.04
Solution Coverage	0.64						
Solution Consistency	0.96						

Parsimonious Condition	Consistency	Raw Coverage	Unique Coverage
Presence of Technology Availability	0.83	0.79	0.26
Absence of Regulations	0.83	0.65	0.11

Legend

Symbol	Interpretation
●	present as a core condition
•	present as a peripheral condition
⊗	absent as a core condition
⊘	absent as a peripheral condition
	blank - “don’t care” (no influence in the configuration)

The first solution indicates a combination of conditions namely, Anthropomorphism (AT), Technology Availability (TAV), Firm Size (SZ), Organizational Structure (OS), Industry Characteristics (IC) and Technology Infrastructure (TI) being present in the absence of Regulations (RS) with no influence by Technology Accessibility, as causal conditions. This configuration has a raw coverage of 0.288274, suggesting that it accounts for approximately 28.83% of the cases leading to the deployment of intelligent software robots. Its unique coverage is 0.0618892, indicating that about 6.19% of the cases are uniquely explained by this combination alone. The consistency of 1 suggests perfect consistency, meaning that in all instances where these conditions are present, the outcome of deploying intelligent software robots occurs. This suggests that a combination of internal organizational factors (such as, firm size and structure), external technological and regulatory environments, and the human-like characteristics of the technology itself are crucial in driving deployment in this context.

The second solution presents a contrasting scenario where Anthropomorphism, Technology Availability, Technology Accessibility (TAS), Firm Size, Industry Characteristics, Technology Infrastructure, and Regulations are all absent, but Organizational Structure (OS) is present. This solution has a raw coverage of 0.26873, accounting for about 26.87% of the cases. Its unique coverage is 0.0830619, meaning that 8.31% of the cases are uniquely explained by this configuration. The consistency in this solution is also 1, indicating that whenever these conditions are present, the outcome invariably occurred. This configuration suggests that even in the absence of favorable technological, industry, and regulatory conditions, and regardless of the firm's size or the technology's human-like features, certain organizational structures alone can significantly drive the deployment of intelligent software robots.

The third solution involves a mix of present and absent conditions. Here, Technology Availability (TAV), Industry Characteristics (IC), and Technology Infrastructure (TI) are present, while Anthropomorphism (AT), Technology Accessibility (TAS), Firm Size (SZ), Organizational Structure (OS), and Regulations (RS) are absent. This solution has a raw coverage of 0.184039 (18.40%) and a unique coverage of 0.0252443 (2.52%). The consistency of 0.965812 is slightly lower than the previous solutions but still very high, indicating that these conditions are almost always associated with the deployment of intelligent software robots. This configuration suggests that even in the absence of anthropomorphic features in the technology, and regardless of the firm's size, structure, and regulatory support, the availability of the technology itself, along with certain industry characteristics and technological infrastructure, can be sufficient to drive the deployment.

The fourth solution indicates a configuration where Anthropomorphism (AT), Technology Availability (TAV), Firm Size (SZ), Organizational Structure (OS), and Regulations (RS) are absent, but Technology Accessibility (TAS), Industry Characteristics (IC), and Technology Infrastructure (TI) are present. This solution has a raw coverage of 0.20114, meaning it accounts for about 20.11% of the cases. The unique coverage is 0.051303, indicating that 5.13% of the cases are uniquely explained by this combination. The consistency of 1 shows that this configuration is a perfect predictor of the deployment of intelligent software robots. This suggests that even in the absence of anthropomorphic features, technology availability, organizational size and structure, and regulatory support, the accessibility of technology, specific industry characteristics, and adequate technology infrastructure are key drivers for the deployment of intelligent software robots.

In the fifth solution, Anthropomorphism (AT), Technology Availability (TAV), Organizational Structure (OS) are present, while Technology Accessibility (TAS), Firm Size (SZ), Industry

Characteristics (IC), and Regulations (RS) are absent. This configuration has a raw coverage of 0.251629 (25.16%) and a unique coverage of 0.0464169 (4.64%). The consistency here is 0.990385, indicating almost perfect consistency. This solution implies that the presence of human-like features in the technology, its availability, and certain organizational structures can drive the deployment, even in the absence of technology accessibility, firm size considerations, favorable industry characteristics, and regulatory support.

The sixth solution shows a scenario where Anthropomorphism (AT), Technology Availability (TAV), and Regulations (RS) are absent, but Technology Accessibility (TAS), Firm Size (SZ), Organizational Structure (OS), and Industry Characteristics (IC) are present. It has a raw coverage of 0.219055 (21.91%) and a unique coverage of 0.0399023 (3.99%). The consistency of 0.914966 is slightly lower but still indicates a strong relationship. This suggests that the accessibility of technology, the size of the firm, certain organizational structures, and industry characteristics are significant factors in the deployment of intelligent software robots, even in the absence of anthropomorphic features, technology availability, and regulatory support.

Finally, the seventh solution involves the presence of Anthropomorphism (AT), Technology Availability (TAV), Technology Accessibility (TAS), Firm Size (SZ), while Organizational Structure (OS), Industry Characteristics (IC), and Technology Infrastructure (TI) are absent. This solution has a raw coverage of 0.213355 (21.34%) and a unique coverage of 0.0407166 (4.07%). The consistency is 1, indicating a perfect match with the outcome. This configuration suggests that the human-like characteristics of the technology, its availability and accessibility, and the size of the firm are crucial factors for the deployment, irrespective of the organizational structure, industry characteristics, and technology infrastructure.

The solution coverage of the seven identified combinations is 0.635179, or approximately 63.52%. This metric indicates the proportion of cases (or instances of the deployment of intelligent software robots in developing economy firms) that are explained by the combined solutions. A coverage of 63.52% suggests that the solutions identified in the fsQCA collectively account for a significant majority of the instances where firms adopted intelligent software robots. However, it also implies that there are other factors or combinations of factors not captured in these solutions that account for the remaining cases. High solution coverage is desirable as it indicates that the model has a broad explanatory power and is capturing a substantial portion of the variations in the outcome.

The solution consistency of the causal recipes was 0.955882, or about 95.59%. Consistency which is a measure of the degree to which the cases that share a specific combination of conditions consistently exhibit the outcome of interest, is considerably high in the identified solutions. This indicates that there is a strong and reliable relationship between the conditions identified in the solutions and the deployment of intelligent software robots in developing economy firms. This high level of consistency suggests that the findings are robust and that the identified conditions are indeed key drivers of the outcome.

In Table 5.5, the above results are analysed against the eight propositions developed in relation to the conditions influencing decisions to deploy ISR in developing economy firms.

Table 5.4: Analysis of Propositions on ISR Deployment

#	Propositions	Configurations	Present	Absent
Soln 1	AT, TAV, TAS, SZ,	AT, TAV, SZ, OS, IC, TI, RS	AT, TAV, SZ, OS, IC, TI, RS	TAS ("Don't care")
Soln 2	OS, IC, TI, RS	~AT, ~TAV, ~TAS, ~SZ, OS, ~IC, ~TI, ~RS	OS	~AT, ~TAV, ~TAS, ~SZ, ~IC, ~TI, ~RS

Soln 3	~AT, TAV, ~TAS, ~SZ, ~OS, IC, TI, ~RS	TAV, IC, TI	~AT, ~TAS, ~SZ, ~OS, ~RS
Soln 4	~AT, ~TAV, TAS, ~SZ, ~OS, IC, TI, ~RS	TAS, IC, TI	~AT, ~TAV, ~SZ, ~OS, ~RS
Soln 5	AT, TAV, ~TAS, ~SZ, OS, ~IC, TI, ~RS	AT, TAV, OS, TI	~TAS, ~SZ, ~IC, ~RS
Soln 6	~AT, TAV, TAS, SZ, OS, IC, TI, ~RS	TAV, TAS, SZ, OS, IC, TI	~AT, ~RS
Soln 7	AT, TAV, TAS, SZ, ~OS, IC, ~TI, RS	AT, TAV, TAS, SZ, IC, RS	~OS, ~TI

Legend: ~ the condition is absent; Soln: Solution; AT: Anthropomorphism; TAV: Technology Availability; TAS: Technology Accessibility; SZ: Firm Size; OS: Organizational Structure; IC: Industry Characteristics; TI: Technology Infrastructure; RS: Regulations

It must be noted that, being framed in the configurational mode, any manner in which a condition appears in a configuration, either alone or together with others, is acceptable in FsQCA for the efficacy of the given condition, as long as they lead to the outcome.

From Table 5.4 all the eight decision elements were found to have been present and contributed to the decision to deploy ISR in at least one of the solutions and none was completely non-existent (“don’t care” or no influence) throughout. Consequently, the proposition proffered on the decisional elements influencing ISR deployment in developing economies, presented below was confirmed.

Proposition : anthropomorphic traits in ISR robots, technology availability, technology accessibility, firm size, organisational structures, industry characteristics, technology infrastructure and regulatory regime are sufficient and necessary conditions which influence the decision by developing economy firms to deploy ISR.

Though all the solutions are relevant and informative, Solutions 1, 6 and 7 are notable as they contain a significant number of the conditions (as high as seven in Solution 1 and six in Solutions 6 & 7), attesting to the contributory efficacy of the eight conditions together.

At the theoretical level, these results are line with other studies which have confirmed the importance of the three TOE factors (technological, organisational and environmental), in decisions related to the deployment of intelligent software robots (e.g. Laut et al., 2021, Marrucci et al., 2023, Radhakrishnan et al., 2022).

The parsimonious solution shown in Table 5.4 represents the simplified explanation for the outcome, with a focus on the *core conditions*. In this case, the parsimonious solution for the deployment of intelligent software robots in developing economy firms includes two core conditions: the presence of Technology Availability (TAV) and the absence of Regulations (RS). In the case of the presence of Technology availability, the condition has a raw coverage of 0.797231, meaning it accounts for approximately 79.72% of the cases where firms adopted intelligent software robots. The unique coverage is 0.256515 (25.65%), indicating that in about a quarter of the cases, Technology Availability alone explains the deployment. The consistency of 0.833901 suggests a strong relationship between the availability of technology and the deployment of intelligent software robots, though it's not perfect. The absence of Regulations has a raw coverage of 0.649837 (64.98%), indicating that in nearly 65% of the cases, the lack of regulatory constraints is associated with the deployment of intelligent software robots. The unique coverage is 0.109121 (10.91%), showing that in about 11% of the cases, the absence of regulations alone can explain the deployment. The consistency of 0.832117 is similarly strong, suggesting a reliable relationship.

Regarding *Technology Availability*, the finding is in accord with the views of scholars such as, Asiaei & Rahim (2019), Adamu & Benachour (2020) and Thatcher & -Ndabeni (2013), who reiterate the call by Musa (2006) for attention to be paid to important contextual factors when designing the deployment models for developing economies. Musa (2006) indicated that most models such as TAM (Davis, 1989) were designed with the developed world in mind and hence assumed the availability of the technology; deployment or usage was thus a matter of choice. He points out that this is not the case in emerging economies, where for limited socio-economic developmental reasons, technology availability cannot be taken for granted and is thus a critical element to consider especially in the deployment of relatively new technologies including, RPA and AI. Technology availability was measured with scales derived from the literature, namely, technology awareness, system characteristics, vendor availability & support and an established user community for support, information and knowledge sharing (see Chapter 3). In relation to the motivation for Research Objective 1, this study's finding that technology availability is a core condition in ISR deployment decisions, indicates how significantly it could affect the deployment and thus could be one of the probable sources of the incidence of low deployment rates of ISR on the continent.

In relation to the absence of regulations as a notable decisional element in the deployment of ISR in developing economy firms, this is an interesting finding, especially when evaluated in the light of recent calls and efforts by various institutions including governments and international bodies such as, the UN for AI regulations. The regulation dimension of this study was evaluated with scales from the literature namely, regulations in relation to laws on responsible & ethical AI, data privacy protection, taxes on robots and national development agenda for ISR (see Table 3.1)

Do regulatory considerations feature significantly in the decision by firms to deploy ISR? The evidence is mixed. The literature suggests that government regulations are critical in the diffusion of emerging technologies as they can either promote or impede the deployment (Basu et al., 2020). For technologies considered to be prone to unethical and harmful usage such as, AI and I4.0 technologies, studies such as, Ghobakhloo et al., (2022) and Mohiuddin et al. (2023) report that the *presence* of regulations encourage deployment. The literature also reports that the *absence* of regulations could *discourage* or slow down the deployment of these emerging technologies such as AI (Rahman et al., 2023; Dinrifo et al, 2022). This study's findings is to the contrary.

The results indicate that the *absence* of regulations *contributes to the decision to deploy* ISR in developing economy firms. There is support for that in the literature as well and it is coming from the perspective of seeing regulations as a barrier, whose removal and absence will encourage the deployment. For instance, a number of studies report that AI regulations on privacy and personal data protection could pose challenges in obtaining data to train AI models, thereby adversely impacting deployment in both developed and developing regions such as, India (Pumplun et al., 2019; Alsheibani et al., 2020; Radhakrishnan et al., 2022). In a related research on the adoption and sustainability of an emerging technology (bitcoin) in a developing economy (Nigeria), Onyekwere et al. (2023) report that while the study's respondents advocated for regulation to curb criminal activities, they strongly opined that the current regulatory regime which banned financial institutions from enabling bitcoin transactions, was a major adoption barrier suffocating innovation in that space.

Two other notable findings from the ISR deployment investigations are first, the presence of IC (Industry Characteristics) and Technology Infrastructure (TI) in 6 out of the 8 solutions. For this study, the *Industry Characteristics* finding is significant because among the scale items used in

measuring it namely, competitive pressure, industry standards, industry associations, and external financial support, was Labour union activities. Most of the IC measures are confirmed in the literature as important deployment factors (Islam et al., 2023; Zhao & Xu, 2023; Gomez et al., 2022; Gupta et al., 2022; Calitz et al., 2021; Simoes et al., 2020; Jacobsson et al., 2017; Calitz et al., 2017). However, Labour Union activities as a deployment variable was not widely investigated (Kwayan, 2023; Schoeman & Seymour, 2022) and was of interest to this study because it came up as a notable issue of concern in the African studies (Tew, 2020; Calitz et al., 2017). Those studies reported the sensitivity around unemployment issues in South Africa which had led to companies having to negotiate with the trade unions on job protection in respect of RPA deployments. It is noted that the Labour union variable in this study is not a separate variable but conjoined with other factors, hence its strength cannot be verified. Nevertheless, it is worth noting as a preliminary insight for further investigations.

Technology infrastructure, was measured with stable energy, broadband connectivity, data ecosystem, cybersecurity, all of which have been confirmed as critical factors in the deployment of emerging technologies, especially in the developing economy environment (Ade-Ibijola & Okonkwo, 2023; Okolo et al., 2023; Tuffour & Nsiah, 2023; Sharma et al., 2022; Dinrifo et al., 2022; Daramola & Etim, 2022; Chen et al., 2022; Kalusopa, 2021; Smith & Neupane, 2018). In relation to the motivation for Research Objective 1, the emergence of the criticality of this condition among the results, suggests that it could probably be one of the sources of the low deployment of ISR on the continent.

The second notable finding was the influence of *Organisation Structures* (OS) as a sole contributor to the ISR deployment decision in Solution 2. The perfect consistency score (1) together with a decent raw coverage of 27% confirm the sufficiency and necessity of this factor. Furthermore,

producing the highest unique coverage (0.08) which is nearly twice that of several configurations, is indicative of the importance of OS as a sole or exclusive contributor to the deployment decision. The Organisational Structures condition or variable was measured with the following scales: availability of skilled human resources, organisational culture, management support, change management structures, internal technology infrastructure and alignment with organisational goals. Several studies (Henderson & Salado, 2023; Mohiuddin et al., 2023; Leppala & Huhtamaki, 2022; Ali et al., 2022; Chen et al., 2022; Sayem et al., 2022; Low et al., 2022; Lewandoski et al., 2021; Hamm & Klesel, 2021) have also confirmed the importance of these measures. Once again, in relation to the motivation for Research Objective 1, (Moffit et al. (2018) and Lamberton et al. (2017) point out the critical role of organisational structures such as, change management structures, skilled human resources, internal technology infrastructure, stakeholder buy-in (e.g. top management support), among several others, in the success or failure of RPA projects in particular. Therefore this finding highlighting the importance of these afore-mentioned organisational structures as a sole contributor to ISR deployment decisions, is valuable as a probable source to look to, for reasons behind the reported high failure IT projects.

5.2.4. Summary of Findings for ISR Deployment

In summary, all seven solutions are within the recommended thresholds and are therefore accepted with none rejected. Therefore, all the conditions which contributed to all the seven solutions are also significant. Consequently, the configurations together confirm the necessity and sufficiency of the eight technological, organisational and environmental elements namely, Anthropomorphism, Technology Availability, Technology Accessibility, Firm Size, Organizational Structure, Industry Characteristics, Technology Infrastructure and Regulations, in

influencing decisions to adopt ISR robots in developing economy firms. This also confirms the study’s proposition on ISR deployment.

Secondly, Technology Availability as a core condition requires notable attention and could also be source of the low ISR adoption rates in Africa. Thirdly, Technology Infrastructure as prevalent condition or factor, is a significant finding and could also probably help explain the low incidence of ISR deployment in Africa. Fourthly, Organisational Structures as a single factor is quite important in influencing the ISR deployment decision in developing economy firms and this could probably help explain the high rate of ISR project failures. Fifthly, the presence of Industry Characteristics as a prevalent peripheral condition in ISR deployment decisions, is a notable finding and sixthly, Labour union activities, as part of Industry characteristics, appear to have some influence in the ISR deployment decisions of developing economy firms and requires further investigations. Finally, the absence of Regulations as a core condition is also a notable finding which cannot be discounted.

Table 5.5 shows the summary of findings for the investigations on the conditions influencing the decision to deploy ISR in developing economy firms, evaluated against the propositions proffered in respect of Research Objective 1.

Table 5.5: Summary of Findings on ISR Deployment Decision Conditions

Conditions influencing ISR Deployment	Finding	Comment on Research Propositions
Technology, Organisational and Environmental	1/ All three TOE dimensions and all eight variables investigated namely, Anthropomorphism, Technology Availability, Technology Accessibility, Firm Size, Organizational Structure, Industry Characteristics,	Fully met

	Technology Infrastructure and Regulations, are necessary and sufficient conditions in influencing the decision to deploy ISR in developing economy firms.	
Additional results	2/The presence of Technology Availability as core condition in ISR deployment decisions especially in developing economies, requires notable attention. Given the importance of technology availability in the African context, this finding could probably help explain the low rates of ISR deployment on the continent.	Not applicable
	3/The presence of Technology Infrastructure as a prevalent peripheral condition in ISR deployment decisions especially in developing economies also requires notable attention. Given the general infrastructural deficiencies in Africa, this could also be a source of the low adoption rates of ISR on the continent.	Not applicable
	4/Organisational Structures as a single factor is quite important in influencing the ISR deployment decision in developing economy firms. Given its importance in facilitating project implementation, this finding could probably help explain the high failure rates of ISR projects and requires attention	Not applicable
	5/The presence of Industry Characteristics (IC) as a prevalent peripheral condition, requires notable attention in decisions to deploy ISR deployments in developing economy firms.	Not applicable
	6/Labour union activities, as part of Industry characteristics, appear to have some influence in the	Not applicable

	ISR deployment decisions of developing economy firms.	
	7/The absence of Regulations as a core condition, require notable attention in decisions to deploy ISR deployments in developing economy firms.	Not applicable

5.3. CONFIGURATIONS FOR EMPLOYEES’ ISR COPING STRATEGIES

Research Question 2: What are the configurations of necessary and sufficient conditions which affect the choice of employees’ coping strategies towards intelligent software robotisation by a developing economy firm?

Level of robotisation (LOR) for an ISR initiative can either be high (requiring minimal human intervention) or complementary (collaborative engagements between humans and machines) (Parasuraman, 2000; Kaber & Endsley, 2004). Furthermore, there are a number of coping strategies adopted by employees in relation to a new IT event. Beaudry & Pinsonneault (2005) provided theoretical support on coping strategies for this study and the Employees’ ISR Coping Strategies Model (Figure 3.4), guided the investigations. Employee’s appraisals of the LOR of their companies ISR as either High or Complementary or as either an Opportunity or a Threat were tested as conditions which in various combinations could influence the choice of various coping strategies.

5.3.1. Respondents’ Profile

Table 5.6 gives a summary of the respondents’ age, gender, number of years they have worked with the company and their role.

Table 5.6: Employees’ Coping Strategies Survey Respondents' Profile

Age (Years)	Number	%
25 – 34	11	50%
35 – 44	11	50%
TOTAL	22	100%
Gender		
Female	7	32%
Male	15	68%
TOTAL	22	100%
Years with the company		
1 – 4	15	68%
5 – 9	4	18%
10 -14	2	9%
15 – 19	1	5%
TOTAL	22	100%
Role		
Customer Service	12	55%
Operations management	6	27%
IT & Engineering	4	18%
TOTAL	22	100%

Out of the 31 persons invited based on theoretical-based sampling, 22 accepted to participate in the investigations, a response rate of 71%. Of these, 50% were aged between 25 to 34 years while the remaining half were between 35 to 44 years. Majority of them (68%) were males. Again 68% had been with their companies for up to 4 years, 18% for 5 – 9 years and the remaining 14% for at least 10 years. Regarding their roles, over half of the respondents (55%) were in Customer Service, 27% in operations (e.g. Innovations, Digital Channels, Loan processing) and 18% in IT & Engineering.

To aid clarity in following the flow of the results, the analysis is presented according to the organisation of the variables in the research framework for coping strategies and is thus best appreciated when read together with the Employees’ ISR Coping Strategies Model (Figure 3.4). Once again it is being reiterated that, in line with requirements and to aid in clarity in following

the analysis, the complex solutions can be found in Appendix B while the parsimonious solutions are presented here.

5.3.2. Configurations for High LOR Coping Strategies

Due to space and clarity concerns in relation to the large volume of analysis material generated, the complex solutions are shown in Table 5.7 with the detailed analysis provided in Appendix B.

Table 5.7: Complex Solution for ISR Coping Strategies under LORH

Complex Solution											
CONFIGURATIONS	Benefit Maximizing		Benefit Satisficing			Disturbance Handling		Self-preservation		Exit	
	1	2	1	2	3	1	2	1	2	1	2
	LORH		⊗	•	⊗		•	⊗		⊗	•
Threat (APT)	⊗		⊗	•	•	⊗	•	•	•	⊗	•
Opportunity (APO)	•	•			⊗		•	⊗			
CONSISTENCY	0.88	0.91	0.86	0.83	0.83	0.84	0.9	0.85	0.85	0.79	0.81
RAW COVERAGE	0.75	0.57	0.57	0.4	0.57	0.58	0.31	0.66	0.47	0.54	0.41
UNIQUE COVERAGE	0.23	0.05	0.27	0.03	0.13	0.37	0.1	0.24	0.04	0.3	0.17
SOLUTION COVERAGE	0.8		0.87			0.68		0.7		0.72	
SOLUTION CONSISTENCY	0.86		0.81			0.85		0.86		0.75	

Legend

Symbol	Interpretation
●	present as a core condition
•	present as a peripheral condition
⊗	absent as a core condition
⊙	absent as a peripheral condition
	blank - “don’t care” (no influence in the configuration)

However, the parsimonious (or summarized) solutions are presented here. Both complex and parsimonious solutions were used to arrive at the findings. It must be noted that the thresholds in section 5.2.2 also apply here.

Benefit Maximizing Under LORH (High LOR)

Table 5.8: Parsimonious Solution for Benefit Maximizing under LORH

Parsimonious Solution	Consistency	Raw Coverage	Unique Coverage
Presence of Appraisal of Opportunity	0.85	0.83	0.83

The parsimonious solution shown in Table 5.8 identified the appraisal of ISR as an opportunity (APO) alone as the key condition leading to Benefit Maximizing. This solution has a raw coverage of 0.828859, meaning it accounts for approximately 82.89% of the cases leading to the outcome. Remarkably, the unique coverage is also 0.828859, indicating that this single condition exclusively explains all the cases it covers. The consistency of 0.857639, while slightly lower than the complex solution, still indicates a high level of reliability. This parsimonious solution suggests that appraising an ISR as an opportunity is the most critical factor in determining whether employees will adopt a Benefit Maximizing strategy. This finding highlights the significance of employees'

appraisal of an ISR as an opportunity in shaping their coping strategies, particularly in the context of Benefit Maximizing.

Benefit Satisficing Under LORH

Table 5.9: Parsimonious Solution for Benefit Satisficing under LORH

Parsimonious Solutions	Consistency	Raw Coverage	Unique Coverage
Presence of High Level of Robotisation	0.81	0.79	0.28
Presence of Appraisal of Threat	0.80	0.65	0.14

The parsimonious solution shown in Table 5.9 identifies appraisals of high level of robotisation (LORH) and threat (APT) as important conditions. The LORH condition alone has a raw coverage of 0.786074 (78.61%) and a unique coverage of 0.28104 (28.10%), indicating its significant role in explaining the outcome. The APT condition has a raw coverage of 0.647651 (64.77%) and a unique coverage of 0.142618 (14.26%), also showing its importance. Therefore the choice of Benefit Satisficing as a coping strategy amongst employees in the context of ISR, both the appraisals of a high level of robotisation and threat are important.

Disturbance Handling Under LORH

Table 5.10: Parsimonious Solution for Disturbance Handling under LORH

Parsimonious Solutions	Consistency	Raw Coverage	Unique Coverage
Presence of High Level of Robotisation and Absence of Appraisal of Threat	0.84	0.58	0.35
Presence of Appraisal of Threat and Presence of Appraisal of opportunity	0.87	0.37	0.14

The parsimonious solutions shown in Table 5.10 indicates as important conditions, the appraisal of a high level of robotisation (LORH) combined with the absence of appraising an ISR as a threat (APT), and the appraisal of ISR as an opportunity (APO) combined with the appraisal of it as a threat (APT). The perception of a high level of robotisation (LORH) combined with the absence of appraising ISR as a threat (APT) condition has a raw coverage of 0.575283 (57.53%) and a unique coverage of 0.345518 (34.55%), indicating its significant role in explaining the outcome. The appraisal of ISR as an opportunity (APO) and a threat (APT) at the same time, has a raw coverage of 0.366406 (36.64%) and a unique coverage of 0.136641 (13.66%), also showing its importance.

Self-preservation Under LORH

Table 5.11: Parsimonious Solution for Self-Preservation under LORH

Parsimonious Solution	Consistency	Raw Coverage	Unique Coverage
Presence of Appraisal of Threat	0.82	0.75	0.75

The appraisal of ISR as a threat (APT) is identified as the parsimonious solution shown in Table 5.11 when considering this coping strategy. The APT condition alone has a raw coverage of 0.748345 (74.83%) and a unique coverage of 0.748345 (74.83%), indicating its significant role in explaining the outcome. This suggests that employees will adopt the self-preservation coping strategy once they perceive ISR as a threat.

Exit Under LORH

Table 5.12: Parsimonious Solution for Exit under LORH

Configuration	Solutions	
	1	2

High Level of Robotisation	●	⊗
Appraisal of Threat	⊗	●
Appraisal of Opportunity		
Consistency	0.79	0.81
Raw Coverage	0.54	0.41
Unique Coverage	0.30	0.17
Solution Coverage	0.72	
Solution Consistency	0.75	

Exit strategy considers the behavioral adaptation mechanism adopted by a user in response to the appraisal of an ISR as a threat, coupled with limited control over the IT event, their work, and themselves, leading them to find the situation too demanding and overwhelming to cope with emotionally. The complex solution shown in Table 5.12 reveals two configurations that lead to the outcome of Exit. The first configuration indicates that an appraisal of a high level of robotisation (LORH) combined with the absence of appraising an ISR as a threat (APT) leads to the Exit strategy. This configuration has a raw coverage of 0.543134, meaning it explains about 54.31% of the cases. Its unique coverage is 0.301056, suggesting that approximately 30.11% of the cases are exclusively explained by this configuration. The consistency of 0.78699 indicates a reasonable level of reliability in this configuration leading to the outcome.

The second configuration involves the non-appraisal of an ISR event as a high level of robotisation (LORH) combined with the appraisal of a threat (APT). This configuration has a raw coverage of 0.414613 (41.46%) and a unique coverage of 0.172535 (17.25%), indicating its significance in explaining the outcome. The consistency of 0.80789 is slightly higher, suggesting a reasonable level of reliability. The overall solution coverage of 0.715669 suggests that these configurations explain about 71.57% of all cases, and the solution consistency of 0.747243 indicates a moderate level of overall reliability.

Interestingly, the parsimonious solution for the Exit strategy mirrors the complex solution, indicating that the configurations identified are both essential and sufficient for explaining the outcome. This suggests that for the Exit strategy to be chosen amongst employees, there would be the identification of ISR as being of high level and as well employees appraising it as a threat.

5.3.3. Configurations For Complementary LOR Coping Strategies

Again, for reasons of space and clarity in relation to the large analysis material generated, the complex solution is shown in Table 5.13 with detailed explanations provided in Appendix B.

Table 5.13: Complex Solution for ISR Comping Strategies under LORC

Complex Solution													
CONFIGURATIONS	Benefit Maximizing		Benefit Satisficing			Disturbance Handling		Self-preservation		Exit			
	1	2	1	2	3	1	2	1	2	1	2	3	4
LORC		⊗	⊗		⊗	•	⊗		⊗	⊗		⊗	•
Threat (APT)	⊗			•	•	•	•	•	•		•	•	⊗
Opportunity (APO)	•	•	⊗	⊗		⊗	•	⊗		⊗	⊗		•
CONSISTENCY	0.88	0.93	0.87	0.83	0.89	0.88	0.87	0.85	0.88	0.82	0.75	0.77	0.83
RAW COVERAGE	0.75	0.54	0.53	0.57	0.47	0.56	0.32	0.66	0.53	0.52	0.54	0.43	0.53
UNIQUE COVERAGE	0.25	0.04	0.09	0.14	0.03	0.36	0.12	0.18	0.05	0.05	0.11	0.01	0.23
SOLUTION COVERAGE	0.79		0.7			0.67		0.71		0.88			

SOLUTION CONSISTENCY	0.86	0.83	0.88	0.86	0.72
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However, the parsimonious (summarized) solutions are presented and discussed here. Both complex and parsimonious solutions were used to arrive at the findings.

Benefit Maximizing Under LORC (Complementary LOR)

Table 5.14: Parsimonious Solution for Benefit Maximizing under LORC

Parsimonious Solution	Consistency	Raw Coverage	Unique Coverage
Presence of Appraisal of Opportunity	0.86	0.83	0.83

The parsimonious solution shown in Table 5.14 for the Benefit Maximizing strategy simplifies the complex solution by focusing solely on the appraisal of ISR as an opportunity (APO). This single configuration has a raw coverage of 0.828859 (82.89%) and a unique coverage of 0.828859 (82.89%), indicating its predominant role in explaining the Benefit Maximizing strategy. The consistency of 0.857639 is slightly lower than the complex solution but still indicates a high level of reliability.

Benefit Satisficing Under LORC

Table 5.15: Parsimonious Solution for Benefit Satisficing under LORC

Parsimonious Solutions	Consistency	Raw Coverage	Unique Coverage
Absence of Appraisal of Opportunity	0.78	0.68	0.11
Presence of Appraisal of Threat	0.80	0.65	0.08

The parsimonious solution shown in Table 5.15 for the Benefit Satisficing strategy simplifies the complex solution by focusing on two main conditions: the absence of appraising an ISR as an opportunity (~APO) and the appraisal of ISR as a threat (APT). The ~APO configuration has a raw coverage of 0.684564 (68.46%) and a unique coverage of 0.114094 (11.41%), while the APT configuration has a raw coverage of 0.647651 (64.77%) and a unique coverage of 0.0771812 (7.72%). The Benefit Satisficing strategy in the context of a complementary ISR is chosen when an ISR is not appraised as an opportunity but appraised as a threat. Both the complex and parsimonious solutions emphasize these appraisals, with the parsimonious solution providing a more streamlined understanding of the dominant pathways. This analysis offers valuable insights into the conditions under which employees in developing economy firms adopt a Benefit Satisficing coping strategy in response to ISR initiatives.

Disturbance Handling Under LORC

Table 5.16: Parsimonious Solution for Disturbance Handling under LORC

Parsimonious Solutions	Consistency	Raw Coverage	Unique Coverage
Presence of Appraisal of Threat and Presence of Appraisal of opportunity	0.87	0.37	0.10
Presence of Complementary Level of Robotisation and Absence of Appraisal of Threat	0.83	0.59	0.04
Presence of Complementary Level of Robotisation and Presence of Appraisal of Opportunity	0.87	0.62	0.01

The parsimonious solution shown in Table 5.16 for the Disturbance Handling strategy simplifies the complex solution by focusing on three main conditions. The presence of appraisal of opportunity and appraisal of threat configuration has a raw coverage of 0.366406 (36.64%) and a unique coverage of 0.0983464 (9.83%). The appraisal of an ISR as complementary and absence of a threat, has a raw coverage of 0.591819 (59.18%) and a unique coverage of 0.0365536 (3.66%). Lastly, the appraisals of an ISR as complementary and an opportunity, has a raw coverage of 0.617929 (61.79%) but no unique coverage, indicating its overlap with other conditions.

Self-preservation Under LORC

Table 5.17: Parsimonious Solution for Self-preservation under LORC

Parsimonious Solution	Consistency	Raw Coverage	Unique Coverage
Presence of Appraisal of Threat	0.82	0.75	0.75

The parsimonious solution shown in Table 5.17 for the Self-Preservation strategy simplifies the complex solution by focusing on the primary condition: APT (Appraisal of Threat). This configuration has a raw coverage of 0.748345 (74.83%) and a unique coverage of 0.748345 (74.83%), indicating its strong explanatory power. The consistency of 0.823959, though slightly lower than the complex solution, still indicates a high level of reliability.

Exit Under LORC

Table 5.18: Parsimonious Solution for Exit under LORC

Parsimonious Solutions	Consistency	Raw Coverage	Unique Coverage
Absence of Appraisal Opportunity	0.74	0.69	0.07
Presence of Complementary Level of Robotisation	0.77	0.78	0.22

Presence of Appraisal of Threat	0.69	0.58	0.01
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The parsimonious solution shown in Table 5.18 for the Exit strategy simplifies the complex solution by focusing on the primary conditions: \sim APO (absence of appraising an ISR as an opportunity), LORC (appraisal of a complementary Level of Robotisation), and APT (Appraisal of Threat). This configuration has a raw coverage of 0.947183 (94.72%) and a unique coverage of 0.21919 (21.92%) for LORC, indicating its strong explanatory power. The consistency of 0.677582, though lower than the complex solution, still indicates a moderate level of reliability.

To extract relevant and valuable results from such a large number of solutions, Pappas & Woodside (2021) recommend a combination of the parsimonious solutions with the intermediate solutions by identifying solutions that appear in both. The parsimonious solutions are a summation of the complex solution with a focus on the core conditions, while the intermediate solution is derived from a counterfactual (what if) analysis of the parsimonious solution and the complex solutions. Hence the combined analysis of the parsimonious and intermediate will ensure both important core and peripheral conditions are noted for a better interpretation of the results.

Table 5.19 show the outcome of the analysis of both the *complex* and *parsimonious* solutions identifying commonalities.

Table 5.19: Analysis of Propositions on Coping Strategies

Coping Strategies	Propositions	Results	Conditions Present & Absent
Benefit Maximizing Under LORH	LORH, APO, HC	APO+HC	APO, HC present; LORH absent
Benefit Satisficing Under LORH	LORH, APO, LC	(i) LORH+LC; (ii) APT+LC	LORH, APT, LC, present;

			APO absent
Disturbance Handling Under LORH	LORH, APT, HC	(i) LORH+~APT+HC; (ii) APT+APO+HC	ALL present + APO
Self-preservation Under LORH	LORH, APT, LC	APT+LC	APT, LC present; LORH absent
Exit Under LORH	LORH, APT, NC	(i) LORH+~APT+NC; (ii)~LORH+APT+NC	ALL present
Benefit Maximizing Under LORC	LORC, APO, HC	APO+HC	APO,HC present; LORC absent
Benefit Satisficing Under LORC	LORC, APO, LC	(i)~APO+LC; (ii)APT+LC	APT+LC present; LORC, APO absent
Disturbance Handling Under LORC	LORC, APT, HC	(i) APT+APO+HC; (ii)LORC +APO+HC	ALL present + APO
Self-preservation Under LORC	LORC, APT, LC	APT+LC	APT, LC present; LORC absent
Exit Under LORC	LORC, APT, NC	(i)~APO+NC; (ii)LORC+NC; (iii)APT+NC	ALL present

Legend: ~ the condition is absent; LORH (High LOR); LORC (Complementary LOR); APO- Opportunity; APT- Threat; HC-High Control; LC- Low Control; NC-No Control.

It must be noted that, being framed in the configurational mode, any manner in which a condition appears in a configuration, either alone or together with others, is acceptable in FsQCA for the efficacy of the given condition, as long as they lead to the outcome. The analysis that follows discusses first, the High Level of robotisation (LORH) scenario, followed by the Complementary level of robotisation (LORC) leg.

In relation to High LOR, from Table 5.19, all the proposed conditions were found fully in three out of the five coping strategies, namely Benefit Satisficing, Disturbance handling and Exit. For the remaining two (Benefit Maximizing & Self-preservation), the notable condition absent for both of them was an appraisal of the ISR event as a High LOR (LORH). This means that for some employees, they do not need to appraise the level of robotisation as high before choosing these two strategies, as long the remaining conditions (appraisals of opportunity of threat and level of control) are present. Interpreted in the light of the fact that for both strategies, their remaining two proposed conditions were met, this is a plausible scenario. Coping literature on the test of LOR as an influencing factor in coping strategy selection, was rare to enable the relevant critical analysis. Hence this could be considered as a useful finding in relation to LORH, which could be explored further.

Another notable unexpected result was the fact that for Disturbance handling , apart from all the proposed conditions being present, an ISR could also be appraised as both an opportunity and threat at the same time in order to adopt this strategy. In the coping literature, these two constructs are theorized as distinct constructs as pointed out by Bala & Venkatesh (2016) and confirmed by others such as Bhattacharjee et al. (2018) & Paluch et al. (2022) in their use of the constructs. This result is thus a departure from the norm. From a theoretical perspective (that is in relation to CMUA and this study's coping model), Disturbance Handling is a strategy adopted in the face of threat when the employee has high control over their work conditions, emotions and the ISR technology. The strategic actions taken includes, adjusting the technology, work procedures, and emotions, with the purpose of minimizing the perceived adverse effects of the ISR event. Thus, in relation to the twin appraisal of opportunity and threat, the theory explains the threat dimension, leaving open the opportunity dimension. A possible explanation could be that if an employee perceives an ISR

event as threatening their job while at the same time offering an opportunity for a job upgrade or career advancement, they may first want to address the threat by ensuring that they are still in employment, before taking advantage of the opportunities. Thus they may first undertake the required training, handle their emotions and adjust the way they work to accommodate the changes (Disturbance Handling).

In relation to Complementary LOR (LORC), all the proposed conditions were found fully in two out of the five coping strategies, that is, Disturbance handling and Exit. Out of the remainder, two also exhibited the notable absence of the appraisal of the level of robotisation (LORC), similar to the LORH situation earlier discussed. For the remaining strategy, namely, Benefit Satisficing, one of the proposed conditions (an Opportunity appraisal) was absent and rather its opposite (a Threat appraisal) was chosen. The work of Peters & Feste (2023) is informative in illuminating the possible reason for this. Using configurational analysis, they link personality profiles to two types of coping strategies, proactive (problem focused) and reactive (emotion focused) coping. They contend that extroverts with a conscientious nature are not afraid to tackle a problem head on to achieve clearly defined goals. Thus in the context of this study, on identifying an ISR event as a threat with low control, instead of taking the corresponding coping strategy, Self-preservation, which is an introverted emotion-focused approach (see Chapter 4), they would rather make all the efforts within their control to adapt to the situation (Benefit Satisficing).

5.3.4. Summary of Findings for Coping Strategies

In summary, firstly, most of the FsQCA configurational solutions were within the recommended thresholds with a few variations which are acceptable as indicated by Uruena & Hidalgo (2016). Consequently, the results confirm the necessity and sufficiency of *all* the *individual* conditions or factors (High level of robotisation, Complementary level of robotisation, Opportunity, Threat and

Level of Control) in influencing employees' coping strategy, with none completely non-existent ("don't care" or no influence) throughout. This is because, individually they all appear in various configurations which cause the outcome, indicating their relevance. Thus the first proposition on the three high order constructs of the Employees' ISR Coping Strategies Model, *level of robotisation*, *self-interest* and *level of control* was met, indicating that the constructs are sufficient and necessary conditions for influencing employees' choice of coping strategy towards ISR deployments. In the coping literature, factors such as, appraisals of Opportunity or Threat (that is, self-interest appraisals) and Level of control are confirmed by a major theory such as, CMUA (Beaudry & Pinsonneault, 2005) and the studies that have validated its efficacy (Elie-Dit-Cosaque & Straub, 2011; Fadel, 2012; Stein et al., 2015; Bala & Venkatesh, 2016; Bhattacharjee et al., 2018 & Paluch et al., 2022). Level of robotisation (LORC or LORH), is rarely *tested empirically* as a factor in coping strategy selection (e.g. Ulfert et al., 2022), though its relevance has been noted by other scholars (e.g. Seiffer et al., 2021 and Zhang et al., 2022). This study's findings could thus provide preliminary insights.

Secondly in relation to the research objective on employees' coping strategies towards ISR in developing economy firms, ten propositions were proffered suggesting some causal conditions, but no specific combinations. The analysis of the results as shown in Table 5.19 indicates that all three proposed conditions for a given coping strategy (LOR, self-interest and level of control), were found *fully* in the configurations for the coping strategies of Benefit Satisficing, Disturbance Handling and Exit, while two out of the three conditions (self-interest and level of control) were found *partially* in Benefit maximizing, and Self-Preservation.

Thirdly, there were some notable findings the first being that though the level of robotisation appraisals (LORH or LORC) were all present in the strategies as a whole, some individual

strategies did not consider them. The next notable finding related to employee’s appraisal of the level of robotisation (both high and complementary) as a threat (APT) and opportunity (APO) at *the same time*. This is a novel finding and was seen in the Disturbance Handling strategy. Lastly, for Benefit Satisficing, an opportunity appraisal (APO) was proposed as a factor, but it was absent and was rather substituted with a Threat appraisal. Table 5.20 shows the summary of the findings.

Generally the results showed the complexities of human behaviour and the need to employ as many alternative methods as possible to fully grasp the range of nuances, thereby justifying the use of configurational analysis in this study.

Table 5.20: Summary of Findings on Coping Strategies Conditions

Coping strategy	Finding	Comment on Research Propositions
Benefit Satisficing	The Appraisals of the presence of a High level of Robotisation (LORH), Threat (APT) moderated by a Low control (LC), were found to be sufficient and necessary conditions in influencing the choice of the Benefit Satisficing coping strategy	Fully Met
Disturbance Handling	Appraisals of the presence of High Level of robotisation (LORH) OR Complementary level of robotisation (LORC), Threat (APT) moderated by a High control (HC), were found to be sufficient and necessary conditions in influencing the selection of the Disturbance Handling coping strategy.	Fully Met
Exit	Appraisals of the presence of High Level of robotisation (LORH) OR Complementary level of robotisation LORC), Threat (APT) moderated by No	Fully Met

	control (NC) were found to be sufficient and necessary in influencing the selection of the Exit coping strategy.	
Benefit Maximizing	Appraisal of an Opportunity (APO) moderated by High control (HC) were sufficient and necessary in influencing the selection of the Benefit Maximizing coping strategy.	Partially met
Self-preservation	Appraisal of a Threat (APT) moderated by a Low control (LC) were sufficient and necessary in influencing the selection of the Self-preservation coping strategy.	Partially met
Additional notable Results	Level of robotisation (LORH & LORC), was expected to be present in ALL the strategies however, it was absent for Benefit maximizing and Self-preservation signifying that in certain cases, employees may not consider appraising the LOR as part of selecting a coping strategy	Not applicable
	Disturbance Handling , was expected to be selected for appraisals of an ISR as Threat only, however it was also selected for appraisals as both a Threat and Opportunity at the same time.	Not applicable
	Benefit Satisficing , was expected to be selected for appraisals of an Opportunity (APO) only, however it was rather selected for appraisals of a Threat (APT)	Not applicable

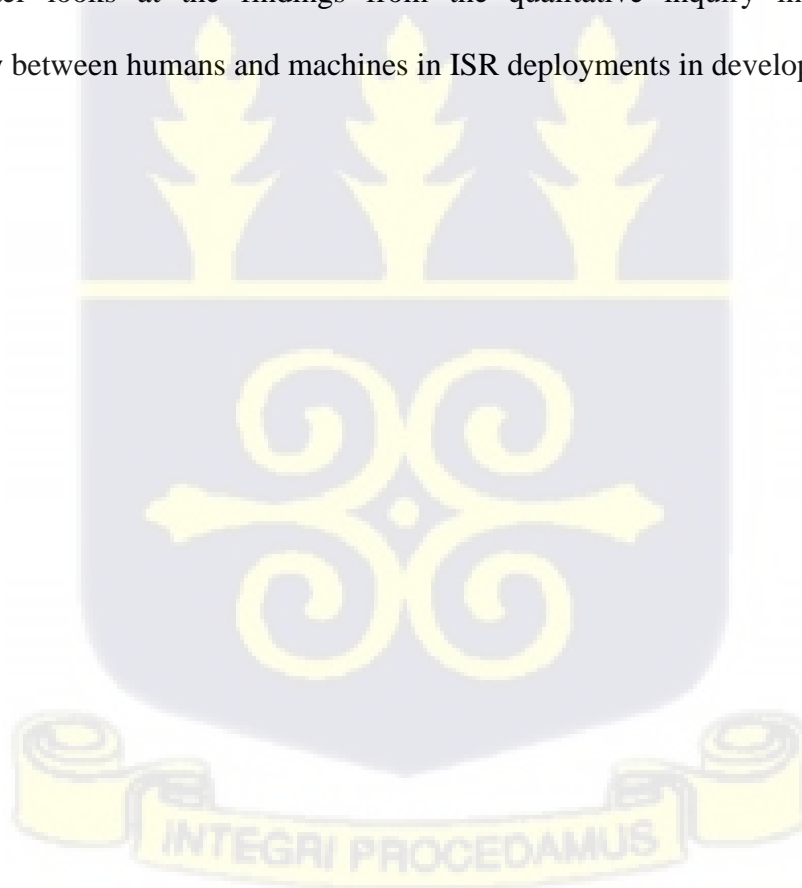
5.4. CHAPTER SUMMARY

This chapter discussed the findings on the quantitative inquiries and configurational analysis on conditions influencing ISR deployments and employees' coping strategies. The FSQCA procedure was outlined and thresholds for assessing the reliability of the findings were also provided.

From the analysis on ISR deployment, it emerged that the eight technological, environmental and organisational conditions examined, were all sufficient and necessary in influencing the decision to deploy ISR in developing economy firms. They were therefore useful in explaining the low ISR adoption rates in developing countries.

From the analysis on employees' coping strategies, it was found that, the level of robotisation (LOR), the level of control an employee has on their working conditions, their emotions and the robot, together with a potential for self-interest, were necessary and sufficient conditions for them to choose either an opportunity- or threat-related strategy

The next chapter looks at the findings from the qualitative inquiry into the nature of complementarity between humans and machines in ISR deployments in developing economies.



CHAPTER SIX

NATURE OF COMPLEMENTARY ISR IN DEVELOPING ECONOMY FIRMS

6.1. CHAPTER OVERVIEW

The previous chapter discussed the findings of the configurational analysis on the conditions influencing the decision to deploy ISR by developing economy firms, which is useful in explaining the reasons for the low ISR adoption rates in this region. It also discussed and provided insights on the conditions influencing employees' choice of coping strategies towards the introduction of ISR into their working environment.

This chapter follows up on that with a discussion of the findings on the qualitative inquiry to understand to understand how complementarity between machines and humans have been implemented in intelligent software robotisation in developing economy firms. This addresses research question 3 of the study.

Research Question 3: How is complementarity between humans and machines being implemented in intelligent software robotisation deployments in a developing economy firm?

6.2. CASE DESCRIPTIONS

This section provides a synopsis of the multiple case organisations investigated. The companies comprise 2 banks, 1 insurance company, 1 telecommunications company and a business process outsourcing company. To avoid profiling two banks with similar characteristics, it was decided to profile the banking industry instead since this provides background factors likely to influence both banks. Consequently, this approach was extended to the remaining companies and their industries

were also profiled. Table 6.1 gives a summary of the salient data on the companies, with extensive industry information provided in Appendix C.

Table 6.1: Summary Description of Case Companies

	Organisations	Industry	Services	Ownership	Assets (Ghc billions)	Robotised Processes	ISR Duration (Yrs)
1	PremBank	Banking	Universal Banking	Foreign	21.4	4	4
2	MulBank	Banking	Universal Banking	Foreign	24.6	4	4
3	IndInsure	Insurance	Non-Life insurance	Local	0.4	2	1
4	RadBPO	Outsourcing	Call-center	Foreign	N/A	2	1
5	PradTel	Telecoms	Mobile network	Foreign	13.0	5	3

6.3. INTERVIEWEES

Five (5) organisations out of nine (9) responded to the invitation to be interviewed and they came from banking (2), insurance (1), telecommunications (1) and business process outsourcing (BPO) (1) industries.

Table 6.2: Interviewees Roles and Experience

Case Company	Interviewees Roles	Years with company
PremBank	1/ PremBank-K: Head, Change, Solutions & Innovation	7-9
	2/ PremBank-D: Platform Engineer	
MulBank	3/ MulBank-G: Lead for Intelligent Automation	
IndInsure	4/ IndInsure-M: Head, IT	N/A
RadBPO	5/ RadBPO-P: Country Director	1.5 -8
	6/ RadBPO-A: Training & Quality Assurance Manager	
	7/ RadBPO-T: RPA Developer	
PradTel	8/ PradTel-M: Project Manager, Robotics and Automation	3 -20
	9/ PradTel-S: Manager, IT Quality Assurance & Performance	
	10/ PradTel-R: Project Coordinator, Robotics and Automation	
	11/ PradTel-E: Project Manager, AI Models Development	
	12/ PradTel-MA: Manager, Revenue Assurance & Fraud	
	13/ PradTel-D: Compliance Controller, Sale Intelligence	
	14/ PradTel-B: Quality Analyst	
Total Number of Interviewees = 14		

A total of 14 individuals from these 5 companies were interviewed in 12 sessions and a breakdown of their roles and experience are provided in Table 6.2. PremBank provided two interviewees (a Platform engineer and Innovations manager) who were involved in decision-making and implementation of the ISR initiative. In MulBank the Lead for Intelligence Automation who was involved in both decision-making and implementation was interviewed, likewise the insurance firm, IndInsure, which was represented by the IT Head. From the BPO firm, the Country Director, a decision-maker, together with an RPA Developer and Skill Development Manager who were

involved in the implementation, availed themselves to be interviewed. Finally, PradTel, the telecom company, which had comparatively larger ISR deployment teams involving several departments, provided seven persons from their IT, project management, quality assurance, sales intelligence, revenue assurance and AI model development functions. Their association with the robots included decision-making, implementation and utilisation as shown on the table. Years of experience with the various organisations spanned a period of 1.5 years to 20 years.

6.4. ISR DEPLOYMENT DECISION ELEMENTS

Motivations For ISR Deployment

In their study on organisational adoption of ISR tools such as RPA, Kaniadakis & Linturn (2022) list the expectations of senior management as including, cost savings, “do more with less” (efficiency), improved quality, employee reduction, employee redeployment, risk reduction and improved customer experience. Other studies have noted similar motivations, for instance, Madakam et al. (2022) on cost savings and Dey & Das (2019) on headcount reduction. Furthermore, other significant motivations are process optimization (Plattfaut, 2019) and freeing employees from mundane tasks to enable them pursue more interesting work (Kokina & Blanchette, 2019; Lacity et al. 2021).

The analytical approach here was guided by Miles & Huberman (1994). Hence the data was condensed (paraphrased, coded and themes extracted), followed by display (Table 6.3) conclusion and reporting. Data condensation (coding and theme extraction) was deductive, guided by the literature on RPA deployment motivations, earlier mentioned. VERBATIMS OR QUOTES NOT SHOWN HERE CAN BE FOUND IN APPENDIX D.

IndInsure-M: Instead of using more analyzer's to do that we thought it would be faster and cheaper if we implemented the RPA.

PradTel-MA: From our side, the reason why we decided to go in for the RPA is to reduce man hours that are spent in doing the review. Secondly, to expand the number of validations as in the number of bills that can be validated in a month. And also to have the accuracy. These are the three reasons why we went in for the RPA.

RadBPO: BOT has been implemented for our call center agents to help them do accurate resolutions for Customer solutions

IndInsure-M: The motivation was simply to automate certain routine tasks that we think can be done easily using the BOTS and more efficiently and quickly.

From the analysis, the reason given for adopting ISR by developing economy firms is generally for process improvement to achieve process accuracy, speed, less headcount, better productivity as well as cost savings.

Table 6.3: Analysis of Deployment Motivations

Source	Paraphrased quotes	Deductive Codes	Theme
IndInsure	less headcount, cheaper, faster	efficient production	process improvement gains
PradTel	less man hours, expand the number of validations, accuracy	efficient production	
		high quality production	
RadBPO	accurate resolutions	high quality production	

Finding 1: ISR deployment in developing economy firms, is motivated by the need for process improvement to achieve efficient production (more productivity at less cost and time) and high quality output.

Awareness of ISR

Technology awareness in general as an important factor of adoption has been noted by a number of studies such as, Sunder et al. (2023) and Lukito et al. (2022). Specifically, the role of senior management’s technology awareness in adoption, has also been mentioned for instance by Kaniadakis & Linturn (2022), Yang et al (2021) and Calitz et al. (2017). Kaniadakis & Linturn

(2022) provide insights on the introduction of RPA into an organisation by senior management and their subsequent influential role in implementation. Yang et al. (2021) found in their study (in a global accounting setting) that, resistance to the adoption of RPA came more from senior management than junior level staff and this was mainly due to a lack of AI literacy and awareness of the benefits of these technologies. Calitz et al (2017) who investigated the adoption of robots in South Africa, also mention that the problem senior management of companies in Africa face, is knowing about available technology on the market and the competitive advantages and benefits they offer to their companies. This they assert has affected the adoption of new technologies on the continent.

Table 6.4 provides a visual display of the analysis from the responses, still following Mile & Huberman (1994) as previously outlined. Coding and theme extraction was open and inductive, guided mainly by the content of the responses.

PremBank-D: The good thing is that we have a board member that I mean is very much incline with this. I mean he has a lot of insight when it comes to implementation and how it will help the organization goal. When he assumed his role as board member, he actually tasked that more Investment should go into AIs / robotics.

The analysis reveals that some of the means through knowledge about ISR was introduced into developing economy firms to initiate steps towards deployment, were through internal channels, namely referrals and exploration by both senior and junior staff. This is in contrast to external awareness channels such as marketing adverts and promotions. It is also worth noting that in the instance where ISR was discovered through exploration, it was remarked that ISR had not been contemplated as part of company strategy prior to its introduction. It must also be added this finding is for two out of the five companies interviewed. The remaining three did not mention their

awareness channels, hence it is possible their experience is different from the findings. (See Appendix D for the other quotes).

Table 6.4: Analysis of Awareness of ISR technology

Source	Paraphrased quotes	Inductive Codes	Themes
PremBank	a board member mentioned it	senior staff	internal channel
		referral	
PremBank	a guy from the department mentioned it	Junior staff	
		referral	
MulBank	we went to dig around and showed the used cases	both senior & junior	
		exploration	

Finding 2: Some of the means by which developing economy firms became aware of ISR technology were internal, through referrals by both senior and junior staff as well as, exploration.

Top Management Support

Top management support is said to be among the often cited and important technology adoption factors (Jaegar et al., 2020; Kumar et al., 2017) and it is exhibited in several ways such as, helping in establishing a vision and strategy for supporting the implementation in various ways (Kaniadakis & Linturn, 2022; Ferro & Martins, 2019; Chua et al., 2019).

Little thematic analysis was required here since the relevant responses pointing to top management support were quite clearly expressed.

Hence some of the companies indicated that their ISR initiatives enjoyed support at the highest level of management, that is, at the board and strategic level.

PremBank-D: So robotic process automation (RPA) is something that is driven at the board level right? For our company being driven at the board level means that there's more visibility when it comes to implementation.

Finding 3: ISR initiatives in developing economy firms enjoy top management support

Regulatory regime

It emerged that apart from general regulations on data and privacy protection, there were no regulations, specifically governing the implementation of intelligent-based technologies, though they were planned. This came up for the banking industry.

The reasons given for the absence of regulations are quite informative, that is, categorisation of ISR as a low level, auxiliary and enhancement activity (process improvement) not warranting attention for now; the nascency of ISR and hence a wait-and-see attitude; and the existence of self-regulation mechanisms at the industry and enterprise levels. The absence of regulations as an encouragement for ISR adoption has been discussed in the literature, noting that data protection laws could make it difficult to obtain data to train AI models (Pumplun et al., 2019; Alsheibani et al., 2020; Radhakrishnan et al., 2022).

The themes were explicitly expressed, requiring no coding and theme extraction in respect of the objectives of the study.

PremBank-D: When we talk about RPA we are looking at, for the industry I work with, that's the banking industry has its regulator as the Bank of Ghana, and they have not drawn any set of regulations when it comes to that right, but there are other regulations like privacy but there is nothing specific when it comes to AI and that. For that industry wise and from a company perspective, we already have policies. In doing these implementations we follow those policies. We might have regulations for processing or cloud, but there's nothing specific for AI & RPA. This is because I run the cloud project for my bank, for cloud every implementation the regulator has to know everything from start to finish, and then they will give you approval before the application goes live but for

this RPA that we have deployed, the regulator was not... because it's more like adding some kind of intelligence or accuracy or I mean process improvement exactly. I know BOG does personal engagements, and for them, they think it is too young to intervene. They also think that at the industry and enterprise level, there are local controls that would take care of the teething issues that will come up but I know that's work being done from that point.

Finding 4: Currently, there are no regulations specifically governing the implementation of ISR, at least in the banking industry of some developing economies, though regulations are planned.

Finding 5: Some of the reasons given for the absence of regulations include: categorisation of ISR as an auxiliary & enhancement activity; ISR as an immature field not yet ready for regulation and the existence of self-regulation mechanisms at the industry and enterprise levels.

6.5. ROBOT PROFILE

Generally in most of the companies, there was a diverse mix of robotisation tools in use for ISR, comprising RPA, AI and other algorithmic tools. Most of them were proprietary, with one instance of in-house developed or homegrown robots. The focus of this study was on RPA enhanced with AI features. This section discusses the age and some characteristics of robots, specifically their level of intelligence and anthropomorphic features.

Age

The range of years for which the robots had been deployed in the companies interviewed, was from 1 to 4 years. (See Appendix D for quotes).

Level of Robot Intelligence

According to Huang & Rust (2018), there are four levels of machine intelligence based on learning and adaptability, namely mechanical (rules-based), analytic, intuitive and empathetic intelligence, with the highest being empathetic, as explained in detail in Chapter Two.

The analytic procedure was still Miles & Hubermann (1994), with a deductive approach to coding and theme extraction guided by the literature mainly, Hung & Rust (2018). This is shown in Table 6.5 Also critical realism retrodution was used to understand the reason behind the choice of implementing mechanical intelligence in the ISR deployments.

PradTel-S: Remember it's a new journey for us as well, so at least you must start from... you don't skip 0 to 9 and start counting from 11 as I heard someone say recently. So it's a new journey for us so we are basically doing the rule based...for the moment. Interviewer: But are there plans to move to AI or add some intelligent features or functionalities? PradTel-S: Definitely depending on our maturity curves, if we lay the foundation and become more prolific and mature with it then we can go to the next stage, which is to inject some kind of machine learning to be able to derive more benefits from it.

PremBank-D: OK so ours is currently rules-based...the AI part hasn't been incorporated yet. What I mean is that we are looking at fully automating the account opening process right? We are looking at picture recognition, taking advantage of that. I will say that these features are currently in development.

MulBank-G: So we played a lot with RPAs; we have done over 50 applications so now our focus is trying to get AI, the machine learning part, which is why my role is called Intelligent Automation, not just automation and intelligent automation means machine learning, AI.

IndInsure-M: They are simply a rules-based. Yes, with time we will make them intelligent but because we are at the beginning of this RPA journey, we have a lot of things that we actually want to automate. So I am sure that when we get to the level where we are done with most of them, then we can bring in the intelligence so that it will learn and be able to help the users who want to use the system efficiently.

RadBPO-P: For us it's just a rules-based as of right now. Since our technology is integrated with our client's technology, there is a lot of risk of data confidentiality, data leakages, IT security concerns. So AI will have to be the next step, once the clients have some confidence in their system...and proper security is being implemented. It has to go hand-in-hand. While I say this, AI can also be implemented; we are ready with it but it is

more from the adaptation of our clients who should also be ready to have an AI access their systems and take the data, information from their application servers.

Table 6.5: Analysis of Level of robot Intelligence

Source	Paraphrased quotes	Deductive Codes	Theme
PradTel	we are doing the rules-based; if we become more prolific and mature, we shall inject machine learning	(a) rules-based; (b) ML planned;	mechanical intelligence
PremBank	ours is currently rules-based, the AI part is currently in development.		
MulBank	we have done 50 [rules-based] RPA, now our focus is trying to get AI, the machine learning part		
IndInsure	They are simply rules- based; with time we will make them intelligent		
RadBPO	For us it's just rules-based as of right now, so AI will have to be the next step; depends on confidence in system security and readiness of client's systems		

Apart from stating the choice of rules-based or mechanical intelligence, most respondents also provided some information for the reason for this choice. The information is varied and not uniform, hence it needed to be analysed to extract commonalities. The critical realism retroduction approach of identifying structures and mechanisms was used here to assist with the explanations. Since most of the initiatives were at the infant stages, the approach to intelligence was a phased one, articulated aptly with the “journey” metaphor by some respondents. Thus most companies had begun with rules-based RPA, with the AI or learning enhancements at the development or

planning stages. From Huang & Rust's (2018) RPA categorisations, ISR in most companies were currently at the level of "mechanical intelligence", where robots had been assigned mainly routine and repetitive tasks, requiring minimal adaptability.

An element of caution was detected in the responses. For instance, an IT Quality Assurance Manager of PradTel, mentioned the need to build confidence in the company's skills and experience (to a matured level) in handling an environment with intelligent robots. Also for the Country Director of RadBPO, which offers call center services, there was caution in relation to security concerns and systems compatibility, where there are intra-organisation integrations. In their case, the BPO's systems needed to talk to those of its client organisations and there was the need for confidence in the security and compatibility of both organisations' systems.

From the CR retrodution, a number of structures and mechanisms emerged. Firstly, client relationship structures, especially provider-client systems integration *structures*, have generated security concerns accompanied by caution as *mechanisms*, in the choice of mechanical intelligence with planned advance learning as a strategy (event being explained by CR retrodution). Secondly, unavailability of organisational skills (structures) and hence the lack of skills maturity, has also generated caution (mechanism) in implementing advanced learning capabilities (event).

There is a gap in the literature identified by Kokina & Blanchette (2019), on the dynamics surrounding how companies transition between the various levels of intelligent robotisation, prompting a call for detailed research into that. However, from the above responses, it would appear that the transition is motivated by the desire to go one step at a time, based on caution.

Finding 6: The level of intelligence is being implemented with a phased approached starting with mechanical intelligence (rules-based features) and moving towards enhancement with

advanced learning capabilities, due to some concerns such as those related to security and skills availability. Caution is therefore a mechanism in determining the level of intelligence.

Anthropomorphism

Anthropomorphism is, a tendency to attribute human-like traits, such as names and gender to non-human objects (Bao et al., 2022; Mazurova, 2019). Quite a lot of research has been conducted on anthropomorphism in front-end, customer-facing software robots such as, chatbots (e.g. Bao et al., 2022; Wagner et al., 2019). However there is inadequate material on anthropomorphism in back-end software robots such as, RPA as indicated by the very few studies which have examined the subject, namely Waizenegger & Techatassanasoontorn (2020) on RPA and Seiffer et al. (2022) on software robots in general including RPA. Both studies found a positive influence of anthropomorphism on interactions with software robots in general and RPA in particular.

Once again, the responses regarding anthropomorphism were clearly articulated thereby requiring little thematic analysis. However the critical realist analytical approach was employed to unearth assumed (not directly observable) explanations for part of the results (Boateng, 2020). This was in relation to the reasons for the low-level interactivity in back-end software robots.

Of the four anthropomorphic features examined in this study (names, gender, look/avatar and interactivity) only one company indicated assigning names and avatars to their robots, though temporarily.

MulBank-G: In terms of humanlike characteristics, we sometimes name our bots in beginning stages and give them avatars. We used to give them funny names because it was exciting and it was our way of marketing; names like R7 robots. But now the organization knows it, so we don't do that anymore but we usually name them by function like the marketing bot.

This observation is somehow in line with the findings of Waizenegger & Techatassanasoontorn (2020) who reported that their respondents treated their RPA robots anthropomorphically and hence regarded the robots as teammates and referred to them as being sick (presumably when they have challenges).

However, generally, most of the robots deployed in the other four companies who participated in this study, had no names, gender or avatars for their robots. The response below is representative and indicative:

PradTel-B: Currently the robots we use don't have human names; they don't look human. They perform the functions of humans, they only look like humans in terms of intelligence but not a physical look.

In relation to the fourth feature, interactivity, it was reported to be present and was described variously:

PradTel-D: Sure, for instance when you are supposed to dump the data in a particular link at a certain period, if it is not there it gives you feedback that there's nothing for it to work on, so it requires you to feed it.

PradTel-MA: They are very interactive. For instance, if the robot can't find a particular rate in a tariff book but that same rate was applied in the bill, the robot will tell you that they cannot find it. It would highlight and underline it in the same bill, telling you that for this particular bill, they are unable to validate it for various reasons.

There were a few instances where the robots communicated their results to customers directly through notifications (loan processing and commissions) and issuance of receipts (underwriting) (see Table 6.6). But by and large, the operations of the robots were mainly in the back-end, “behind the scenes”, with low levels of engagements.

Finding 7: Anthropomorphism in back-end software robots in developing economy firms, was limited to low-level interactivity, discarding names, gender and avatars.

Respondents who had reported limited interactivity in their robots, could not offer any reasons for the omission of names, gender and personality traits from the robots. In analysing the possible reasons for this, two observations were made. Firstly, it was observed that the RPA robots examined are mainly employed at the back-end and are more or less invisible or “behind the scenes”, with no direct, dedicated conversations or dialogues with customers and users, as it happens with chatbots. They do, however, engage frequently by providing feedback on their work and communicating their results, as indicated in the previous section on interactivity. But most of these engagements are mostly through notifications and alerts and are not extensive in time and volume.

Secondly a check revealed that all the companies interviewed had some experience with *customer-facing chatbots with various levels of anthropomorphic features*, deployed on various channels. PremBank has a chatbot on their website and via WhatsApp; MulBank has it via their app; IndInsure’s is via their website; that of PradTel can be accessed via their website, app and social media channels such as, WhatsApp, Facebook etc. RadBPO are chatbot developers themselves. Consequently, there is a high likelihood of a familiarity with the role of anthropomorphic features in software robots among the companies’ robot developers. For them to have adopted anthropomorphism in the customer-facing robots (chatbots) and left it out of the non-customer facing robots also probably indicates an appreciation of the importance of anthropomorphism in encouraging interactions with the robots (Waizenegger & Techatassanasoontorn, 2020; Seiffer et al., 2020). While chatbot usage is voluntary on the part of customers, thereby requiring encouragement via anthropomorphic cues, RPA in the companies interviewed is woven into required business processes, thereby making its usage usually “obligatory” for employees and therefore requiring little or no encouragement. Furthermore customers’ engagements with chatbots

are much more extensive in time and volume than those with the back-end software robots, thereby requiring some motivation (in the form of anthropomorphic cues such as, a friendly personality, a preferred gender and so on) to sustain the interaction. Thus, the level of engagement (duration and volume) and usage requirement (mandatory or voluntary) of a software robot could be elements in the determination of assigning anthropomorphic features to the robots. This could probably account for the limited use of anthropomorphism in RPA robots by the companies interviewed. This requires further empirical investigation.

From the above analysis, the back-end role and functions of the robots (structures) could have contributed to the limited level of direct engagement with customers & users as well as an “obligatory” usage requirement (mechanisms) which in turn may have led to the decision to have limited anthropomorphic traits in the robots, since there was little need for “encouragement” for users.

Finding 8: The limited anthropomorphic features of back-end software robots in developing economy firms could probably be attributed to the mechanisms of their low level of direct engagement with customers & users (duration & volume) and their “obligatory” usage requirement.

6.6. AREAS OF ROBOT DEPLOYMENT AND ROLES

This section describes the various areas of their businesses in which companies had deployed the ISR robots and the functions assigned to them.

Miles and Huberman (1994) was used to analyse the robots’ assigned functions to appropriately categorize them. The coding was guided by the literature on robot task allocation, particularly the

work of Asatiani et al. (2019) which was part of the theoretical foundations of this study. Also very useful was Parasuraman's (2000) four-stage model of human information processing as applied to robot functions, namely information acquisition, information analysis, decision and action. The results of the analysis are shown in Table 6.6.

Business Sections

Among the five companies interviewed, the robots were deployed in the following areas/sections/departments of their businesses: Customer services, IT Service desk, Finance, Card operations, Investor Service, Credit, Revenue assurance & Fraud, Call Center, Accounting, Mobile Money, Sales & Distribution, IT Quality Assurance, Marketing and Network.

Functions

As noted in the previous section, the general functions assigned to robots mainly comprised back-end functions, namely, data capturing/acquisition, processing & analysis, application navigation and low level decision-making, while for the front-end, they were assigned limited communication with customers.

In respect of specific business functions, the robots were engaged in loan processing; account opening & closure, Visa reconciliations; Banking Hall & Teller operations reconciliations, ATM transactions reconciliations; Airtime top ups reconciliations; prevention of revenue leakages; financial reporting; customer support (call center); underwriting (policy processing & management); expense approval processing; calculations & validations of sales commissions & postpaid bills; quality assurance of deployed technologies; email responses and routing for IT service desk and self-service requests (e.g. password reset). Of these functions, detailed

information was provided on ten to allow detailed analysis shown in Table 6.6. The detailed quotes on the ten functions are provided in Appendix D.

Table 6.6: Analysis of robot Functions

Source	Activity	Paraphrased quotes	Deductive Codes	Theme
PremBank	Visa reconciliations	the robot picks up an internal Excel file of customer Visa transactions, compares with data from the Visa company	data acquisition & analysis	back-end
IndInsure	Underwriting	the robot pushes all policies issued by agents from a frontline application into a legacy system, does two daily batch runs and issues receipts to agents	data acquisition, analysis & communication with customers	back-end; front-end
PradTel	Bill validation	the robot picks latest tariff book, compares approved tariffs with billing for customer transactions	data acquisition & analysis	back-end
PradTel	IT quality checks	the robot mimics human navigations through various systems to check functioning and output	application navigation	back-end
PremBank	loan processing	the robot extracts data from scanned loan application forms, validates infor, approves, rejects or <i>refers to next level</i> ; if approved, credits customers and gives notification	data acquisition & analysis, low level decision-making & action execution; communication with users;	back-end; front-end
PremBank	account opening	the robot extracts data from scanned forms submitted, validates infor submitted (e.g.	data acquisition & analysis	back-end

		ID details), pushes data into standby database		
IndInsure	expense request approval	the robot picks submitted request form, sends it to all approvers and follows up till approved	data acquisition & analysis,	back-end
MulBank	airtime top-up reconciliations	the robot downloads data from aggregator's portal on airtime dispensed, reconciles with internal data and prepares a report	data acquisition & analysis	back-end
RadBPO	call center agent interactions with customers	the robot navigates various applications to extract data for staff and also performs calculations	application navigation, data acquisition & analysis,	back-end
PradTel	sales commissions validations	the robot calculates vendors' commissions and send them a weekly report	data analysis & communication with customers	back-end; front-end

Finding 9: ISR robots deployed in developing economy firms are mainly assigned to back-end processes with limited frontend functions

6.7. NATURE OF COMPLEMENTARITY

Level of Robotisation (LOR)

The level of robot control over various assigned tasks was diverse in the various companies, usually ranging between high and complementary LOR. Of the ten processes examined in detail, four had a high LOR with the remaining six being complementary (see Table 6.7).

Responses were quite clearly articulated in the light of the definitions of the various levels of robotisation provided in Chapter Four, hence little thematic analysis was required to extract the results. However, in finding explanations for the choices of the LOR, a critical realism-based analytical approach was used to identify relevant mechanisms contributing to the phenomenon (Boateng, 2020).

High LOR

For some tasks such as, Visa reconciliations, IT quality checks and bill validation and underwriting, the robots had a high level of control (see Appendix D for other verbatims)

PremBank-D: When it comes to the Visa reconciliation, I would want to use very high level because it doesn't require any human intervention. The robot picks up the excel file, does the reconciliation and then shares the results with the Visa officer, that is, the card operations officer and then that's it. That process is highly automated.

Given that a high LOR involves minimal human intervention, in the literature, it is the face of automation and hence usually associated with employee anxieties about their employment security (Schwabbe & Castellaci, 2020; Nam, 2019; Dahlin, 2019; Acemoglu & Restrepo, 2017). In this study however, a high LOR was not widespread enough to cause employment anxiety as it was restricted to a few processes in each company. This is corroborated by the findings under Employee security below, reporting no layoffs, though one company had to address employees' fear of job loss. Such anxieties could possibly occur more frequently in the future as most of the companies aspire to a High LOR in the future, another finding of this study. Overreliance and deskilling, are further outcomes of a High LOR (Endsley, 2018 & 2017; Onnasch et al., 2014)

Complementary LOR

Majority of the robotised processes had a complementary LOR as remarked by one of the project managers.

PradTel-M: So, a lot of these processes that we have here are such that it is not fully autonomous. At some point the robot does the activities to a point and then the users involved carry it over. This is because the robots that have been deployed may vary a little but generally there's a human dependency. For some of the processes the robot needs to wait for approval before it can continue with the work it is supposed to do. And for some of them as well, the robots send an output to a user to validate before continuing. So there are a few human dependencies, but it is not such that the bot doesn't carry out its own assigned task. These are unattended robots, so they are scheduled and they execute the tasks that are assigned to them. The only reason why they wouldn't be able to complete to the end is because there is a human dependency, which may come in the form of review or approval.

Specifically, complementarity was reported for activities such as, call center (customer) support, commission calculations & communication, account opening and loan processing and airtime top-up reconciliation. (See Appendix for other verbatims).

RadBPO-A: Firstly, to do with the interface, the current solution we have is a blended interface, which has the agent interacting with the customer as long as it has to do with logical decision making, then the bots comes in. And the bots does those steps and in the flow of that interaction, the bots takes over and does certain checks with 100 percent accuracy check and speed of answering. It throws those information as the results, then again the agent takes over from there, this is the kind of solution we currently operate with, we don't have end to end solution.

The above analysis, led to the following finding:

Finding 10: The LOR in developing economy firms are a mixture of high LOR and complementary LOR, with the majority being complementary

The aspiration for companies in respect of the level of robotisation, is to achieve a High LOR, that is, achieving fully automated processes with little human intervention.

PremBank-D: There is an ideal situation that we are looking at, where human intervention would be in exceptional cases but.. Interviewer: you haven't gotten there yet. PremBank-D: At all! we have not, I used that as my benchmark for what I said as low...

So why are the companies using or adopting a complementary LOR, if they are aspiring to more High LOR? The responses for LOR were analysed once again this time with a critical realist lens, with the aim of identifying relevant structures and mechanisms from the verbatims below to help offer an explanation.

PradTel-M: The human intervention still has to be there because we're dealing with money. We don't have that level of confidence yet because they are a bit skeptical about handling money. That is for the sales and digital.

PradTel-S: Obviously because of the maturity level. If after a year or two we notice that the task being performed by the bot has always been 100 percent, perhaps we'll shift to a mode that whatever the bot does we will accept it and move to the next process. For now we still have the human intervention.

MulBank-G: [on airtime top-up reconciliations] We study a bot and its behaviour to see how it picks up exceptions. Once you let it learn all the exceptions then you can trust it to do the settlement. So, there is a period where you let a human intervene then they [the robots] will be picking up. Once it gets high enough and it is trusted, then you can allow it to handle the other processes.

From the analysis, it emerged that the organisational imperatives related to performance, that is, performance policies or requirements for instance in relation to finance (structures), have generated caution about confidence and trust in the robots (mechanisms) which in turn has led to the event or phenomenon of having mixed LOR though the aspiration is more High LOR.

Hence an important insight is the fact that for most companies, complementarity is a phase in the march towards full robotisation. Consequently, complementarity is motivated by caution, especially the need to build confidence and trust in the performance of the robots.

These reported motivations for complementarity is contrary to the recommendations of Asatiani et al. (2019), which advocates for complementarity on the basis of job preservation and prevention of the loss of skills.

Finding 11: In designing the level of robotisation, the long-term aspiration of most developing economy firms is to achieve full high LOR in their ISR initiatives, however they have implemented complementary LOR as a phase and cautionary measure towards that aspiration. Caution is therefore a mechanism in determining the level of robotisation.

Human-Machine Task Allocation

The current literature hold the view that software robots such as, RPA are suited for mundane, routine and repetitive tasks while humans are best at creativity and judgment (Hassan, 2022; Asatiani et al., 2019; World Economic Forum, 2020).

The responses were analysed with Miles & Hubermann (1994). The coding and theme extraction was guided by Parasuraman (2000) and significantly by Asatiani et al. (2019), whose work on human-machine task allocation in robotisation provide some task categorisations such as, mindless tasks (routine and repetitive), epistemic tasks (data analysis, information processing), pragmatic tasks (decision-making & execution) and mindful tasks (creative, out-of-the box thinking)

Table 6.7 shows the activities examined and the specific task allocation between humans and machines, incorporating themes derived from the analysis of the quotes, samples of which are provided below.

Generally, in line with current thinking (e.g. Zhou et al., 2021) and recommendations (Asatiani et al., 2019), most of the robots for the companies interviewed, were assigned mundane, routine, repetitive, high volume task.

PradTel-M: Some of these processes are also redundant and or irrelevant. You end up using maybe ten days to fifteen days to complete these tasks that don't grow you as a person or don't really contribute to promoting, increasing our net promoter score in any way, so essentially, redundant, mundane, repetitive and high volume tasks. We acknowledged the need to optimize these processes, streamline them and then automate.

Specifically, the robots were engaged in data processing & analysis, navigation of applications, some low-level decision making and communication of their output to the ultimate beneficiary, the customers. The humans on the other hand were mainly assigned the tasks of reviews, approvals, execution of actions and communications with customers. See Appendix D for verbatims on the following processes: Visa reconciliations, underwriting, bill validation, IT quality checks, loan processing, account opening, expense request approval, airtime top-up reconciliations, call center agent interactions with customers and sales commissions validations.

Table 6.7: Analysis of Human-Machine Task Allocation

LOR	Activity	Robots	Humans	Categorization
General	ALL	Routine, repetitive, mundane, high-volume	N/A	Mindless (robots)
High	Visa reconciliations	data acquisition & analysis	N/A	Epistemic (robots)
	underwriting	Data acquisition, analysis &	N/A	Epistemic (robots)

		communication with customers		
	Bill validation	data acquisition, analysis	N/A	Epistemic (robots)
	IT quality checks	application navigation	N/A	Epistemic (robots)
Complementary	loan processing	data acquisition, analysis, low level decision-making, communication with customers;	approval	Epistemic (robots); Pragmatic (humans);
	account opening	data acquisition & analysis,	approval and communication to customers	Epistemic & pragmatic (robots); Pragmatic (humans)
	expense request approval	data acquisition & analysis,	approval	Epistemic (robots); Pragmatic (humans);
	airtime top-up reconciliations	Data acquisition & analysis	execution	Epistemic (robots); Pragmatic (humans);
	call center agent interactions with customers	application navigation, data acquisition & analysis,	decision-making	Epistemic (robots); Pragmatic (humans);
	sales commissions validations	data analysis & communication with customers	approval	Epistemic (robots); Pragmatic (humans);

Source: Author

Finding 12: In developing economy ISR initiatives, epistemic and mindless tasks were allocated to robots while humans were assigned the pragmatic tasks.

6.8. IMPACT OF ISR AND ROBOT GOVERNANCE

The beneficial impact of ISR is among the motivations for adopting ISR and the literature outlines a number of these benefits (Chugh et al., 2022; da Silva Costa et al., 2022; Kokina & Blanchette, 2019). This section discusses the observed changes which the various ISR initiatives have had on various facets of the implementing organizations' operations.

Little thematic analysis was required here because questions for this section were structured questions based on specific themes derived from the literature on the benefits of RPA. Hence the responses were in line with those themes, namely, completion times, accuracy or error reduction, productivity, cost-savings, employment security and deskilling. However, nuances and other insights from the responses are also discussed.

Completion Times

All the companies reported an improvement in the completion and delivery times of the robotised processes, with some providing quantifiable data. For instance, for call center staff interactions with customers, navigation through applications had improved ten times faster. Also bill validations, had improved from 100 validations in a day (24hours) to 100 in 2-3 hours; sales agent commission payment was now done monthly compared to quarterly.

RadBPO-T: Then speed wise, that is where I was talking about, the UI is much faster than the agent will do. When I assess, it is about ten times faster than an agent to do the interaction, but with the API calls, it's about three times faster than the UI automation.

PradTel-D: I said initially that we used to pay on a quarterly basis, but with the robot coming in we do it on a monthly basis.

Accuracy (or Error Reduction)

Most of the companies also reported improvements in accuracy and error reductions, sometimes up to 99% or 100% accuracy generally for the robot's activities. Again the sample responses here are the quantifiable or tangible ones.

PremBank-D: If you talk about accuracy, we are looking at 99% activities of the RPA

MulBank-G: So when you have a bot that is trained, there is zero chance of error. So it's 100 percent for our bots in that regard.

Productivity

Quantifiable and tangible impact for the robotised processes included, an increment in bill validations from 10 by humans to over 100 by robots per month and proactive refunds in Visa reconciliations and freeing up time for more critical work.

PradTel-MA: Also at first the maximum we could do was just ten validations but with the robot it can do as much as a hundred and even more.

PradTel-MA: This has even given the staff ample time to attend to other critical issues because you should know that it is not only the bill reviews that is the only control that we do in RA [Revenue Assurance], we have over thousands of controls which are equally high risk. Team members have time to attend to those areas too, rather than always sticking to bill review.

Cost Savings

The impact on cost savings came in various forms related to labour, such as, employment reduction, saved salaries & overtime payments, reduction in average hourly labour cost of robots compared to humans. Also identified in relation to cost savings was prevention of revenue loss

from underbilling, Some companies however indicated that it was early days yet to determine if cost savings had been made, since time was required to cover initial acquisition costs or to address issues of fluctuating costs and scaling.

MulBank-G: Yes, there is cost savings. One of the first use cases we did, there was going to be a process where they needed to have about 13 contract staff to do a particular process but when we demonstrated that a bot could do it, they didn't employ [all those thirteen] so there was cost saving;.. the bot doesn't mind the volumes, right? So there's cost savings if the volumes of the process increases, if there was no RPA you will have to employ more people but now we don't need to.

PradTel-MA: Another thing is with the staff you have to pay overtime aside their salaries but we don't with the robot because it's something you've already paid for.

PremBank-K: Initial cost to acquire (CTA) was higher, mainly on license costs; breakeven after 3 years.

Finding 13: The implementation of IRS in developing economy firms has generally led to improvements in completion times, accuracy, productivity and cost savings.

The impacts discussed so far are in line with the literature on the benefits of RPA in general (Chugh et al., 2022; da Silva Costa et al., 2022; Kokina & Blanchette, 2019). However there were also some “unanticipated” benefits as similarly reported by Vitharanage et al. (2020). For instance, it was reported that ISR had freed staff from weekend work and also reduced opportunities for staff bill fraud activities.

PradTel-MA: Prior to this members had to go to the office on weekends because sometimes the month ends on a weekend therefore the team had to converge at the office and do the validation but once the robot is there, there's no need for anyone to be there.

PradTel-MA: I was also having this school of thought that maybe if a staff knows of a customer, the staff can just tweak that customer's bill so that the customer wouldn't pay that much. But the robots don't know anyone, so it will just go according to what is in the tariff master. Secondly if I was to be doing the validation I'll intentionally pick the bill of a friend, a company that I know. Even though we are underpaying [undercharging] them, I'll still say everything is fine. And no one will check it because RA has validated it. IT will

just go ahead and print but with the robotics you cannot tell the robot that when it gets to this person and the rates are wrong, you still go ahead or if they were undercharged, you still go ahead; it will still flag it because everything is configured in the system, not by RA but by the project team.

Finding 14: Apart from expected benefits, ~~HR~~ ISR deployments in developing economy firms also turned up “unanticipated benefits”, including freeing staff from weekend work and reduced opportunities for fraud.

Employment Security

All the companies reported no layoffs as a result of introducing the robots. Rather, as a result of changes in manpower requirements, staff were either moved to other departments where they were needed or they were given different roles in their current departments.

PremBank-D: OK so they have been rather reassigned to other departments who need the manpower. So basically for these three areas that we talked about that is what has happened. There hasn't been any layoffs and we are not looking at laying off but rather retooling them, upskilling them to do other things.

MulBank-G: We don't do layoffs, rather reassign. Some people are skeptical around RPA, but it's not here to take away your jobs. Its here to assist you to help you grow so whenever we improve a process, we allow you to be able to join either another team or buy you more time to do your other core jobs very well or properly. So there have never been any layoffs because of RPA

RadBPO-P: For us RPA has helped us to redefine our agents to learn more, to do more learning and development with them, to use them into successor planning in terms of the next leaders or help in doing quality audits or certain other projects, ... no layoffs and it does not help us reduce hiring or freeze, because those are completely different; that has never been the objective.

Recruitment freeze is the non-employment of additional staff for existing processes due to increasing workload. While some respondents such as, RadBPO-P noted that this was not an

objective for his company (see quote above), other companies reported instances of recruitment freeze.

PradTel-B: You start a section with three people and after two years maybe then the people that do that work, the increasing work should have been maybe 10 people but because you have robots the headcount is the same.

MulBank-G: The bot doesn't mind the volumes, right? So there's cost savings if the volumes of the process increases, if there was no RPA you will have to employ more people but now we don't need to.

Finding 15: In developing economy firms, ISR initiatives have not resulted in employee layoffs, rather there have been redeployments and recruitment freezes.

However in one of the few cases where RPA usage was not obligatory at the early stages of implementation, there was reported anxiety among staff about their job security and the fears were serious enough to warrant management's intervention.

RadBPO-A: To answer your second question with the level of apprehensions that come. Yes at the time of implementation this surfaced. Although we deployed that, we did not have the optimum usage because some agents might have heard that the machine might take over. Then there was this reassurance that had to go to the floor. There was some orientation done for all the agents. We made them understand that there is one aspect which the machine will never have, which is compassion and that can only be within the human, so your jobs are secured, this is to ensure that your life is easy so that the level of error can be reduced and also to do with this, speed of answering is more. So that assurance went out and with time they understood this. So they have now imbibed the solution and they are using it.

Finding 16: In developing economy firms, some ISR initiatives have created employee fears about job loss.

Deskilling

Among the adverse impacts of automation in general, especially higher levels with minimal human intervention, is the possibility of overreliance which could in turn lead to deskilling, which is the loss of human skills in relation to the automated activity, according to the Theory of Technology Dominance (Arnold & Sutton, 1998; Sutton et al., 2023). Technology dominance or overreliance therefore precedes deskilling and this take place over a long period of time.

Observations on occurrence

The range of years of ISR implementations in the companies interviewed, was between one (1) to four (4) years, which could be a relatively short period of time in relation to deskilling. Against this backdrop, none of the companies could definitely confirm the occurrence of significant deskilling.

However, one company whose initiative was 4 years old, reported possible signs of overreliance, which could signal the possible beginnings of deskilling;

MulBank-G: but now the employees have fallen in love with the bots so much that when it breaks down, they don't want to go back to the manual, it's like it has to be fixed. We can't do it by ourselves, I may have even forgotten how to do it. There is a high dependency on the Bots, because of how efficient they are. So, we struggle to have that fall back process most of the time.

Reasons for observations on deskilling

As reported by Asatiani et al. (2019), deskilling is observed when there is an outage of a robotisation technology and staff are required to fall back on their former manual skills. Hence apart from the time element, some of the other reasons given for not noticing deskilling, included reported robust engineering and faster recovery times from outages.

PradTel-D: There hasn't been any system downtime yet.

PremBank-D: Regarding the people previously on the schedule being asked to go back to manual process due to system failure, when you talk about RPA and its failure we have not experienced any of such. I don't know whether it's the tool we are using or the processes we went through to develop our RPA [which] has brought us this far. The worst case scenario is where a server goes off due to maintenance or unforeseen issues but it is recovered immediately, robot service is restarted and we move on. With the engineering of the process, so what happens is, the failure of this process is mainly from infrastructure side. The process itself does not fail, because we have gone through a lot of steps to refine it. For every process we have, first of all we do the user acceptance test. During development people are made to test it; we do a lot of testing for refinements.

Another reason for not noticing deskilling was the fact that some companies still had the manual processes running alongside the robotised processes hence the manual skills were still available and not yet lost at least within the company as a whole.

RadBPO-P: We have not gone hundred percent, it's too early to see that agents have lost knowledge of doing manual interactions,

IndInsure-M: For the underwriting bit it is not even all the policies that we automated. The very common ones that has the volumes you know, that is what we have automated. So though we have done that, people still do underwriting for those policies.

PradTel-B: No, no, so our work is not all automated, we do a lot of manual work.

Measures for prevention of Deskilling

Measures outlined by companies for the prevention of deskilling include documented processes for reference (manuals or guidebooks), refresher training, deliberate action to have manual processes run alongside robotised ones and the use of subject matter experts.

PradTel-MA: We have something we call techniques manual or process documents. You have to document how you did it from A-Z. So that it's not like if we automate it for a longer time we forget what happened. Our aim is if you're not around someone can take over. We have all processes documented. Even if you forget you can go to the manual and go through the processes and execute that control perfectly, seamlessly. The techniques

manual is there for all controls being done and are reviewed quarterly, half-yearly. We use that same manual to build the robotics.

IndInsure-M: Yes for the underwriting and the process we have manuals on all of them, how to write all the policies. So even if automation takes over under writing 100 percent, anytime we have any challenge, users will have to come in. They will be able to use the [old] system to do the underwriting. And also trainings are organized internally to refresh staff memory on how to do these things.

RadBPO-P: That instead of having 400 people doing it manually, you need to deploy certain 2% or 3% or five or six desks which can do it manually and treat it as an exception.

RadBPO-P: Number two we are ensuring that the bot machines are being used by different agents on rotation so they would get help and then they will also not lose their knowledge retention over how it is done manually.

There was also indication that for some companies no deskilling prevention measures had been conceived of, because in case of robot failure, there were no plans to go back to manual processes but rather to focus more on recovery and have the robots back in service.

PremBank-D: The other side is that the current process will not be altered but will be enhanced. If production fails, we go to the DR right, to recover? Yeah, its all about the time to recover

RadBPO-P: However, the future would be that RPA will be there to stay and the need for people to learn manual interaction should go away. Interviewer: How about when the system fails? RadBPO-P: That is an exception.....if the bot fails, it will not be failed forever, somebody will work on it and fix it right, its a matter of those two hours, three hours or a day; God forbid if it takes more than 24 hours, but then the BOT is there to make life easy. I understand that it's a technology, it will fail at times and at that time you need to have an attitude of fixing it quickly and swiftly

Also no prevention measures were taken because some companies had confidence in the ability of their staff to retain their skills.

IndInsure-M: I don't think that it will get to a point where people would not have the skill to be able to do this underwriting.

PradTel-D: But it happens. Previously we used to do a lot of Excel work and Excel is such that if you don't use it often some of the formulas, you'll lose them. I don't foresee any of us losing the skill.

M:B: If there is a challenge you have to struggle a little bit more but it's not to the extent you will have forgotten what you used to do in the past.

As part of measures to prevent deskilling and maintain task control, Asatiani et al (2019) recommended that, as much as possible, robots should be configured with the same information representations that human workers will use in their supervisory control roles. One company did not support this view, saying that it defeated the logic of optimization.

MulBank-G: So, remember the bot was trained on what they [humans] did. There are some instances because of technology we may optimize the process and not do it how they [humans] do it. So, for example, if they [humans] were doing it manually they may have to log on to the system to go and get some information but we do have API's which we can call on and mix into it to call some of the information, which as a human being you may not be able to do that. When that happens, they will not be able to follow that same bot process. Some processes, it's the exact same thing, so they can fall back, but for some processes ...

Finding 17: Though most ISR initiatives in developing economies were not old enough to notice significant cases of deskilling, some signs such as, over-reliance had been observed.

Finding 18: Measures adopted by developing economy firms to prevent loss of skills in their organisations in relation to robotised processes include, keeping guidebooks and having both manual and robotised procedures run concurrently.

Robot Governance

Regarding internal arrangements to ensure that ISR activities are conducted in accordance with best practices, all the companies confirmed having policies, procedures and processes for: business case or ISR justification; selection of the activities to be robotized; ISR technology &

vendor selection; implementation guidelines (configuring, testing, deployment); access management; license management; vendor management; reusable codes repository management; training as well as, monitoring and maintenance.

Finding 19: Most developing economy firms confirmed having instituted policies, procedures and processes for the governance of their ISR initiatives.

6.9. SUMMARY OF FINDINGS

A summary of the 19 findings are presented in Table 6.8.

Table 6.8: Summary of Findings on the Nature of Complementarity

Theme	Finding
Motivations For ISR deployment	Finding 1: ISR deployments in developing economy firms, is motivated by the need for process improvement to achieve efficient production (more productivity at less cost and time) and high quality output.
Awareness of ISR	Finding 2: Some of the means by which developing economy firms became aware of ISR technology were internal, through referrals by both senior and junior staff as well as, through exploration.
Top Management Support	Finding 3: ISR initiatives in developing economy firms enjoy top management support
Regulations	Finding 4: Currently, there are no regulations specifically governing the implementation of ISR, at least in the banking industry, of some developing economies, though regulations are planned.
	Finding5: Some of the reasons given for the absence regulations include: categorisation of ISR as an auxiliary & enhancement activity; ISR as an immature field not yet ready for regulation and the existence of self-regulation mechanisms at the industry and enterprise levels.

Level of robot intelligence	Finding 6: The level of intelligence is being implemented with a phased approached starting with mechanical intelligence (rules-based features) and moving towards enhancement with advanced learning capabilities, due to some concerns such as those related to security and skills availability. Caution is therefore a mechanism in determining the level of robot intelligence.
Anthropomorphism	Finding 7: Anthropomorphism in back-end software robots in developing economy firms, is limited to low-level interactivity, discarding names, gender and avatars.
	Finding 8: The limited anthropomorphic features of back-end AI-RPA robots in developing economy firms could probably be attributed to the mechanisms of their low level of direct engagement with customers & users (duration & volume) and their “obligatory” usage requirement.
Functions of the robots	Finding 9: ISR robots deployed in developing economy firms are mainly assigned to back-end processes with limited frontend functions
Level Of Robotisation (LOR)	Finding 10: The level of robotisation (LOR) in developing economy firms are a mixture of high LOR and complementary LOR, with the majority being complementary
	In designing the level of robotisation, the long-term aspiration of most developing economy firms is to achieve full high LOR in their ISR initiatives, however they have implemented complementary LOR as a phase and cautionary measure towards that aspiration. Caution is therefore a mechanism in determining the level of robotisation.
Human-Machine Task Allocation	Finding 12: In developing economy ISR initiatives, epistemic and mindless tasks are allocated to robots while humans are assigned the pragmatic tasks.
Benefits	Finding 13: The implementation of ISR in developing economy firms has generally led to improvements in completion times, accuracy, productivity and cost savings
	Finding 14: Apart from expected benefits, ISR deployments in developing economy firms also turned up “unanticipated benefits”,

	including freeing staff from weekend work and reduced opportunities for staff fraud
Employment Security	Finding 15: In developing economy firms, ISR initiatives have NOT resulted in employee layoffs, rather there have been redeployments and recruitment freezes.
	Finding 16: In developing economy firms, some ISR initiatives have created employee fears about job loss, serious enough to require management intervention
Deskilling	Finding 17: Though most ISR initiatives in developing economy firms were not old enough to notice significant cases of deskilling, some signs such as, over-reliance, had been observed.
	Finding 18: Measures adopted by developing economy firms to prevent loss of skills in their organisations in relation to robotised processes include, keeping guidebooks and having both manual and robotised procedures run concurrently.
Robot Governance	Finding 19: Most developing economy firms confirmed having policies, procedures and processes for the governance of their ISR initiatives.

6.10. CHAPTER SUMMARY

This chapter discussed the findings of the qualitative inquiry on the nature of complementarity between humans and machines in developing economy firms.

The 19 findings provide rich data on areas such as, motivations for ISR deployments, robot profile, areas of robot deployment and roles, nature of complementarity (level of robotisation, dynamics of human-machine task allocation,) impact of ISR and robot governance, all which expand our knowledge on the subject.

CHAPTER SEVEN

PROPOSED FRAMEWORK FOR COMPLEMENTARY ISR DEPLOYMENT

7.1. CHAPTER OVERVIEW

The previous chapter discussed in detail, the results for the inquiry into the nature of complementarity in ISR deployments in developing economy firms and provided nineteen findings which gave rich insights into and expanded our knowledge of the ISR phenomenon in developing economies.

This chapter now synthesizes the relevant key findings from both the quantitative and qualitative inquiries which addressed the three research objectives, to derive a proposed framework for implementing ISR in developing economy firms. This is in fulfillment of the stated purpose of this thesis.

Research purpose: To develop a framework for the deployment of intelligent software robotisation in developing economy firms, founded on complementarity principles and integrating, machine, human and organisational dimensions.

7.2. ANTECEDENTS OF THE FRAMEWORK

This research was motivated by the low rate of ISR adoption in developing economies, in spite of the benefits to be derived from the technology amidst a reported high failure rates of ISR projects. Subsequently the research efforts sought to understand the reasons behind these two issues, with the ultimate aim of contributing knowledge to their solutions. Through Research Objective 1,

conditions influencing the decision to deploy ISR were found which assists in explaining the reasons for the low adoption rates and high rates of failure. That addressed the technology adoption facet. However, through the work of various scholars (Wang et al., 2021; Malik et al., 2021; Parasuraman & Manzey, 2010), we understand that there are other facets, particularly human dimensions, which ought not to be ignored in ISR deployments. For instance employees anxieties about their employment security and their coping strategies particularly towards software robots was one such issue, which had also not received enough attention in the literature. Research objective 2, sought to fill this gap with the findings derived on the conditions influencing employee's selection of coping strategies. Through the literature review, it also emerged that implementation approach was also a contributory factor to the high ISR project failure rate (Moffitt et al., 2018; Lamberton, et al., 2017; Waizenegger & Techatassanasoontorn, 2020). In response, Research Objective 3 sought to understand alternative implementation approaches such as, complementarity which though had been recommended for addressing the adverse effects of the preferred implementation approach (High LOR), was under researched as a solution. Now the findings from all three objectives provide some appreciable data to enable us to understand the foundational blocks for the successful deployment of ISR in developing economies. The proposed framework is presented in this chapter, comprising a description of its key conditions and their literature support, shown in Table 7.1, with a visual presentation depicted in Figure 7.1 and discussion of the various phases of deployment outlined in the framework.

7.3. PROPOSED FRAMEWORK FOR COMPLEMENTARY ISR DEPLOYMENT

The proposed framework is a set of conditions and elements which together, influence the successful deployment of ISR in developing economies. The conditions are categorized into four

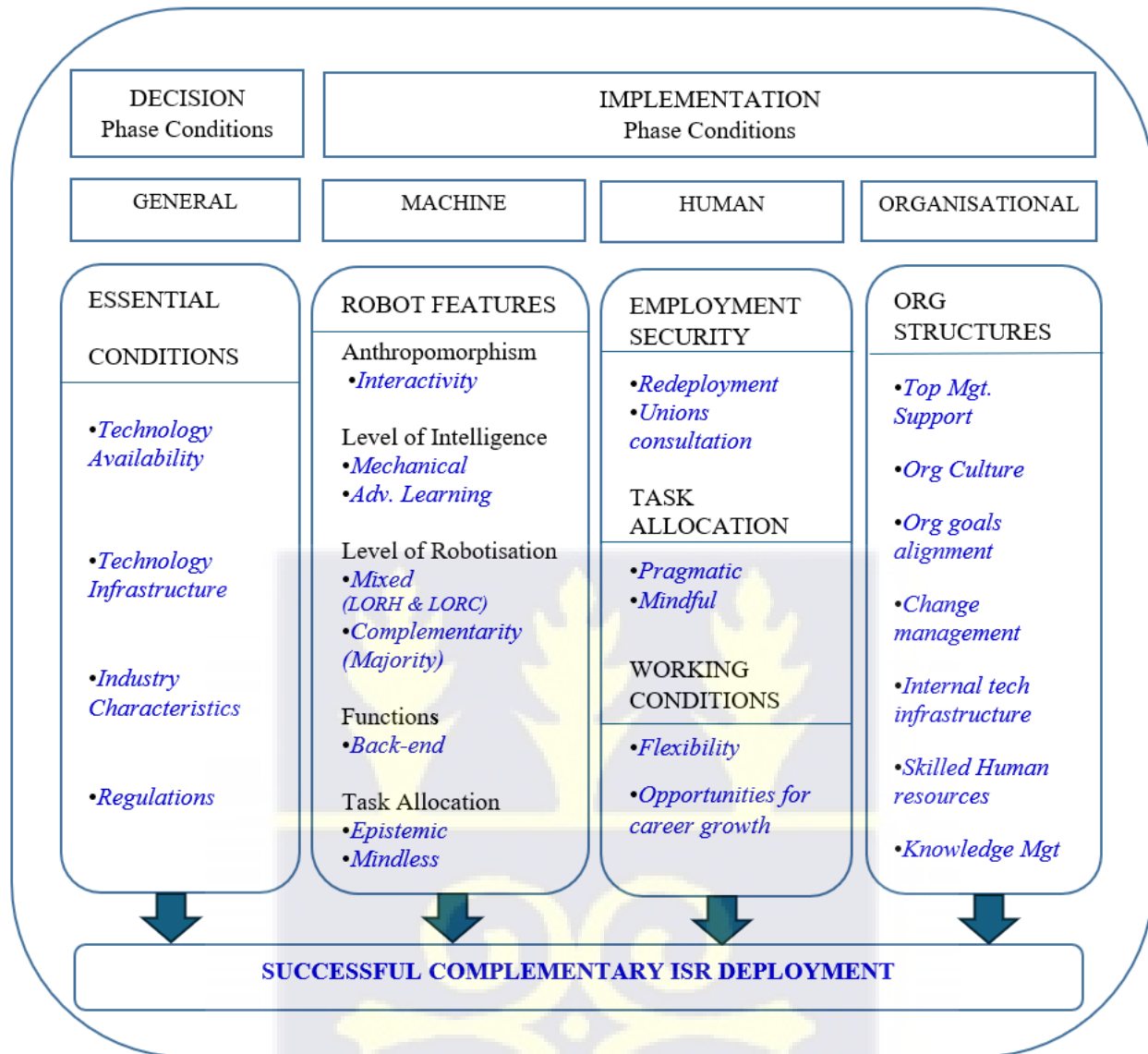
themes, general, human, machine and organisational, which are expected to play critical roles during the two phases of deployment, the decision and implementation phases.

7.3.1. Decision Phase Conditions

Essential conditions for successful ISR deployment:

The decision phase outlines the general and essential conditions to be considered by management as they deliberate on deploying ISR. This comprises the various conditions which can serve as either a barrier or enabler to successfully deploying ISR in developing economies and thus contributes to the low rate of ISR adoption in that region. From the quantitative inquiry analysed configurationally, some technological, environmental and organisational conditions which are sufficient and necessary for ISR deployment in the developing economy context were identified. The notable ones were the presence of technology availability, technology infrastructure, industry characteristics and the absence of regulations; the organisational condition is discussed at the implementation phase. These conditions have been discussed extensively in Chapter Five. In addition to the evidence of their efficacy from this study, the literature also confirms the importance of these conditions in several studies some of which are cited here and on Table 7.1 (e.g. Musa, 2006; Gomez-Gonzalez et al. 2020; Asiaei & Rahim, 2019; Ade-Ibijola & Okonkwo, 2023; Okolo et al., 2023; Islam et al., 2023; Zhao & Xu, 2023; Gomez et al., 2022; Pumplun et al., 2019; Alsheibani et al., 2020).

Figure 7.1: Proposed Framework for Complementary ISR Deployment



The expectation is for management to be aware of these conditions and deliberate upon them to make an informed ISR deployment decision.

7.3.2. Implementation Phase Conditions

At the implementation phase, there are three conditions namely, the machine, human and organisational, all of which are critical to a successful deployment and thus require equal attention.

Table 7.1: Conditions for Proposed Framework for Complementary ISR Deployment

	General Conditions	Dimensions	Description	Literature support
Decision Phase	Essential Conditions	Technology Availability	Technological & environmental conditions which could determine the success or failure of the deployment of ISR	(Musa, 2006; Gomez-Gonzalez et al. 2020; Asiaei & Rahim, 2019)
		Technology Infrastructure		(Ade-Ibijola & Okonkwo, 2023; Okolo et al., 2023; Tuffour & Nsiah, 2023; Sharma et al., 2022)
		Industry Characteristics		(Islam et al., 2023; Zhao & Xu, 2023; Gomez et al., 2022; Gupta et al., 2022; Calitz et al., 2021; Simoes et al., 2020; Jacobsson et al., 2017; Calitz et al., 2017)
		Regulations		(Pumplun et al., 2019; Alsheibani et al., 2020; Radhakrishnan et al., 2022; Onyekwere et al. (2023))
Implementation Phase	Machine Conditions	Dimensions	Description	Literature support
	Anthropomorphism	Interactivity	Robot's ability to communicate with users	Go & Sundar, 2019; Bao et al.,
	Level of Intelligence	Mechanical intelligence (initial)	Robot's ability to respond to input through learning and adaptation	Findings from this study (Chapter 8)
		Advanced learning capabilities (maturity)		Findings from this study (Chapter 8)
	Level of Robotisation	Mixture (LORH&C)	Extent of human and robot interventions in robotised operations	Findings from this study (Chapter 8)
		Complementarity (Majority)		Findings from this study (Chapter 8)
	Functions	Backend operations	Type of general role assigned to robots	Findings from this study (Chapter 8)
Task allocation	Epistemic, Mindless	Category of tasks assigned to robots; epistemic(data processing & analysis); mindless (routine, repetitive, mundane) tasks	Asatiani et al. 2019; Findings from this study (Chapter 8)	

Human Conditions	Dimensions	Description	Literature support
Employment security	Redeployment	Means of addressing employees' job security concerns	Findings from this study (Chapter 8)
	Unions Consultation		Findings from this study (Chapter 8)
Task Allocation	Pragmatic, Mindful	Category of tasks assigned to humans in a robotised instance; pragmatic (decision-making & execution); mindful (creativity) tasks	Asatiani et al. 2019; Findings from this study (Chapter 8)
Working Conditions	Flexibility	Aimed at assisting employees cope favorably with the introduction of ISR	(Beaudry & Pinsonneault, 2005; Bhattacharjee et al., 2018 & Paluch et al., 2022; Bala & Venkatesh, 2016; Elie-Dit-Cosaque & Straub, 2011); Findings from this study (Chapter Five)
	Opportunities creation		(Beaudry & Pinsonneault, 2005; Bhattacharjee et al., 2018 & Paluch et al., 2022; Bala & Venkatesh, 2016; Elie-Dit-Cosaque & Straub, 2011); this study (Chapter Five)
Organisational conditions	Top management support	Organisational structures which facilitate an effective ISR project execution by addressing mainly human-centered issues	(Henderson & Salado, 2023; Mohiuddin et al., 2023; Leppala & Huhtamaki, 2022; Ali et al., 2022; Chen et al., 2022; Sayem et al., 2022; Low et al., 2022; Lewandoski et al., 2021; Hamm & Klesel, 2021; Asatiani et al., 2019)
	Organisational culture		
	Organisational goals alignment		
	Change management		
	Internal technology infrastructure		
	Skilled Resources		
	Knowledge management		
Governance procedures			

Machine Conditions

This refers to elements related to the robots to be deployed, their features and capabilities and assigned roles. The conditions included in the proposed framework were derived from the findings of the qualitative enquiry on the nature of complementarity in developing economy firms, discussed in Chapter Six.

Anthropomorphism: From this study's findings it emerged that some level of interactivity was implemented in the robots examined. Assigning human-like traits to robots, are a means of reducing resistance and establishing a connection with the robots, in a bid to enhance their acceptance (Seiffer et al., 2021; Pfeuffer et al., 2019; Vladova et al., 2022). Though this practice is prevalent in customer-facing software robots such as, chatbots which interact a lot with humans, it has not been used extensively in back-end software robots. The quantitative inquiry found anthropomorphism as an influential condition in ISR decisions (Chapter Six), while the qualitative inquiry described a limited application, restricted to interactivity (Chapter Six). To engender acceptance, though the back-end software robots may be "invisible", communication with robots is enhanced by an interactivity trait (Go & Sundar, 2019; Bao et al.2022), hence some level of interactivity is recommended for the AI-RPA robots.

Level of intelligence: It emerged from the qualitative inquiry (Research Objective 3), that developing economy firms were treading cautiously in implementing intelligence in their robots. This was due to concerns about security and the immaturity of available skills to handle an intelligent technological environment. The approach was therefore to begin with mechanical intelligence (rules-based) and proceed gradually to add advanced learning capabilities as the concerns are addressed (Chapter Six).

Level of robotisations (LOR): this refers to the extent of human and robot intervention in robotised operations. From this study, it emerged again that caution was being applied in determining the level of human and machine intervention in the robotised processes. The aspiration of most developing economy firms is to achieve full robotisation in as many tasks and processes as possible. The preferred LOR is thus High LOR. Most of the firms, however had a mixture of High LOR and Complementary LOR where human intervention was still required, with the humans having oversight control over the robot's operations in the form of reviews and approvals. Complementary LOR was thus being used as a cautionary measure to build high confidence and trust in the performance of the robots, before handing over full tasks to them. This mixed and cautionary approach is one that other developing economy firms could consider.

Functions and Task Allocation: For now most of the AI-RPA robots examined were employed in back-end operations, namely, data capturing, processing & analysis, application navigation and low level decision-making. They had limited engagements with customers. In relation to the nature of their tasks, it is epistemic (data processing and analysis) as well mindless (routine, repetitive and mundane). These are recommendations based in literature (Asatiani et al., 2019) and the findings of this study.

Human Conditions

This dimension deals mainly with conditions which enable employees cope with the introduction of AI-RPA robots into their work environment. The conditions are partly from literature and mainly from this study's findings from Research Objective 2 where employees shared their perspectives on coping with ISR.

Employment security: Most firms reported not laying off staff but rather redeploying them in cases of High LOR where the robots had taken over human tasks. This is recommended as it helps allay

employees' anxieties about job losses in relation to ISR. Furthermore, labour union activities in protecting members' jobs against losing them to robots, came up in the literature review. It was subsequently examined in the quantitative inquiry for Research Objective 1 and was found to be a factor to consider as part of Industry Characteristics (Chapter 5). Therefore, it is recommended that where union activities could be an impediment, the unions should be brought in to the ISR implementations deliberations to discuss the impact of ISR on jobs for the mutual benefit of all parties.

Task Allocation: Comparing their capabilities to that of machines, humans are regarded as being best at creativity and judgment (Hassan, 2022; Asatiani et al., 2019; World Economic Forum, 2020). This view is supported by one of the foundational papers for this study (Asatiani et al., 2019) who advocate complementarity and prominent human involvement in robotised operations. This study's findings also points to the fact that in a cautionary mode, most developing economy firms assign humans the task of judgement or high level decision-making in robotised processes and tasks. Thus they are responsible for reviewing and approving the work of the robots and where decisions are to be made, they are deferred to.

Working conditions: To address Research Objective 2, the Coping Model of User Adaptation (Beaudry & Pinsonneault, 2005) was adapted to assess the influence of three conditions, (i) level of robotisation (high or complementary), (ii) employees' level of control over their working conditions, the robot technology and their emotions, as well as (iii) the potential for self-interest fulfillment (opportunity or threat) on employees selection of coping strategies towards ISR robots. The findings indicate that all three are influential in the selection of both opportunity related strategies (that is, favorable/positive attitudes such as, Benefit Satisficing) and threat-related strategies (unfavorable/negative attitude such as, Exit). It is informative that employees select the

“ideal” strategy (from an employer’s perspective), that is, Benefit Maximizing, based on two conditions, level of control and self-interest, without LOR appraisals. In Benefit Maximising, employees actively engage in the ISR activities and aspire to become experts and go-to persons in the deployment. Therefore, to engender favorable and positive attitudes towards ISR deployments in developing economies, it is recommended that, Flexibility is allowed in employees working condition to enable some level of control. Furthermore, efforts should be made to take advantage of ISR deployments to create opportunities for staff to grow professionally, through for instance, skill development programmes and job profile upgrades. Redeployment can thus be used creatively to match employees’ areas of career interests to their new assignments.

Organisational Conditions

In the complexities associated with ISR technology deployment, organisational structures have been found to be an important pillar for successful deployment. In fact, this study’s quantitative inquiry into Research Objective 1 on the conditions influencing ISR deployment decisions, strongly confirms the important role of organisational structures. It was found to be the only factor which on its own could lead to ISR deployment. In the inquiry, organisational structures were measured with skilled human resources, organisational culture, top management support, change management structures, internal technology infrastructure and alignment with organisational goals. The efficacy of these metrics are validated by several studies (Henderson & Salado, 2023; Mohiuddin et al., 2023; Leppala & Huhtamaki, 2022; Ali et al., 2022; Chen et al., 2022; Sayem et al., 2022; Low et al., 2022; Lewandoski et al., 2021; Hamm & Klesel, 2021). It is therefore recommended that at the implementation stage, these organisational structures are given the necessary attention.

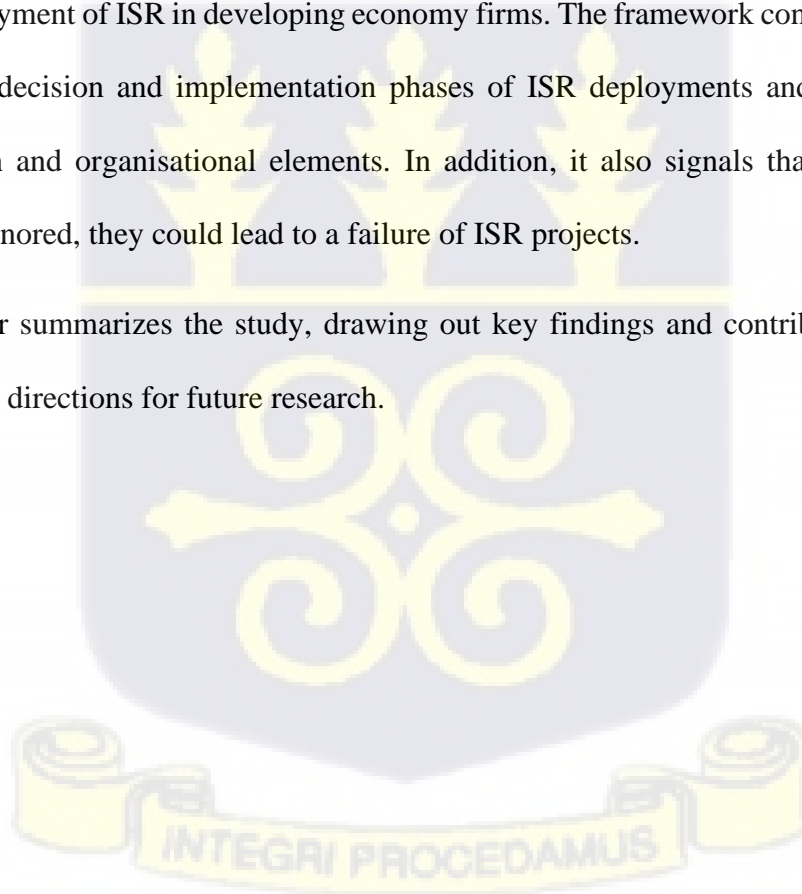
7.3.3. Successful ISR Deployment

This is the expected outcome of the proposed framework. If at the decision stage, management chooses the right rationale and considers the essential conditions for success, while at the implementation stage, it considers the appropriate machine, human and organisational elements, it is expected that the ISR deployment will stand a high chance of avoiding failure.

7.4. CHAPTER SUMMARY

This chapter synthesized the key findings of this study to develop a proposed framework for the successful deployment of ISR in developing economy firms. The framework consists of conditions influencing the decision and implementation phases of ISR deployments and include general, machine, human and organisational elements. In addition, it also signals that if the identified conditions are ignored, they could lead to a failure of ISR projects.

The next chapter summarizes the study, drawing out key findings and contributions as well as implications and directions for future research.



CHAPTER EIGHT

SUMMARIES, CONTRIBUTIONS AND FUTURE DIRECTIONS

8.1. CHAPTER OVERVIEW

The previous chapter synthesized the findings of this study to develop a proposed framework for the successful deployment of ISR in developing economy firms, thereby fulfilling the purpose of this research.

This chapter provides an overarching summary of this study, drawing out the key findings on the three research questions. A synopsis of the background to the study is given, as well as the objectives and various research undertakings to realize the study's purpose. Contributions made by the study, recommendations derived from the findings in addition to limitations of the study and suggestions for future research are also included in this chapter.

8.2. SUMMARY OF RESEARCH FOUNDATIONS AND PROCEDURES

This study was motivated by the post-COVID economic challenges experienced by most African countries. It was predicated by the fact that in spite of the attractive economic benefits (such as, cost savings and increased productivity) of intelligent software robotisation, developing regions such as, Africa were still experiencing slow adoption rates, though some efforts were being made. Against the backdrop of a reported high failure rate of ISR projects globally and concerns about the ethical implementation of ISR technologies including RPA and AI, there was the need for an investigation to provide insights to help organisations obtain maximum value from these technologies, while at the same time addressing any socio-economic or organisational risks and

concerns. The purpose of the research was thus to develop a framework for the implementation of intelligent software robotisation in developing economy firms.

Intelligent software robotisation was conceptualized from a review of extant literature on automation with software robots and intelligent process automation. Often a robot (and hence robotisation) is conceived of only in association with a physical or embodied entity. However, Uskenbayeva et al. (2019) remind us that robotisation also refers to disembodied “software robots” as well. Automation with intelligent software robots has also been described variously as “cognitive automation (CA)”, “intelligent automation (IA)”, and “intelligent process automation (IPA)”, with no consensus on either a definitive term or definition. However, what most authors who use these terms have in common is a characterisation based on the underlying technology, namely RPA combined with AI (Taulli, 2020; Kumar & Khanna, 2023). This paper follows that characterisation to define ISR. Regarding the definition of ISR, the study adopts Lacity & Willcocks (2021) and Engel et al. (2021) to define ISR as, the use of disembodied programmable mechanisms with intelligent capabilities, to reduce human intervention in business processes, characterised by both structured and unstructured data. Another key concept in this study which was conceptualized from literature, is complementarity. This is an ISR implementation approach which emphasizes a human-machine collaborative design, with the humans exercising overall control. This study follows Asatiani et al. (2019) and Zhou et al. (2021), who espouse the view that both humans and machines have strengths and weaknesses which complement each other through collaboration. Thus when the two work together on a task, they achieve superior results than when they work individually. Complementarity has been proposed as a means of addressing the adverse effects of other ISR implementation approaches such as, High LOR; these downsides include overreliance, deskilling and job losses (Asatiani et al., 2019).

For a critically analysed and well-founded problem definition grounded in contemporary issues, extant literature on ISR and related topics were also reviewed and a number of themes and knowledge gaps were identified in areas such as, implementation approaches, employees' employment security concerns, impact of ISR, theorizations on ISR, African ISR studies and research methodologies. On implementation approach, the review revealed a dominance of research on approaches which viewed software robotisation as a replacement of human labour (high LOA), with less attention to a complementarity approach (Asatiani et al., 2019). Also encountered was the reported high failure rates of ISR implementations, which was a matter of concern. With employment security, there was more focus on identification of job loss as an issue and less on solutions such as understanding and facilitating employees' coping strategies specifically towards software robots. Regarding impacts, there was adequate attention paid to financial benefits and less on human-centered impacts. Inadequate theorization on categorisations of ISR technologies to guide appropriate choice was another gap identified. Furthermore, on theorization on ISR adoption, more studies were found using traditional IS adoption models (e.g. TAM, UTAUT) and less *software* robot-specific adoption models with software robot-specific constructs. For instance, robot traits such as, anthropomorphism had been studied for physical robots and front-end software robots such as, chatbots but not for back-end software robots such as, RPA. Moreover, the robot models leaned heavily towards individual level analysis with very few organisational analysis. In respect of the study's context, the review exposed the paucity of ISR research in Africa; the very few studies sighted were mainly from two countries with a concentration on the financial sector. The African studies also highlighted the issue of labour union activities in respect of job protection in ISR deployments. Methodologically, there were more qualitative studies and for the quantitative studies, more variance-based multi-variate analysis.

Configurational analysis is nascent and not yet near the levels of the two major methodological approaches.

Different theoretical foundations and methodological approaches were adopted for the research objectives and these are summarized under each research objective.

The results of the literature review formed the basis for the selection of themes and questions to be addressed in relation to the research purpose. The derived research objectives are presented below:

- (i) To examine the factors and their respective configurations/combinations that influence the decision to deploy intelligent software robotisation in firms in developing economies.
- (ii) To analyse the factors and their respective configurations/combinations that influence employees' choice of coping strategies towards the deployment of intelligent software robotisation by firms in developing economies.
- (iii) To explore the nature of complementarity between humans and machines in intelligent software robotisation deployments by firms in developing economies.

8.3. MAJOR RESEARCH FINDINGS

The investigations into the above three objectives yielded a number of findings which are summarized in Table 8.2.

Research Objective 1: Conditions influencing the decision to deploy ISR

Objective: To examine the configurations of necessary and sufficient conditions which influence the decision to deploy intelligent software robotisation by a developing economy firm.

This objective was derived from the need to understand the elements influencing the low adoption rate of ISR in Africa, as well as the reported high failure rate of ISR projects generally, both issues identified in the literature review (Tables 2.3 & 2.4 – Summary of gaps & Summary of issues to be addressed in this doctoral dissertation in Chapter 2). Consequently, in responding to various calls for further research to expand knowledge on ISR deployment (e.g. Coombs et al. 2020), an organisational level conceptual framework based on the TOE (Technology, Organisational and Environment) model (DePietro, Wiarda & Fleischer, 1990) was designed. To address theoretical, contextual and methodological gaps identified in the literature, the research model incorporated elements such as software robot specific constructs such as, *anthropomorphism* and important issues such as, *labour union* activities.

Data was collected from five firms in the banking, insurance, telecommunications and BPO industries via 20 valid survey questionnaires returned from 27 delivered and self-administered online. The data was analysed with the FsQCA configurational analytical approach.

The findings indicate that, the presence of all three TOE dimensions (Technological, Organisational and Environmental) and all eight conditions investigated namely, Anthropomorphism, Technology Availability, Technology Accessibility, Firm Size, Organizational Structure, Industry Characteristics, Technology Infrastructure and Regulations, are necessary and sufficient conditions in influencing the decision to deploy ISR in developing economy firms.

Notable conditions which require attention included, the presence of Technology Availability (a core condition); Organisational Structures (a significant sole condition); Industry Characteristics (a prevalent or widespread condition, also containing Labor Union activities); Technology Infrastructure (prevalent condition) and the absence of Regulations (a core condition).

In all, the findings could help explain the reasons for the low rates of ISR deployments in Africa, as well as help mitigate the high rate of failure of ISR projects.

Research Objective 2: Conditions influencing employees' choice of coping strategies towards ISR deployments

Objective: To analyse the configurations of sufficient and necessary conditions which influence employees' choice of coping strategies towards the deployment of intelligent software robotisation by a developing economy firm.

This objective was prompted by the employment security concerns of employees in relation to ISR which emerged from the literature review, as well as, the need to shift focus from highlighting the problem and consequences to developing a better understanding of how to handle the issue, also a gap derived from the literature review (Table 2.3 & 2.4 in Chapter 2). It was also a response to the knowledge gap in the literature on coping strategies specifically in relation to software robots (Seiffer et al., 2021; Coombs et al., 2020). Some of the accompanying calls for further research pointed out the unintended and unanticipated consequences which automation in general could have on people and hence the need for human-centered research in addition to the prevalent machine-centered ones (Wang et al., 2021; Darioshi & Lahav, 2021; Asatiani et al., 2019; Parasuraman & Manzey, 2010; Kokina & Blanchette, 2019).

The research model to address this objective was adapted from the Coping Model of User Adaption (CMUA) (Beaudry & Pinsonneault 2005) and included a software-robot specific construct namely the *level of robotisation (LOR)*, also derived from the gaps in the literature.

Data was collected through a self-administered online survey delivered to a sparse sample of 31 employees, out of which 22 valid responses were returned. The employees were from the same organisations used for Research Objective 1 and the data was also analysed with FsQCA.

It was found firstly that the appraisals of the presence of the *level of robotisation* of an ISR event (High or Complementary) and *self-interest* (Opportunity or Threat) moderated by employee's *level of control* (High, Low and No) are all necessary and sufficient conditions influencing employees' choice of ISR coping strategies.

Secondly, for the choice of specific coping strategies, the results indicated that, appraisals of the *level of robotisation*, *self-interest* and employee's *level of control* were all necessary and sufficient for the choice of *Benefit Satisficing*, *Disturbance Handling and Exit*. However, for *Benefit Maximizing and Self-preservation*, the appraisal of *self-interest* moderated by *employees' level of control* in the absence of an appraisal of the level of robotisation are necessary and sufficient conditions.

Research Objective 3: The nature of ISR complementarity in a developing economy firm.

Objective: *To identify the nature of complementarity between humans and machines in intelligent software robotisation deployments in a developing economy firm.*

This objective responded to the implementation approach gap identified in the ISR literature review in relation to complementarity (Table 2.3 & 2.4 in Chapter 2). Furthermore, concerns had been expressed about some of the adverse effects of the alternative implementation approach to complementarity, that is, a high level of robotisation. The concerns included overreliance, complacency and deskilling and complementarity had been proposed in the literature as a means of addressing them (Sutton et al., 2023; Asatiani et al, 2019).

To fulfill this objective, a research framework was adapted from Asatiani et al (2019) consisting of six recommendations for complementarity implementations. With it, the ISR initiatives of the five institutions sampled for Research Objectives 1 and 2, were examined through 12 semi-structured interviews with 14 employees. First a within-case analysis was conducted on the individual cases, followed by a cross-case analysis to identify commonalities, differences and general insights, which were all subsequently integrated into a consolidated set of findings. The thematic analysis was guided by Miles and Huberman (1994), within which framework, coding was mainly theory based (deductive) supported by critical realism retrodution.

In all there were 19 findings, shown on Table 6.7 with a synopsis presented here. The findings were grouped under 12 themes namely, (i) *Motivations for ISR Deployment* (driven by need for process improvement, efficient production & quality output); (ii) *Awareness of ISR* (through internal members); (iii) *Top Management Support* (available up to board level); (iv) *Regulations* (though planned, currently absent which is (v) due to reasons such as, immaturity of the ISR field and existence of self-regulation mechanisms within the industry); (vi) *Level of robot intelligence* (handled with a phased approach, starting with rules-based, moving later to advanced learning features); (vii) *Anthropomorphism* (mainly low level-interactivity) which could be (viii) due to reasons such as, low level of robot engagements with customers & users and usage requirements); (ix) *Functions of the robots* (mainly back-end activities); (x) *Level of robotisation* (mixed and mainly complementary, but (xi) aiming for more High LOR); (xii) *Human-Machine Task Allocation* (epistemic and mindless tasks assigned to robots, with pragmatic given to humans); (xiii) *Benefits of ISR* (expected ones such as, increased speed of delivery, accuracy, productivity & cost savings together with (xiv) unexpected ones such as, reduced fraud opportunities & more free weekends for staff); (xv) *Employment Security* (no layoffs, more redeployments, but (xvi)

reported case of employees' anxieties about job losses requiring management intervention); (xvii) *Deskilling* (burgeoning signs of overreliance with (xviii) mitigation measures including process manuals & running both manual and robotised processes concurrently); (xix) *Robot Governance* (policies available for robot management such as access management, monitoring & maintenance, etc.).

8.4. CONTRIBUTIONS TO RESEARCH

This research set out to address a number of gaps, categorized as issue, theoretical, methodological and contextual gaps, which were identified in the literature and whose resolution contribute to knowledge.

The first and major issue gap from the literature which motivated this research, was the need to explain the low rate of adoption of ISR deployments in developing economies amidst reports of high failure rates of ISR projects. There were related calls for research to expand our knowledge on ISR implementations (Coombs et al., 2020). In response, this study contributed knowledge on the technological, organisational and environmental conditions which influence ISR deployment decisions and could help explain the low adoption and high failure rates of ISR initiatives in developing economies. The eight conditions identified are Anthropomorphism, Technology Availability, Technology Accessibility, Firm Size, Organizational Structure, Industry Characteristics, Technology Infrastructure and Regulations. The second issue gap addressed by this study relates to labour union activities which was a prevalent issue in the African ISR literature (Tew, 2020) but had not been extensively investigated. It was included in the TOE model under industry characteristics and that condition came up as influential condition. Thirdly and also from the literature review, it turned out that the complementary ISR implementation approach, had

received little attention first as a means of job retention and allaying employment security concerns and secondly as measure for mitigating the adverse effects of a high LOR. This study responded to the related calls for more investigations into complementarity (Engels et al.,2022; Asatiani et al., 2019) and consequently the third research objective contributed rich information on motivations for ISR deployment, robot profile, areas of robot deployment & roles, nature of complementarity (level of robotisation, human-machine task allocation), impact of ISR and robot governance. This has contributed to expanding our understanding of the implementation of ISR in developing economy firms. The paucity of studies examining employees individual coping strategies specifically to software robots was the fourth issue gap which had led to several calls for research (Seiffer et al., 2021; Asatiani et al., 2020; Waizenegger & Techatassanasoontorn, 2020; Coombs et al., 2020). The insights from the findings on the second research objective of this study, in relation to the conditions leading to the selection of various coping strategies by employees is useful because it is based on assessment of a new construct previously not tested namely, LOR.

Theoretically, the literature review revealed a paucity of models using software robot-specific constructs to understand ISR issues, leading to calls for more of such research (Ulfert et al., 2022). Consequently, this study firstly incorporated anthropomorphism as a construct in the TOE model. Secondly the level of robotisation (LOR) which had also not been previously tested as a factor in employee coping strategy, was also incorporated into the coping strategy model. Both constructs emerged as notable conditions in ISR issues. The finding on complementary LOR being used as a cautionary measure in preparation for full high LOR together with the reasons unearthed for such an approach, is an insightful contribution not available in the literature. Similarly, the cautious approach to implementing intelligence in robots is also a novel insight for the developing economy context as are the reasons. Kokina & Blanchette (2018) had called for research to understand the

dynamics surrounding how companies transition between the various levels of intelligent robotisation. The findings on the approach to implementing intelligence, provides insights which could be explored further in that respect. Finally, the proposed framework for implementing ISR in developing economies developed by this study makes some theoretical contribution to ISR deployments in developing economies.

Methodologically, the sparse use of configurational analysis in examining ISR topics (Laut et al., 2021; Waizenegger & Techatassanasoontorn, 2020) and also in the African literature was a gap identified in the literature. This study expands the use of configurational analysis, revealing the benefits it can bring to IS research by facilitating the generation of fresh insights on IS topics.

Contextually the study addresses the thinness of the ISR literature on developing economy cases, especially in the Africa region (Calitz et al., 2021; Ahmed, 2021). Hopefully the study adds to other similar studies which seek to grow the volume of research on the deployment of emerging intelligent technologies on the continent.

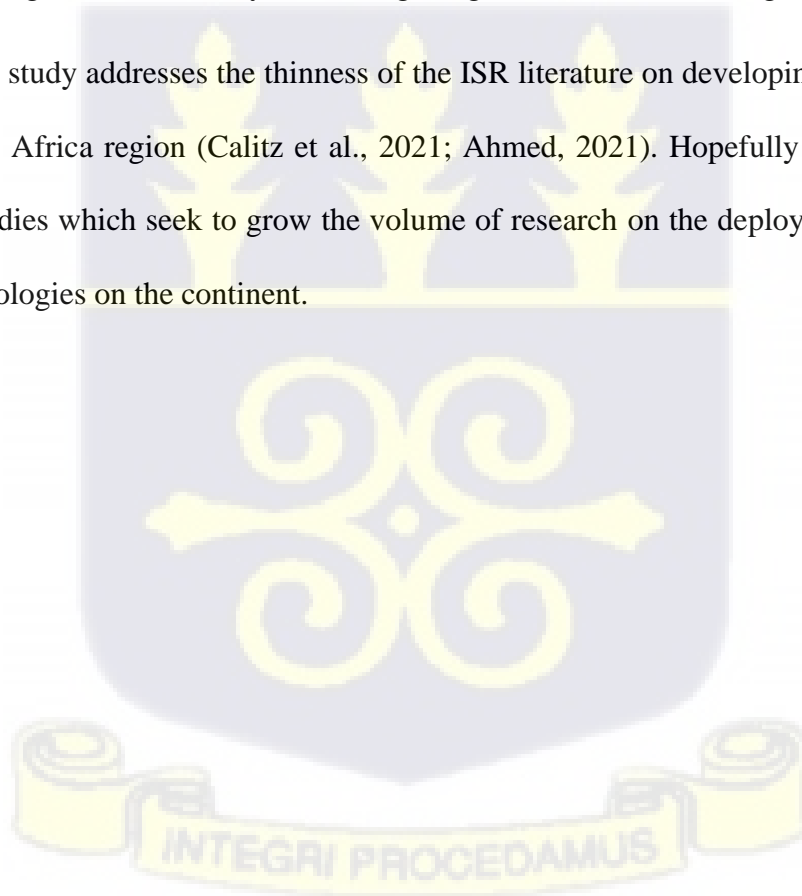


Table 8.1: Summary of Major Research Findings & Contributions

Research Objective	Finding	Knowledge Gaps & Contemporary Issues Addressed	Contributions
<p>Research Objective 1: To examine the configurations of necessary and sufficient conditions which influence the decision to deploy intelligent software robotisation by a developing economy firm.</p>	<p>1/ All three TOE dimensions and all eight variables investigated namely, Anthropomorphism, Technology Availability, Technology Accessibility, Firm Size, Organizational Structure, Industry Characteristics, Technology Infrastructure and Regulations, are necessary and sufficient conditions in influencing the decision to deploy ISR in developing economy firms.</p> <p>2/The presence of Technology Availability as core condition in ISR deployment decisions especially in developing economies, requires notable attention. Given the importance of technology availability in the African context, this finding could probably help explain the low rates of ISR adoption on the continent</p> <p>3/The presence of Technology Infrastructure as a prevalent peripheral condition in ISR deployment decisions especially in developing economies also requires notable attention. Given the general infrastructural deficiencies in Africa, this could also be a source of the low adoption rates of ISR on the continent</p>	<p>1/The literature review (Chapter 2) confirmed low adoption rates of ISR in developing economies such as, Africa, against a backdrop of reported high failure rates of ISR projects globally. There were related calls to expand knowledge on ISR deployment dimensions (Coombs et al., 2020) which this study responded to. The TOE framework (Chapter 3) and FsQCA configurational analysis (Chapter 5) were employed to investigate conditions influencing ISR deployment decisions</p> <p>2/Theoretically, the literature review revealed a paucity of models using software robot-specific constructs to understand ISR issues, leading to calls for more of such research (Ulfert et al., 2022). This study responded to the call and incorporated anthropomorphism as a construct in the TOE model (Chapter 3)</p> <p>3/ Labour union activities came up in the literature review (Chapter 2) as a prevalent issue related to ISR deployment in Africa and required investigations. Hence it was</p>	<p>1a/This study has contributed knowledge on the technological, organisational & environmental conditions which influence ISR deployment decisions and could help explain the low adoption and high failure rates of ISR initiatives in developing economies (Chapter 5). Technology availability, Technology Infrastructure and Organizational structures, were among the notable findings in this respect. Such specific empirical analysis on low adoption and high failure rates of ISR initiatives in Africa, is lacking in the literature and hitherto, was the subject of speculation (e.g. Matinde, 2021)</p> <p>1b/From the findings of this and other objectives, this study developed a framework for the deployment of ISR in developing economies, incorporating machine, human, organisational and complementarity dimension (Chapter 7). The aim is to provide guidance to firms. This is equally sparse in the literature.</p> <p>2/Anthropomorphism had not been tested extensively as a necessary & sufficient condition for the deployment of <i>back-end</i> software robots. This study contributed some information indicating that Anthropomorphism is a condition or factor to consider in back-end software robots, though at a low level (Chapter 5&6).</p>

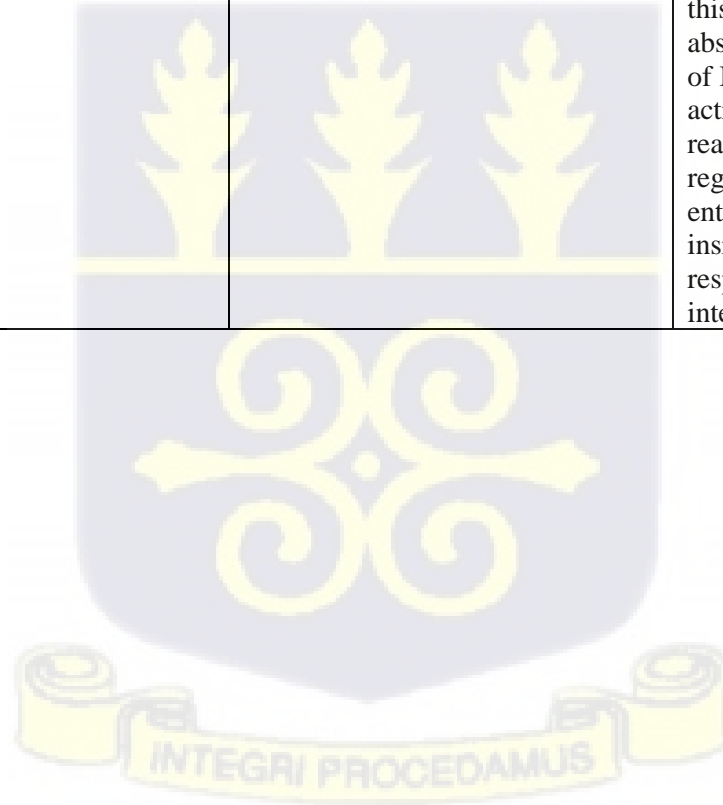
	<p>4/Organisational Structures as a single factor is quite important in influencing the ISR deployment decision in developing economy firms. Given its importance in facilitating project implementation, this finding could probably help explain the high failure rates of ISR projects and requires attention</p> <p>5/The presence of Industry Characteristics (IC) as a prevalent peripheral condition, requires notable attention in decisions to deploy ISR deployments in developing economy firms.</p> <p>6/Labour union activities, included in the measures of Industry characteristics, appear to have some influence in the ISR deployment decisions of developing economy firms.</p> <p>7/The absence of Regulations as a core condition, require notable attention in decisions to deploy ISR deployments in developing economy firms.</p>	<p>included in the TOE model (Chapter 4)</p> <p>4/The scanty use of configurational analysis in ISR subjects, and in the African context was a gap identified in the literature review (Chapter 2). It was addressed by using FsQCA to analyse research objectives 1 & 2</p>	<p>3/The finding that labour union activities (as part of industry characteristics) may require some attention in ISR deployments, is an exploratory contribution, which can be built upon in future research</p> <p>4/Methodologically, this study expands the use of configurational analysis, helping to expose its benefits (e.g. its suitability for small samples) and grow its use in IS research.</p>
<p>Research Objective 2: To analyse the configurations of sufficient and necessary conditions</p>	<p>1/ The appraisals of, the presence of (i) the Level of robotisation of an ISR event (High, Complementary), (ii) level of employee control (High, Low), (ii) the potential for self-interest fulfillment (Opportunity, Threat) are all necessary and</p>	<p>On the theme of employment security, a knowledge gap was identified in the literature on understanding employees' coping strategies, specifically in relation to software robots. Ostensibly, this was ultimately to enable</p>	<p>The level of robotisation (LOR) was found to be an influential condition in the selection of three coping strategies by employees (Benefit Satisficing, Disturbance Handling & Exit). From the literature reviewed, it would seem this study is among the rare instances where LOR (high or complementary) has been</p>

<p>which influence employees' choice of coping strategies towards the deployment of intelligent software robotisation by a developing economy firm.</p>	<p>sufficient conditions for employees to select the coping strategies of Benefit Satisficing, Disturbance Handling & Exit</p> <p>2/ The appraisals of the presence of (i) a level of employee control (High, Low), (ii) the potentials for self-interest fulfillment (Opportunity, Threat) and the absence of the Level of robotisation of an ISR event (High, Complementary), are necessary and sufficient conditions for employees to select the coping strategies of Benefit Maximizing & Self-preservation.</p> <p>3/The choice of ISR coping strategy is a complex human behaviour, sometimes defying rules, as demonstrated by (i)certain conditions leading to unexpected outcomes, such as appraisals of threat, resulting in the choice of an opportunity-related strategy such as, Benefit Satisficing; (ii) the appraisal of an LOR as both an opportunity and threat at the same time</p>	<p>employees cope better. There were related calls for research on coping with software robots (Seiffer et al., 2021; Coombs et al., 2020). This objective responded to that call with a model adapted from the CMUA (Beaudry & Pinnsonneault, 2005), incorporating the Level of robotisation (LOR) construct. In so doing, the model addressed a theoretical gap related to less models using software robot-specific constructs (earlier mentioned under anthropomorphism).</p>	<p>investigated as a factor in the selection of coping strategies towards IT events in general and for ISR specifically. The finding is useful in developing interventions to help employees cope with employment security issues in relation to ISR</p>
<p>Research Objective 3: To identify the nature of complementarity between humans and machines in intelligent software robotisation deployments in a</p>	<p>In all there were 19 findings, shown on Table 6.7 with a synopsis presented here. The findings were grouped under various themes namely, (i) Motivations for ISR Deployment (driven by need for process improvement, efficient production & quality output); (ii) Awareness of ISR (through internal</p>	<p>This objective sought to address the little attention paid in the literature, to the complementary ISR implementation approach, first as a means of job retention and allaying employment security concerns and secondly as measure for mitigating the adverse effects of a high LOR. There were related</p>	<p>The qualitative inquiry for this objective which provided in-depth information on motivations for ISR deployment, robot profile, areas of robot deployment & roles, nature of complementarity (level of robotisation, human-machine task allocation), impact of ISR and robot governance, has contributed to expanding our understanding of the implementation of ISR in developing</p>

<p>developing economy firm.</p>	<p>members); (iii) Top Management Support (available up to board level); (iv) Regulations (though planned, currently absent which is (v) due to reasons such as, immaturity of the ISR field and existence of self-regulation mechanisms within the industry); (vi) Level of robot intelligence (handled with a phased approach, starting with rules-based, moving later to advanced learning features); (vii) Anthropomorphism (mainly low level-interactivity) which could be (viii) due to reasons such as, low level of engagements with customers & users and obligatory usage requirements); (ix) Functions of the robots (mainly back-end activities); (x) Level of robotisation (mixed and mainly complementary, but (xi) aiming for more High LOR); (xii) Human-Machine Task Allocation (epistemic and mindless tasks assigned to robots, with pragmatic ones given to humans); (xiii) Benefits of ISR (expected ones including increased speed of delivery, accuracy, productivity & cost savings together with (xiv) unexpected ones such as, reduced fraud opportunities & more free weekends for staff); (xv) Employment Security (no layoffs, more redeployments, but (xvi) reported case exists of employees' anxieties about job losses requiring management intervention); (xvii)</p>	<p>calls for more investigations into complementarity (Engels et al.,2022; Asatiani et al., 2019), which this objective responded to.</p>	<p>economy firms. Such detailed qualitative data is not easily available in the literature.</p> <p>Some novel insights emerged from the qualitative inquiry which can be considered as new contributions from this study. These relate to, level of intelligence of the robots, the level of robotisation, anthropomorphism and regulations.</p> <p>On implementing the intelligence components of ISR, it emerged that the approach of developing county firms is a phased one, based on caution and thus starting with mechanical intelligence (rules-based) before moving to enhancements with advanced learning capabilities. Their caution was predicated by concerns about internal skills maturity to handle an intelligent machine environment and system security (PradTel-S & RadBPO-P). First, this is a useful insight when pitching the adoption of intelligent technologies to developing economy firms since it provides an understanding of intelligence implementation from a firm's perspective. Secondly, the finding contributes preliminary insights into addressing a gap in the literature identified by Kokina & Blanchette (2019), on the dynamics surrounding how companies transition between the various levels of intelligent robotisation.</p> <p>On the level of robotisation (LOR), most developing economy firms are aiming for a high LOR, given the cost savings and this is</p>
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	<p>Deskilling (burgeoning signs of overreliance with (xviii) mitigation measures including process manuals & running both manual and robotised processes concurrently); (xix) Robot Governance (policies available for robot management such as access management, monitoring & maintenance, etc.).</p>	<p>to be expected. The novel insight from the qualitative inquiry is related to Complementary LOR. Here again, the LOR approach is a phased one based on caution. Being mindful of the adverse effects of a High LOR, most firms are adopting Complementary LOR as a cautionary measure to build high confidence and trust in the performance of the robots, before handing over full tasks to them. Complementarity is therefore not being adopted to retain jobs and preserve skills as recommended in the literature, but is rather adopted as a cautionary measure. Again this is useful insight in understanding the implementation of complementary LOR from a firm's perspective, which was not found in the literature.</p> <p>On Anthropomorphism, the literature on assigning traits such as, names, gender, avatars, personality, communicative or interactive ability to back-end software robots is very thin. The quantitative inquiry on ISR deployment, indicated that Anthropomorphism is an influential condition in the decision to deploy ISR. The qualitative inquiry provides further information on the nature of the anthropomorphic traits assigned. Traits such as, names, gender and avatars are not so prevalent in back-end software robots; rather, they are given some level of interactivity. The reason for the absence of names, gender and so on could be the limited level of direct engagement with customers & users (duration & volume) and their</p>
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			<p>“obligatory” usage requirement. This is a useful research insight for conceptualizing anthropomorphism as a variable in software robot adoption studies, which is not easily available in the literature. This researcher's own difficulties in finding such material is notable.</p> <p>On regulations, the quantitative inquiry on ISR deployment, revealed that the absence of regulations is a core condition influencing the decision to deploy ISR in developing economies. The qualitative inquiry augments this by providing some reasons for the absence of regulations namely, categorisation of ISR as an auxiliary & enhancement activity; ISR as an immature field not yet ready for regulation and the existence of self-regulation mechanisms at the industry and enterprise levels. This contributes some useful insight to the calls for regulations on the responsible and ethical implementation of intelligence-based technologies.</p>
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8.5. IMPLICATIONS FOR POLICY

Three findings from this study stand out as having important ~~policy~~ implications for the development of policy aimed at reversing the low adoption rates of ISR in developing economies. The first ~~is~~ is the finding on technology availability as a core condition influencing decisions by firms to deploy ISR. As mentioned earlier, the comments by Musa (2006) and echoed by Asiaei & Rahim (2019), Adamu & Benachour (2020) and Thatcher & -Ndabeni (2013), not to ignore contextual factors in technology adoption, especially for emerging economies is poignant. Technology availability is one such issue which Musa (2006) indicates should not be taken for granted. Hence a deliberate effort must be made through the relevant policies to ensure the availability ISR technology. It could be efforts on awareness creation on the existence of such technologies and the benefits they bring, or encouraging vendor availability and skills development as well as making the technology affordable.

The second finding equally requiring attention is Technology Infrastructure exemplified by stable energy, broadband connectivity, data ecosystem, cybersecurity. The fact that quite a lot has been written on this (Ade-Ibijola & Okonkwo, 2023; Okolo et al., 2023; Tuffour & Nsiah, 2023; Sharma et al., 2022; Dinrifo et al., 2022; Daramola & Etim, 2022; Chen et al., 2022; Kalusopa, 2021; Smith & Neupane, 2018) and it still turns up in research findings emphasizes its criticality.

Finally the absence of regulations as a condition leading to the decision to deploy of ISR was an interesting finding but not surprising because it has been noted in the literature. In India for instance, a number of studies have noted that regulations on privacy and personal data protection could pose challenges in obtaining data to train AI models, thereby adversely impacting AI adoption (Pumplun et al., 2019; Alsheibani et al., 2020; Radhakrishnan et al., 2022).

For this study, the reasons that emerged for the absence of regulations are quite informative. These include, categorisation of ISR as an auxiliary and enhancement activity; ISR as an immature field not yet ready for regulation and the existence of self-regulation mechanisms at the industry and enterprise levels. The self-regulation mechanisms could be encouraged while monitoring this nascent field, in order not to stifle the growth and innovation.

8.6. IMPLICATIONS FOR PRACTICE

Reference is made here to this study's proposed framework for implementing ISR in developing economies (Chapter Seven). The various segments provide useful guidelines on human, machine, organisational and complementarity conditions which aim at a successful ISR deployment and the avoidance of failure in ISR initiatives

8.7. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

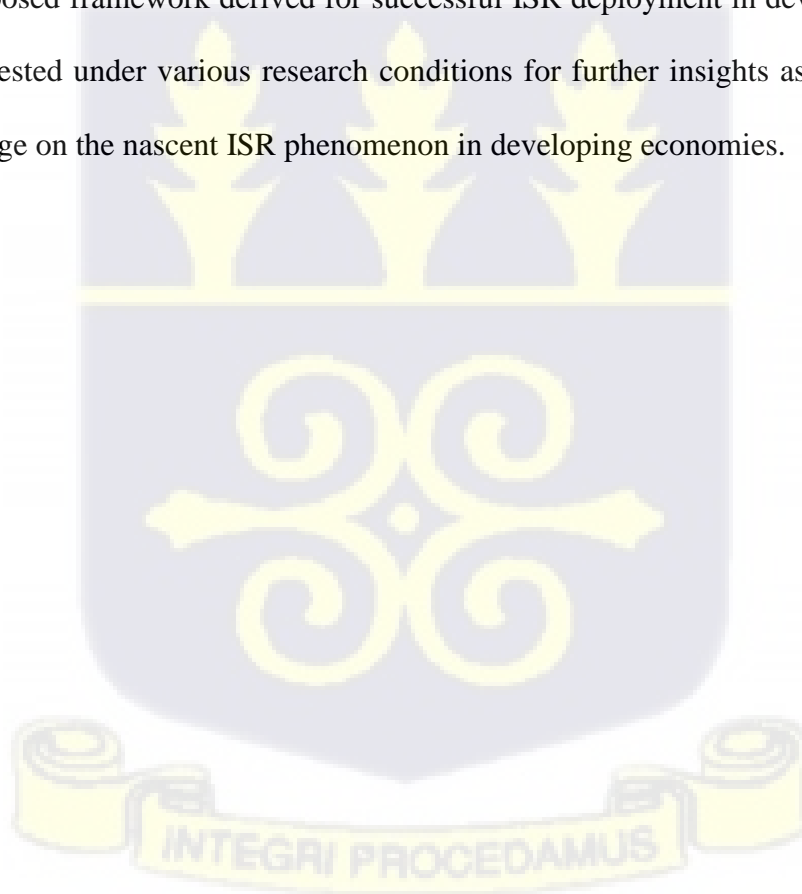
Firstly, the study was limited by the nascency of ISR, marked by the small number of companies that had deployed it. This posed some limitation on the available population for the study. In the future when ISR uptake has become widespread, further studies could take advantage of the larger population for fresh insights.

Secondly the sector scope could be expanded. The African literature reported studies mainly in the financial sector; this study also examined the financial sector but extended the scope to the telecommunication and BPO (business process outsourcing) sectors. Future studies could continue to widen the scope for possible fresh insights. Still on sectors, the case companies were all from

the private sector. It will be a useful contribution to knowledge if in future, the deployment of ISR in public institutions is investigated.

Thirdly there were a number issues which could benefit from further investigation. The labour union activities variable was examined together with others under the industry characteristics condition. It is recommended that future research investigates it as a separate variable, given its importance in the African context. Also though this study contributed some insights on companies' transition between various level of intelligence technologies, the finding is not exhaustive enough and can be used as preliminary insights which can be built upon to explore the topic further.

Finally, the proposed framework derived for successful ISR deployment in developing economy firms could be tested under various research conditions for further insights as part of efforts to expand knowledge on the nascent ISR phenomenon in developing economies.



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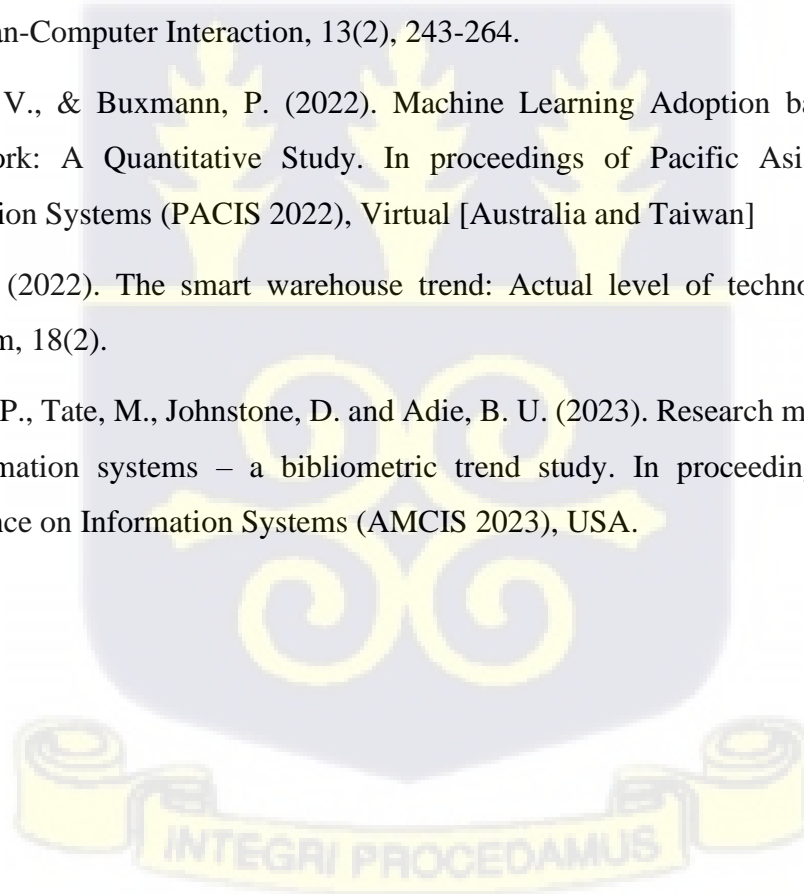
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APPENDIX A: AN OVERVIEW OF CONFIGURATIONAL ANALYSIS WITH FsQCA

Introduction

FsQCA (Fuzzy set qualitative comparative analysis) is a variant of Qualitative comparative analysis (QCA). Papas & Woodside (2021) citing Ragin (1987) indicate that “*QCA is an asymmetric data analysis technique that combines the logic and empirical intensity of qualitative approaches that are rich in contextual information, with quantitative methods that deal with large numbers of cases and are more generalizable than symmetric theory and tools*” (Papas & Woodside, 2021; p.1).

QCA uses Boolean algebra whose two prominent features are binary data (0 or 1) as primary input and the use of logic (e.g. AND, OR operators) in its analysis and procedures (Ragin, 1987; Pappas & Woodside, 2021). It is also founded on set theory, which focuses on groups and membership relationships. Given its set-theoretic foundations, what differentiates FsQCA from other variants of QCA, such as Crisp set QCA (CsQCA) is the criteria for set membership. CsQCA was the original variant developed with a strict binary membership criteria (0-out, 1-in). FsQCA is an extension of CsQCA with a wider membership criterion namely, an object with any value ranging between 0 and 1 (e.g. 0.02, 0.4, 0.99) can be a set member (Ragin, 2008b)

Regarding its qualitative and quantitative features, Ragin (1987) describes QCA as an algebraic (quantitative) technique for qualitative comparisons. The use of Boolean algebra, set theory and their related mathematical procedures characterize QCA’s quantitative dimension. Among its qualitative features are its case-oriented approach, where analysis could involve a few cases as happens in the case study approach often associated with qualitative research (Ragin, 1987). Its configurational technique of looking for several possible combinations of causes, as against

calculating for one best combination, is also typically qualitative. Furthermore, the qualitative research practices of deferring to the researcher's orientation, views and knowledge, rather than purely mathematical tools alone, in the calibration process (transforming categorical data into numerical data), development of truth tables, simplifying the several complex solutions presented and interpreting results, are also qualitative features of QCA (Papas & Woodside, 2021).

The following are some QCA lexicon: “outcomes”, are phenomena of interest to the researcher (e.g. IS adoption); “conditions” are causal factors of an “outcome”; “configurations” are combinations of conditions and “cases” are instances of outcomes (Ragin, 1987; Legewie, 2013; Kane et al., 2014; Papas & Woodside, 2021).

Major Assumptions

The major principal assumptions of FsQCA are, equifinality, conjunctural causation and asymmetrical relationships. Equifinality is the principle that there are multiple combinations of conditions that can produce an outcome or the absence of the outcome (Kane et al., 2014). Conjunctural causation, refers to the principle that single conditions acting on their own may not cause a condition but can do so in conjunction with other conditions (Kane et al., 2014). Asymmetrical relations describe the principle that a condition (or a combination of conditions) that explains the presence of an outcome, may not be the same conditions whose absence cause the absence of the same outcome (Pappas & Woodside, 2021).

Thus comparatively, according to Papas & Woodside (2021), traditional variance-based statistical analysis which rely on null hypothesis significance testing (NHST), will usually look for a single best solution linking conditions and their outcome. However, QCA techniques such as, FsQCA which rely on set theory and Boolean algebra, would look for the different combinations of conditions (configurations) that lead to a given outcome. Also, while variance-based techniques

assume a linear relationship between conditions and outcomes, FSQCA takes the position that, these relationships are complex and may not always be linear. Finally whereas variance-based analysis assume a symmetric relationship between conditions and outcomes, FSQCA assumes an asymmetric one.

Description of Solutions

An important pillar of configurational analysis are the descriptions of the solutions offered by the techniques, such as, necessary conditions, sufficient conditions, core conditions, peripheral conditions, complex solutions, parsimonious solutions and intermediate solutions. It must be noted that solutions take into account, both the presence and absence of a condition.

Kane et al. (2014) indicate that *necessary conditions* are conditions or combinations of conditions whose presence are required for the occurrence of an outcome hence when they are absent, the outcome will not occur; *sufficient conditions* are a number of conditions whose presence will lead to an outcome but the absence of a couple of them, will not overall, affect the outcome's occurrence. Papas & Woodside (2021) note that *core* conditions show a stronger relationship between conditions and outcomes than *peripheral conditions* and hence cannot be taken out of any solution. The authors also describe *complex* solutions as presenting all the possible combinations of conditions, while *parsimonious* solutions are a simplified version of the complex solutions based on simplifying assumptions set by the researcher and most likely include core conditions. *Intermediate* solutions are a subset of the complex solutions and include parsimonious solutions and some peripheral conditions.

Measures of solution relevance

There are several types of consistency measures such as, raw consistency, PRI consistency and solution consistency (Pappas & Woodside, 2021; Mattke et al., 2022; Park et al., 2017). This study focuses on the consistency measure for individual configurations, referred to simply as “*consistency*” and the measure for the whole group of configurations in a solution set or dataset, referred to as “*overall solution consistency*”, which tests “the degree to which all configurations together consistently result” in the outcome (Park et al., 2017; pp. 664). A reasonably high consistency is acceptable for reliability. The two consistency measures described are widely used and also employed by the FsQCA software. Thresholds for consistency measures are presented in Table 5.3.

The second measure in relation to necessity and sufficiency is *coverage* which generally refers to the extent to which *cases* with the same conditions also show the same outcome (Mattke et al., 2022). It has also been explained as the percentage of *cases* which have a given configuration as the cause of the outcome being investigated (Fiss, 2011) or the proportion of the outcome’s causal conditions which are covered by a given condition or combination of conditions (Park et al., 2017). As in the case of consistency, there are also several types of coverage such as, *raw coverage* and *unique coverage* which deal with individual configurations, while *overall solution coverage* assesses all the configurations leading to the outcome together.

Raw coverage refers to the proportion of *cases* that have a given configuration as a cause of the outcome, acknowledging the existence of other configurations also causing the outcome within those cases (Park et al., 2017). “Thus, it shows an empirical relevance and effectiveness of the solution for the outcome, although a higher [raw] coverage does not necessarily mean theoretical importance (Park et al., 2017; p.664). *Unique coverage* on the other hand measures the proportion

of cases which have a given configuration as the *sole* or exclusive cause of the outcome, with no other configurations leading to the outcome within those cases (Mattke et al., 2022). Unique coverage is calculated as a control of overlap in the configurations, hence a very low unique coverage points to considerable overlap and the possible dominance of a given configuration just exhibiting slight variations (Rubinson et al., 2019). Several thresholds have been suggested for unique coverage. For instance several researchers (Schneider et al. 2010; Alves & Lourenco, 2023), some referencing Ragin, have used a threshold of 'greater than 0' and eliminated configurations with 0 unique coverage. Others such as, Woodhouse (2013) and Uruena & Hidalgo (2016) have employed generic thresholds for all coverages including unique coverage and set the bar at between 0.25 and 0.65.

The *overall solution coverage*, measures the extent to which all the configurations together, cover or explain the causes of the outcome; it is comparable with the R-square metric in regression analysis (Pappas & Woodside (2021). Thresholds for the various coverages are provided in Table 5.3.

The final measure of necessity and sufficiency, which is closely related to coverage is the *frequency threshold*, which sets a minimum limit for the number of cases in which a given configuration should be found in order to be considered sufficient (Mattke et al., 2022; Pappas & Woodside, 2021). Thus for instance, with a frequency threshold of 4, only configurations that appear in 4 or more cases are selected as sufficient. It must be noted that a higher frequency threshold reduces the coverage, while a lower frequency threshold increases it. For small N samples, a threshold of 1 or 2 is recommended while for large sample, a much higher number, at least 3 is recommended (Mattke et al., 2022; Pappas & Woodside, 2021).

Benefits and Criticisms

The benefits of FSQCA includes its ability to deal with the complexity of causality by identifying the different combinations of conditions that lead to the presence or absence of an outcome; it also allows analysis with smaller samples (Legewie, 2013). Some of the criticisms of FSQCA concern its failure in measuring the strength or contribution of each condition in the causation of an outcome; the issue of the possibility of subjective bias from a reliance on the researcher's knowledge and views has also been noted (Papas & Woodside).

Uses in IS research

In IS research, the use of configurational analysis in general is comparatively few but progressing steadily. Configurational techniques have for example, been used to study functionalities and potential motivators for a digital coaching system (Mezei et al., 2020); intention to use Blockchain-based decentralized finance (Meier et al., 2022) and guidelines for using QCA (Mattke et al., 2022);

In relation to this study's subjects, FsQCA has been used to examine the adoption of AI in European organisations (Laut et al., 2021); the adoption of Industry 4.0 among manufacturing SMEs also in Europe (Marrucci et al., 2023); employee perceptions and reactions to RPA (Waizenegger & Techatassanasoontorn, 2020) and the effect of personality profiles on coping with technostress (Peters & Feste, 2023).



APPENDIX B: COMPLEX SOLUTIONS FOR COPING STRATEGIES

ASSESSING HIGH LEVEL OF ROBOTISATION (LORH) COPING STRATEGIES

Benefit Maximizing Under LORH

Table B.1: Complex Solution for Benefit Maximizing under LORH

Configuration	Complex Solution	
	1	2
High Level of Robotisation		⊗
Appraisal of Threat	⊗	
Appraisal of Opportunity	●	●
Consistency	0.88	0.91
Raw Coverage	0.75	0.57
Unique Coverage	0.23	0.05
Solution Coverage	0.80	
Solution Consistency	0.86	

The analysis focused on the outcome of Benefit Maximizing, a coping strategy where users appraise an ISR as an opportunity and believe they have control over the situation. The complex solution reveals two configurations that lead to the outcome of Benefit Maximizing when considering appraisals of LORH. The first configuration indicates that the appraisal of ISR as an opportunity (APO) combined with the absence of appraising it as a threat (APT) leads to Benefit Maximizing, with no influence (“don’t care” situation) by the high level of robotisation (LORH). This configuration has a raw coverage of 0.748322, meaning it explains about 74.83% of the cases leading to Benefit Maximizing. Its unique coverage is 0.229027, indicating that approximately 22.90% of the cases are exclusively explained by this configuration. The consistency of 0.882295 suggests a high level of reliability in this configuration leading to the outcome.

The second configuration involves the non-appraisal of high level of robotisation (LORH) combined with the appraisal of ISR as an opportunity (APO). This configuration has a lower raw

coverage of 0.569631 (56.96%), suggesting it is less prevalent in explaining the outcome. However, its unique coverage is relatively low at 0.0503356 (5.03%), indicating that most cases explained by this configuration are also explained by other configurations. The consistency of 0.908969 is high, reinforcing the reliability of this configuration in leading to Benefit Maximizing. The overall solution coverage of 0.798658 indicates that these configurations explain about 79.87% of all cases, and the solution consistency of 0.862319 suggests a high level of overall reliability.

Benefit Satisficing Under LORH

Table B.2: Complex Solution for Benefit Satisficing under LORH

Configuration	Complex Solution		
	1	2	3
High Level of Robotisation	•	⊗	
Appraisal of Threat	⊗	•	•
Appraisal of Opportunity			⊗
Consistency	0.86	0.83	0.83
Raw Coverage	0.57	0.40	0.57
Unique Coverage	0.27	0.03	0.13
Solution Coverage	0.87		
Solution Consistency	0.81		

The results in this section focus on Benefit Satisficing in the context of ISR. The analysis identifies configurations of conditions that lead to this particular coping strategy, which involves employees appraising an opportunity in an ISR but having limited control over the IT event and their work. The complex solution of the fsQCA reveals three configurations that contribute to the outcome of Benefit Satisficing. The first configuration suggests that an appraisal of high level of robotisation (LORH) combined with the absence of appraising it as a threat (APT) leads to Benefit Satisficing. This configuration has a raw coverage of 0.567114, indicating it explains about 56.71% of the

cases. Its unique coverage is 0.267617, showing that around 26.76% of the cases are exclusively explained by this configuration. The consistency of 0.862245 suggests a high level of reliability in this configuration leading to the outcome.

The second configuration involves the non-appraisal of a high level of robotisation (LORH) combined with the appraisal of ISR as a threat (APT). This configuration has a lower raw coverage of 0.403524 (40.35%) and a unique coverage of 0.0310403 (3.10%), indicating that it is less prevalent and less exclusive in explaining the outcome. The consistency of 0.825043 is slightly lower but still indicates a reasonable level of reliability.

The third configuration involves the absence of appraising ISR as an opportunity (APO) combined with the appraisal of it as a threat (APT). This configuration has a raw coverage of 0.57047 (57.05%) and a unique coverage of 0.13255 (13.25%), suggesting a significant role in explaining the outcome. The consistency of 0.830281 indicates a reliable configuration. The overall solution coverage of 0.872483 suggests that these three configurations explain about 87.25% of all cases, and the solution consistency of 0.809339 indicates a good level of overall reliability.

Disturbance Handling Under LORH

Table B.3: Complex Solution for Disturbance Handling under LORH

Configuration	Complex Solution	
	1	2
High Level of Robotisation	●	⊗
Appraisal of Threat	⊗	●
Appraisal of Opportunity		●
Consistency	0.84	0.90
Raw Coverage	0.58	0.31
Unique Coverage	0.37	0.10
Solution Coverage	0.68	
Solution Consistency	0.85	

Disturbance Handling involves employees responding to the appraisal of an ISR initiative as a threat while having control over the situation. The complex solution identifies two configurations that lead to the outcome of Disturbance Handling. The first configuration suggests that an appraisal of a high level of robotisation (LORH) combined with the absence of appraising an ISR as a threat (APT) leads to Disturbance Handling. This configuration has a raw coverage of 0.575283, meaning it explains about 57.53% of the cases. Its unique coverage is 0.372498, indicating that approximately 37.25% of the cases are exclusively explained by this configuration. The consistency of 0.843112 suggests a high level of reliability in this configuration leading to the outcome.

The second configuration involves the non-appraisal of a high level of robotisation (LORH), combined with the appraisal of ISR as an opportunity (APO) and as a threat (APT). This configuration has a lower raw coverage of 0.309835 (30.98%) and a unique coverage of 0.10705 (10.71%), indicating that it is less prevalent in explaining the outcome. The consistency of 0.901266 is high, reinforcing the reliability of this configuration in leading to Disturbance Handling. The overall solution coverage of 0.682333 suggests that these configurations explain about 68.23% of all cases, and the solution consistency of 0.848485 indicates a high level of overall reliability.

Self-preservation Under LORH

Table B.4: Complex Solution for Self-preservation under LORH

Configuration	Complex Solution	
	1	2
High Level of Robotisation		⊗
Appraisal of Threat	●	●

Appraisal of Opportunity	⊗	
Consistency	0.85	0.85
Raw Coverage	0.66	0.47
Unique Coverage	0.24	0.04
Solution Coverage	0.70	
Solution Consistency	0.86	

The analysis for Self-preservation, which involves employees responding to the appraisal of an ISR initiative as a threat while having limited control over the IT event and their work but being able to control themselves, revealed two configurations that lead to the outcome. The first configuration, suggests that the absence of appraising an ISR as an opportunity (APO) combined with the appraisal of an ISR as a threat (APT) leads to Self-preservation. This configuration has a raw coverage of 0.662252, meaning it explains about 66.23% of the cases. Its unique coverage is 0.235572, indicating that approximately 23.56% of the cases are exclusively explained by this configuration. The consistency of 0.854701 suggests a high level of reliability in this configuration leading to the outcome.

The second configuration involves the non-appraisal of a high level of robotisation (LORH) combined with the appraisal of ISR as a threat (APT). This configuration has a lower raw coverage of 0.46736 (46.74%) and a unique coverage of 0.0406811 (4.07%), indicating that it is less prevalent in explaining the outcome. The consistency of 0.847341 is slightly lower but still indicates a reasonable level of reliability. The overall solution coverage of 0.702933 suggests that these configurations explain about 70.29% of all cases, and the solution consistency of 0.861949 indicates a high level of overall reliability.

ASSESSING COMPLEMENTARY LEVEL OF ROBOTISATION (LORH) COPING STRATEGIES

Benefit Maximizing Under LORC

Table B.5: Complex Solution for Benefit Maximizing under LORC

Configuration	Complex Solution	
	1	2
Complementary Level of Robotisation		⊗
Appraisal of Threat	⊗	
Appraisal of Opportunity	●	●
Consistency	0.88	0.93
Raw Coverage	0.75	0.54
Unique Coverage	0.25	0.04
Solution Coverage	0.79	
Solution Consistency	0.86	

Regarding the complementary level of robotisation appraisals, two configurations leading to the Benefit Maximizing outcome were identified under the complex solutions. The first configuration, suggests that the appraisal of ISR as an opportunity (APO) combined with the absence of appraising it as a threat (APT) is a significant pathway to Benefit Maximizing. This configuration has a raw coverage of 0.748322, indicating it explains about 74.83% of the cases. Its unique coverage is 0.249161, suggesting that approximately 24.92% of the cases are exclusively explained by this configuration. The consistency of 0.882295 indicates a high level of reliability in this configuration leading to the outcome.

The second configuration involves the non-appraisal of a complementary level of robotisation (LORC) combined with the appraisal of ISR as an opportunity (APO). This configuration has a raw coverage of 0.536913 (53.69%) and a unique coverage of 0.0377518 (3.78%), indicating its

significance in explaining the outcome. The consistency of 0.927536 is quite high, suggesting a strong level of reliability. The overall solution coverage of 0.786074 suggests that these configurations explain about 78.61% of all cases, and the solution consistency of 0.860422 indicates a high level of overall reliability.

Benefit Satisficing Under LORC

Table B.6: Complex Solution for Benefit Satisficing under LORC

Configuration	Complex Solution		
	1	2	3
Complementary Level of Robotisation	⊗		⊗
Appraisal of Threat		•	•
Appraisal of Opportunity	⊗	⊗	
Consistency	0.87	0.83	0.89
Raw Coverage	0.53	0.57	0.47
Unique Coverage	0.09	0.14	0.03
Solution Coverage	0.70		
Solution Consistency	0.83		

The complex solution reveals three configurations that lead to the Benefit Satisficing outcome. The first configuration indicates that the non-appraisal of a complementary level of robotisation (LORC) combined with the absence of appraising an ISR as an opportunity (APO) is a significant pathway. This configuration has a raw coverage of 0.526846, meaning it explains about 52.68% of the cases, and a unique coverage of 0.0931208, indicating that it exclusively explains about 9.31% of the cases. The consistency of 0.869806 suggests a high level of reliability in this configuration leading to the outcome.

The second configuration, \sim APO*APT, involves the absence of appraising an ISR as an opportunity (APO) combined with the appraisal of ISR as a threat (APT). This configuration has

a raw coverage of 0.57047 (57.05%) and a unique coverage of 0.136745 (13.67%), showing its significance in explaining the outcome. The consistency of 0.830281 is quite reliable.

The third configuration includes the absence of a complementary level of robotisation (LORC) and the appraisal of ISR as a threat (APT). It has a raw coverage of 0.473154 (47.32%) and a unique coverage of 0.0394296 (3.94%), with a consistency of 0.88959, indicating a strong level of reliability. The overall solution coverage of 0.70302 suggests that these configurations explain about 70.30% of all cases, and the solution consistency of 0.827246 indicates a high level of overall reliability.

Disturbance Handling Under LORC

Table B.7: Complex Solution for Disturbance Handling under LORC

Configuration	Complex Solution	
	1	2
Complementary Level of Robotisation	•	⊗
Appraisal of Threat	•	•
Appraisal of Opportunity	⊗	•
Consistency	0.88	0.87
Raw Coverage	0.56	0.32
Unique Coverage	0.36	0.12
Solution Coverage	0.67	
Solution Consistency	0.88	

The Disturbance Handling strategy has two complex solutions that influence its outcome. The first configuration suggests that the appraisal of a complementary level of robotisation (LORC) combined with appraising ISR as an opportunity (APO) and the absence of appraising it as a threat (APT) is a significant pathway. This configuration has a raw coverage of 0.555266, meaning it explains about 55.53% of the cases, and a unique coverage of 0.356832, indicating that it

exclusively explains about 35.68% of the cases. The consistency of 0.876374 suggests a high level of reliability in this configuration leading to the outcome.

The second configuration involves the non-appraisal of a complementary level of robotisation (LORC), combined with appraising ISR as an opportunity (APO) and appraising it as a threat (APT). This configuration has a raw coverage of 0.316797 (31.68%) and a unique coverage of 0.118364 (11.84%), showing its significance in explaining the outcome. The consistency of 0.870813 is quite reliable. The overall solution coverage of 0.673629 suggests that these configurations explain about 67.36% of all cases, and the solution consistency of 0.883562 indicates a high level of overall reliability.

Self-preservation Under LORC

Table B.8: Complex Solution for Self-preservation under LORC

Configuration	Complex Solution	
	1	2
Complementary Level of Robotisation		⊗
Appraisal of Threat	●	●
Appraisal of Opportunity	⊗	
Consistency	0.85	0.88
Raw Coverage	0.66	0.53
Unique Coverage	0.18	0.05
Solution Coverage	0.71	
Solution Consistency	0.86	

The complex solution from the fsQCA identifies two configurations that lead to the Self-Preservation outcome. The first configuration suggests that the absence of appraising ISR as an opportunity (APO) combined with appraising it as a threat (APT) is a significant pathway. This configuration has a raw coverage of 0.662252, meaning it explains about 66.23% of the cases, and

a unique coverage of 0.182592, indicating that it exclusively explains about 18.26% of the cases. The consistency of 0.854701 suggests a high level of reliability in this configuration leading to the outcome.

The second configuration involves the non-appraisal of a complementary level of robotisation (LORC) combined with appraising ISR as a threat (APT). This configuration has a raw coverage of 0.526017 (52.60%) and a unique coverage of 0.0463576 (4.64%), showing its significance in explaining the outcome. The consistency of 0.876972 is quite reliable. The overall solution coverage of 0.708609 suggests that these configurations explain about 70.86% of all cases, and the solution consistency of 0.858945 indicates a high level of overall reliability.

Exit Under LORC

Table B.9: Complex Solution for Exit under LORC

		Complex Solutions			
		1	2	3	4
Complementary Level of Robotisation		⊗		⊗	•
Appraisal of Threat			•	•	⊗
Appraisal of Opportunity		⊗	⊗		•
Consistency		0.82	0.75	0.77	0.83
Raw Coverage		0.52	0.54	0.43	0.53
Unique Coverage		0.05	0.11	0.01	0.23
Solution Coverage		0.88			
Solution Consistency		0.72			

The complex solution identifies four configurations that lead to the Exit outcome. The first configuration suggests that the non-appraisal of a complementary level of robotisation (LORC) and absence of appraisal of ISR as an opportunity (APO) is a significant pathway. This configuration has a raw coverage of 0.518486, meaning it explains about 51.85% of the cases, and

a unique coverage of 0.046655, indicating that it exclusively explains about 4.67% of the cases. The consistency of 0.81579 suggests a moderate level of reliability in this configuration leading to the outcome.

The second configuration involves the absence of appraising ISR as an opportunity (APO) combined with appraising it as a threat (APT). This configuration has a raw coverage of 0.539613 (53.96%) and a unique coverage of 0.105634 (10.56%), showing its significance in explaining the outcome. The consistency of 0.748474 is somewhat reliable.

The third configuration and the fourth further elaborate on the combinations of appraisals and control levels leading to the Exit strategy. The overall solution coverage of 0.880282 suggests that these configurations explain about 88.03% of all cases, and the solution consistency of 0.71582 indicates a moderate level of overall reliability.

fsqca SOFTWARE MATERIALS

Figure B.1: Calibrations for ISR Coping Strategies Conditions

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	LORH1	LORC1	APO1	APT1	COBM1	COBS1	CODH1	COSP1	COEX1	LORH	LORC	APO	APT	COBM	COBS	CODH	COSP	COEX
2	2.6	3.4	4.5	1.25	5	2.33	3.67	1	3	0.17	0.37	0.79	0.09	0.95	0.18	0.24	0.05	0.39
3	2.4	3.6	3.5	2.5	3.33	2.67	3.33	2.67	4	0.11	0.46	0.16	0.61	0.23	0.26	0.11	0.65	0.77
4	2.8	2.2	4	2.25	4	4	4.33	2.33	2.5	0.25	0.05	0.43	0.52	0.49	0.76	0.69	0.5	0.25
5	3.4	4	5	1	5	3.67	4.67	3	3	0.61	0.68	0.95	0.05	0.95	0.63	0.87	0.77	0.39
6	4	3.8	5	1.5	5	3.67	4.33	3	3	0.91	0.57	0.95	0.15	0.95	0.63	0.69	0.77	0.39
7	4	4.8	4.25	1.5	4.67	5	4.67	2.33	3	0.91	0.93	0.62	0.15	0.88	0.95	0.87	0.5	0.39
8	2.6	2.6	4.25	2.75	4	4	5	3.67	3	0.17	0.1	0.62	0.69	0.49	0.76	0.95	0.92	0.39
9	3.6	2.6	3	2	2.33	4.67	5	1	5	0.75	0.1	0.05	0.38	0.05	0.92	0.95	0.05	0.95
10	4.2	4	4	3.75	3.67	3.67	4	2.33	3	0.95	0.68	0.43	0.91	0.35	0.63	0.44	0.5	0.39
11	4	3.4	3.5	2	3.33	3.67	3	2.67	3	0.91	0.37	0.16	0.38	0.23	0.63	0.05	0.65	0.39
12	3.2	5	4	4.25	4.33	4.67	4.67	4	4.5	0.46	0.95	0.43	0.95	0.72	0.92	0.87	0.95	0.89
13	3.6	3.6	3	4	4.33	4	3.67	3.33	2	0.75	0.46	0.05	0.93	0.72	0.76	0.24	0.86	0.15
14	4	4	4	2.5	3.67	3.67	3.67	2.67	4	0.91	0.68	0.43	0.61	0.35	0.63	0.24	0.65	0.77
15	3.2	4	4.5	1.25	4	4	4.67	2	5	0.46	0.68	0.79	0.09	0.49	0.76	0.87	0.33	0.95
16	3.6	4	3.5	3.25	3.67	3.67	3	4	3	0.75	0.68	0.16	0.82	0.35	0.63	0.05	0.95	0.39
17	3	2.8	4.75	1.25	5	1.33	3.67	1.33	1	0.35	0.14	0.9	0.09	0.95	0.05	0.24	0.1	0.05

Figure B.2: fsqca Software Output (Benefit Maximising-COBM)

```

Model: COBM = f(LORH, APO, APT)
Algorithm: Quine-McCluskey

--- COMPLEX SOLUTION ---
frequency cutoff: 1
consistency cutoff: 0.873418

      raw      unique
      coverage  coverage  consistency
-----
APO*~APT      0.748322    0.229027    0.882295
~LORH*APO     0.569631    0.0503356   0.908969
solution coverage: 0.798658
solution consistency: 0.862319

Cases with greater than 0.5 membership in term APO*~APT: 3.4 (0.95,0.95),
  2 (0.95,0.95), 3 (0.9,0.95), 4 (0.9,0.35),
  4 (0.85,0.95), 2.6 (0.79,0.95), 3.2 (0.79,0.49),
  4 (0.62,0.88), 2.8 (0.62,0.49)
Cases with greater than 0.5 membership in term ~LORH*APO: 2 (0.95,0.95),
  2.6 (0.79,0.95), 3 (0.65,0.95), 2.6 (0.62,0.49),
  2.8 (0.62,0.49), 3.2 (0.54,0.49)
*****
*TRUTH TABLE ANALYSIS*
*****

```

Figure B.3: fsqca Software Output (Exit-COEX)

```

Model: COEX = f(LORC, APO, APT)
Algorithm: Quine-McCluskey

--- COMPLEX SOLUTION ---
frequency cutoff: 1
consistency cutoff: 0.822719

      raw      unique
      coverage  coverage  consistency
-----
~LORC*~APO    0.518486    0.046655    0.81579
~APO*APT      0.539613    0.105634    0.748474
~LORC*APT     0.430458    0.000880301 0.771293
LORC*APO*~APT 0.53169     0.233275    0.82967
solution coverage: 0.880282
solution consistency: 0.71582

Cases with greater than 0.5 membership in term ~LORC*~APO: 3.6 (0.9,0.95),
  4 (0.63,0.39), 2.8 (0.57,0.25), 3 (0.57,0.39),
  2.4 (0.54,0.77), 3.6 (0.54,0.15), 3.2 (0.54,0.39)
Cases with greater than 0.5 membership in term ~APO*APT: 3.6 (0.93,0.15),
  3.6 (0.82,0.39), 2.4 (0.61,0.77), 2.6 (0.61,0.77),
  4.2 (0.57,0.39), 3.2 (0.57,0.89), 4 (0.57,0.77),
  3 (0.57,0.39), 3.2 (0.57,0.39), 2.8 (0.52,0.25)
Cases with greater than 0.5 membership in term ~LORC*APT: 2.6 (0.69,0.39),
  3 (0.69,0.39), 2.4 (0.54,0.77), 3.6 (0.54,0.15),
  3.2 (0.54,0.39), 2.8 (0.52,0.25)
Cases with greater than 0.5 membership in term LORC*APO*~APT: 2 (0.84,0.39),
  4 (0.77,0.95), 3.4 (0.68,0.39), 3.2 (0.68,0.95),
  4 (0.62,0.39), 4 (0.57,0.39), 2.8 (0.57,0.57)
*****
*TRUTH TABLE ANALYSIS*
*****

```

Figure B.4: fsqca Software Output (ISR Deployment conditions)

```

Model: DP = f(AT, TAV, TAS, SZ, OS, IC, TI, RS)
Algorithm: Quine-McCluskey

--- COMPLEX SOLUTION ---
frequency cutoff: 1
consistency cutoff: 0.914966

              raw      unique
              coverage  coverage  consistency
              -----  -----  -----
AT*TAV*SZ*OS*IC*TI*RS      0.288274    0.0618892    1
~AT*~TAV*~TAS*~SZ*OS*~IC*~TI*~RS    0.26873    0.0830619    1
~AT*TAV*~TAS*~SZ*OS*IC*TI*~RS      0.184039    0.0252443    0.965812
~AT*~TAV*TAS*~SZ*OS*IC*TI*~RS      0.20114    0.051303    1
AT*TAV*~TAS*~SZ*OS*~IC*TI*~RS      0.251629    0.0464169    0.990385
~AT*TAV*TAS*SZ*OS*IC*TI*~RS      0.219055    0.0399023    0.914966
AT*TAV*TAS*SZ*OS*IC*TI*RS      0.213355    0.0407166    1
solution coverage: 0.635179
solution consistency: 0.955882

Cases with greater than 0.5 membership in term AT*TAV*SZ*OS*IC*TI*RS: 4 (0.63,0.81),
  3.75 (0.56,0.81)
Cases with greater than 0.5 membership in term ~AT*~TAV*~TAS*~SZ*OS*~IC*~TI*~RS: 3 (0.62,0.81)
Cases with greater than 0.5 membership in term ~AT*TAV*~TAS*~SZ*OS*IC*TI*~RS: 2.75 (0.57,0.49)
Cases with greater than 0.5 membership in term ~AT*~TAV*TAS*~SZ*OS*IC*TI*~RS: 3.25 (0.75,0.95)
Cases with greater than 0.5 membership in term AT*TAV*~TAS*~SZ*OS*~IC*TI*~RS: 3.75 (0.52,0.49)
Cases with greater than 0.5 membership in term ~AT*TAV*TAS*SZ*OS*IC*TI*~RS: 3 (0.51,0.27)
Cases with greater than 0.5 membership in term AT*TAV*TAS*SZ*OS*IC*TI*RS: 4.25 (0.64,0.95)
*****
*TRUTH TABLE ANALYSIS*
*****

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APPENDIX C: CASE DESCRIPTION OF INDUSTRIES OF SAMPLED COMPANIES

The case country is the West African nation of Ghana located on the Atlantic coast with a population of 30.8 million (Ghana Statistical Service, 2022). Ghana's annual GDP for 2022 at current prices was estimated at 601.2 billion Ghana cedis (GhC) or USD 73.77 billion (Ghana Statistical Service, 2023a; World Bank, 2023b) and at constant prices, GhC 179.9 billion (Bank of Ghana, 2024a). This was contributed mainly by agriculture (20.9%), industry (34.2%) and services (44.9%) (Ghana Statistical Services, 2023a). Ghana is the world's second largest cocoa producer (Boysen et al., 2023; GCB Bank, 2023a). Also in 2022 it regained the top spot as Africa's largest mine gold producer (Akorlie, 2023) and the eleventh largest producer in the world by some estimates (United States Geological Survey, 2023). Currently the country is experiencing an economic and financial crisis marked by high inflation, high interest rates and a weak currency, due to external shocks, high public debt and a tightening of global financing conditions (African Development Bank Group, 2023; World Bank, 2023c) Consequently in 2023 the country obtained a three-year Extended Credit Facility from the IMF. The conditions of the IMF deal include a USD 3 billion bailout in exchange for a raft of austerity measures, such as, reduction in public expenditure, increased revenue generation (taxation) and negotiations on debt repayments (World Bank, 2023c). As a result, though economic recovery is predicted from 2024 onwards, businesses and individual in the meantime have braced themselves for some tough economic conditions in the coming few years, emanating from the austerity measures.

The case companies comprise two (2) banks, one (1) insurance company, one (1) mobile telecommunications network company and one (1) business processing outsourcing company. The

next sections provide a synopsis of the sectors to which these companies belong, with brief overviews of the companies themselves.

Banking

Ghana's banking sector is a vibrant and competitive one made up of regular banks, community banks, microfinance institutions and savings & loans firm. The focus of this study is on the regular banks which are 23 in number (Bank of Ghana, 2024b), with diverse indigenous and non-indigenous ownership structures. Nine (9) of the banks, representing 39%, are Ghanaian owned. Others originate and are headquartered in Nigeria (5, 23%), South Africa (3, 13%), Mali (1), Britain (1), France (1), Trinidad & Tobago (1) and a conglomeration of nations (2). For three years since 2022, the top four banks by total assets have been three foreign owned and one Ghanaian owned banks (Graphic Communications Ltd, 2023). The banks together with other institutions in the financial sector including insurance companies, contributed 3% of GDP in 2022 (Ghana Statistical Service, 2023a) and employed 1.1% of total employed persons, compared to 38.3% in agriculture, 21.3% in wholesale & retailing and 11.9% in manufacturing as at 2017, according to the Ghana Living Standards Survey 7 (Ghana Statistical Service, 2019). In relation to access, most of the large banks have branches in the major cities and towns of the country with minimal presence in the rural areas. The rural and community banks which are largely community-owned but also licensed by the regulator, serve the rural areas. There are also a number of microfinance institutions, savings & loans entities and credit unions which equally serve the rural folks. The proportion of Ghanaians above 15 years reported to own a bank account was 41% in 2018 rising to 58% in 2021 and dropping to 39.2% in 2023 (Sasu, 2023).

Banks in Ghana provide services commensurate with those offered by top banks around the world, in areas such as corporate, investment and commercial banking. Some of the banks are universal

banks capable of offering a wide range of services while other specialize in areas such as, investment. According to the Bank of Ghana's (2023a) Monetary Policy Report, the main source of funding for banks in Ghana are deposits, which contributed 77.6% of funds for the sector as at August 2023. Also, investments in government short-term instruments (treasury bills) accounted for 51% of the banks' investment portfolio while long-term securities investments amounted to 48.8%, for the same period.

In commercial and retail banking, the sources of competition for the regular Ghanaian banks are their fellow banks, the rural and community banks, microfinance institutions, savings & loans firms, credit unions and electronic money issuers (EMIs) such as, the telecommunications companies and fintechs who provide mobile money services. For instance, the introduction of mobile money has seen financial transactions on these platforms grow phenomenally yearly and surpassing that of the banks. In December 2022, the total value of mobile money transactions was Ghc122 billion compared to Ghc26.6 billion from cleared bank cheques and Ghc 6.9 billion from internet banking; by December 2023, the value of mobile money transactions had risen to Ghc199.3 billion, while the value of cheques cleared fell slightly to Ghc 25.1 billion and internet banking increased substantially to Ghc12.1 billion but both together falling way below the value of mobile money transactions (Bank of Ghana, 2024c). Mobile money has fostered financial inclusion and afforded both existing and potential bank customers (the unbanked and rural population) the opportunity to perform financial transactions such as, payment for goods & services by businesses, deposits, remittances, payments of bills (utilities, TV) and school fees, most of which were formerly done and are still being done at the banks.

Banks in Ghana are among the foremost adopters of modern technology and offer services such as, internet banking, linking of mobile money accounts from other providers to bank accounts,

provision of customer service via chatbots and the use of mobile apps for banking services. The motivations for technology adoption and digital banking include, improving or gaining competitive advantage; offering customers greater convenience, flexibility and control over their bank transactions; reducing inefficiencies such as, long queues inside banking halls, to achieve higher productivity and offering services in a cost-effective manner to help grow profits (Domeher et al., 2014)

The banking sector has gone through a number of crisis in the last decade, two of the significant ones are noted here. The first is the financial sector clean-up from August 2017 to about 2019 during which 9 banks, 347 microfinance companies, 39 microcredit companies/moneylenders, 15 savings & loans companies 8 finance house companies and 2 non-bank financial firms had their licenses revoked (Bank of Ghana, 2019). Reasons for the revocation included failure to meet new recapitalization threshold and various breaches of licensing regulations, such as excessive risk taking, weak corporate governance practices and personal use of depositors' fund. This led to a number of mergers and put a lot of pressure on the 23 remaining banks (out of the 34) to stay viable. The second event is the domestic debt exchange programme (DDEP) launched in December 2022 as part of measures to address the country's high public debt situation including the IMF deal. It involved institutional bond holders (e.g. banks) and excluded individual bond holders and treasury bills. The government offered to exchange existing bonds for new ones with extended maturity dates and reduced interest rates, while preserving the principals without a haircut (Ofori-Atta, 2022). Given banks' high investments in government long-term securities (48.8%) as noted earlier, the DDEP resulted in an increase in impairment losses on financial assets for the banks, from 28.7% in August 2022 to 36.4% in August 2023 (Bank of Ghana, 2023a). For

2022, only 6 out of the 23 banks posted profits before tax, compared to 20 in 2021 and 21 in 2020 (Graphic Communications Ltd, 2023).

The two banks selected for the study are among the top 4 banks (by assets) in the country and are both foreign owned. As at August 2023, Bank A's total assets were valued at nearly GHC19 billion while Bank B's was about GHS17 billion. The two banks have similar operational characteristics, reflecting the intense competition among the top banks in the country. They are both universal banks catering to both corporate and individual clients and have branches in most of the major cities in the country. They both offer a diverse range of digital banking services on their websites and through their mobile apps. They were among the few companies in the country which have implemented ISR and were thus selected.

Insurance

Ghana's insurance industry is as vibrant and competitive as the banking sector, but not as large. From the regulator's latest published industry report, in 2021 the insurance industry's total assets stood at Ghc 11.2 billion and it employed 14,000 persons (National Insurance Commission, 2023).

The insurance sector comprises both indigenous and non-indigenous companies who offer, life and non-life insurance products (motor vehicle, property, accident, fire, general liability). The non-life segment accounted for 51.9% (Ghc2.7 billion) of premiums in the industry in 2021 with the life sector accounting for 48.1% (Ghc 2.5 billion) (National Insurance Commission, 2023).

Average daily claims paid in 2021 stood at GHc1.7 million. Penetration rate is 1.14% excluding health insurance and pensions which are regulated separately by other constitutionally mandated bodies and outside the authority of the National Insurance Commission. They are thus not included in this synopsis.

As at 2021, according to the National Insurance Commission annual report, there were 28 non-life insurance companies, 20 life insurers, 3 reinsurance companies, 101 insurance intermediaries, 3 loss adjusters and 5 reinsurance brokers (National Insurance Commission, 2023). Furthermore, the report notes that, in terms of market share based on premiums, the top ten life insurers in 2021 contributed 76% of total premiums in the life segment, while in the non-life sector, the top ten market leaders contributed 66% of the premiums. Of these, 70% (7) of the non-life insurers are Ghanaian owned firms while the remaining 30% are from South Africa (2) and Senegal (1). In contrast, foreign-owned firms from South Africa (3), UK (2), and Germany (1) dominate the top ten market leadership in the life sector, constituting 60%, with Ghanaian firms (4) taking up the remaining 40%.

In relation to competition, there are about 7000 agents (including telcos and banks) trying to sell to a relatively low customer base (National Insurance Commission, 2023; GCB Bank, 2023b). Furthermore, there is demand for only a few insurance products, which consequently attract more investments to crowd their space and create more competition in that direction. Thus, in the non-life segments, motor vehicle insurance and fire insurance for commercial buildings are compulsory by law and hence account for over 80% of client spending, with the rest contributing less than 20% (GCB Bank, 2023b). The life sector is disadvantaged in that regard because there was no compulsory life insurance until recently under the new insurance act. Further on competition, more players are being granted access to the industry, under the new act, briefly outlined in the next paragraph. Also, initiatives to address the low penetration rate, according to Commission, include the roll out of innovative products and expansive customer education campaign.

One of the notable events in the insurance industry is the new act, titled Insurance Act 2022, (Act 1061), which seeks to ensure better controls, offer better protection to stakeholders and engender

industry growth. Some of its provisions to actualise these goals include more compulsory insurance for imports by sea (marine), public liability (for accidents on a business premises) and professional indemnity (for risks emanating from professional advice). It also makes provisions to promote agriculture and microinsurance in Ghana. The Act also expands investment access to the industry by now permitting foreign insurers not licensed in the country to open contact offices with the approval of the National Insurance Commission (Insurance Act, 2021 (Act 106), 2021)

Another significant event in the industry is the revision of the minimum capital requirements for insurance companies which was raised in 2019 by 233% from Ghc 15m to 50m (National Insurance Commission, 2019) with a compliance deadline of 2022. The reason is to ensure the growth and robustness of the sector. Consequently, indigenous companies who could not meet the requirements have had to turn to much more resourced foreign-owned insurers who now have the opportunity to expand their operations with partnerships or mergers thereby broadening the competition landscape (Williams, 2022).

On the technology front, the insurance industry has equally embraced digital technologies to improve operational processes and strengthen distribution of insurance products. Though traditional paper-based processes still exist to a large extent, digital technologies are gradually gaining grounds. Hence for instance, to renew one's motor vehicle insurance (a highly demanded service), one need not go to an insurance office to spend long hours in queues. One can scan and upload their old policy to a designated location, pay for the new policy by mobile money when approved and receive the policy by email. Paper insurance stickers which are pasted on vehicles to signal compliance to law enforcement officials, are also now optional. The Motor Insurance Database (MID) created in 2020 can be queried via a mobile phone short code, using a vehicle's registration number, to check the insurance status of a vehicle. The MID has been credited with

reducing the incidence of premium rate undercutting and contributed to profit realization in the non-life sector for the first time in three years as at 2021. A similar database, the Marine and Aviation Insurance Database is planned. The MID and the use of digital technologies has “ensured comfort, convenience, and undisrupted services in paying and receiving premiums” (National Insurance Commission, 2023, p.43).

The insurance company selected for the study is among the top ten non-Life insurers (by assets) in the country with nearly 7% of the market share and about Ghc 470 million in total assets as at September 2023. The company also has operations in the life sector. It is Ghanaian owned and headquartered in Accra, but with branches in the major urban canter in the country.

Telecom

The telecom industries in developing economies, are very key players in both technological and economic development. They provide the digital and communication infrastructure and services which support and power most of the modern digital technology innovations driving private sector business value propositions and public sector services. They also provide jobs either directly or indirectly and contribute significantly to government revenues. However they also face some tough operating conditions. Ghana’s telecom’s industry exemplifies this.

Post independence, Ghana’s telecommunications sector like most others around the world, used to be dominantly state-owned until the 1990s when it was deregulated. Liberalisation has been attributed to a number of factors including, the growing global trend of weaning the industry off state control and monopolies which began in the US in the 1980s; pressure from international development aid agencies such as, the World Bank to address operational inefficiencies as part of aid conditions, and also government’s own efforts to modernise and reform the industry in response to changing national and consumer needs, to enable it play a much more effective role in

socio-economic development (Frempong & Atubra, 2001; Tobbin, 2010). The launch of the Accelerated Development Programme (ADP) in 1994 and National Telecom Policy in 2004 are key policy milestones which drove significant changes in the industry. Other important events include the granting of licenses to private investors to operate mobile telecommunication services in 1992 beginning with Mobitel; the setting up of the National Communication Authority in 1996 to regulate the industry; the separation of the state-owned telecommunications company, Ghana Telecom, from the postal services and its incorporation as a public liability company in 1995, followed by its subsequent partial privatisation in 1997 with a sale of 30% stake to Telekom Malaysia; at the same time the granting of a license to Westel in 1997 to operate fixed line services to ensure a duopoly with Ghana Telecom in that space (Frempong & Atubra, 2001; Tobbin, 2010).

In the intervening forty years, the industry has undergone tremendous transformation as seen in the current dominance of private participation in the industry, as well as the evolution of business models from the provision of purely telecom services to the inclusion of financial services (mobile money, savings & loans and microinsurance). The focus of this study is on the mobile telecommunications, which is the dominant industry sector, hence this synopsis provides corresponding relevant data.

Currently in Ghana, there are 4 mobile network operators (MNO) of Ghanaian, Nigerian and South African origins. The top two market leaders from South Africa dominate the sector with about 66% and 19% shares of the market (National Communications Authority, 2023). According to the regulator's latest annual industry report, NCA (2023), the number of mobile voice subscriptions as at 2022 was 40.05 million at a penetration rate of 126.05%. The report also indicates that the MNOs directly employed 2,834 persons in 2022, made up of 1,441 permanent and 1,393 contract staff. Indirect employment in the various sales and distributions channels (distributors, agents,

mobile money vendors, partnerships etc.) could be much larger. For instance, in 2022, the number of registered mobile money agents alone was 699,592 out of which about 505,122 were active (Bank of Ghana, 2023b). The ICT industry as a whole, including the telecommunication sector, contributed 3.3% of GDP in 2022 (Ghana Statistical Service, 2023b). In terms of size, profitability and growth, one of Ghana topmost companies can be found in the telecom sector and in relation to contribution to government revenues, it is also the single largest tax payer in the country (Dzokpo, 2019; Prinsloo, 2023).

Services offered by the MNOs include SMS, mobile voice (local, international, roaming), fixed voice, mobile data, fixed data, fixed broadband delivered via various wireless technology such as GSM, CDMA, 3G, 4G, LTE and media such as cables (land and submarine), microwave, fibre optics (NCA, 2023; GCB Bank, 2023c). In addition, since 2009, the MNOs have been offering financial services, namely mobile money and insurance. The market leader also offers data hosting services in several data centres around the country.

Quite a number of notable recent events in the areas of competition, fraud management, taxation and quality of service, have helped defined the nature of Ghana's mobile telecommunications today and a few are mentioned here. To offer consumers competitive service options, certain initiatives have been implemented such as, mobile number portability (the option to switch operators without changing one's telephone number), mobile money interoperability (the option to transfer money and buy airtime across networks) and co-location of cell towers (arrangements for operators to mount their antennae on competitors' cell towers) to improve reception and limit proliferation of the towers. To clean up the national mobile telephone subscription data for accurate accounting and monitoring purposes, as well as, to help manage fraud, a sim re-registration exercise using only the national ID was undertaken from 2022 to 2023. To raise funds to address

the economic impact of Covid-19, an e-levy of 1.5% of mobile money transaction value was introduced in 2022 (GSMA, 2023); this was later revised to 1% in 2023. Following persistent complaints about the poor quality of mobile telecom services, the regulator has also been known to fine the MNOs for not meeting certain quality thresholds (GCB Bank, 2023c)

The operators face a lot of pressure from multiple sources, such as customers, competitors, the regulator, tax authorities and investors, to stay viable. Unfortunately, not all firms are able to withstand the intense competition and tough operating conditions, hence a number of them have had to exit. In 2018, one of the MNOs, Espresso, had its operating licence revoked for violation of licence conditions, including failure to pay yearly regulatory fees and failure to offer licensed services since 2014; it was also indebted for interconnection payments, microwave usage and porting services (MyjoyOnline, 2019). That year, another MNO, Glo, was threatened with closure for failure to settle a debt of Ghc 10 million in unpaid taxes (Bokpe, 2018). Also in 2018, Airtel merged with Tigo to form AirtelTigo, as part of efforts to stay profitable (GCB Bank, 2023c). However, in 2020 after the incurrence of losses for four quarters, AirtelTigo agreed to a buy-out by the Ghana government for \$25 million (Frimpong, 2020). Very recently, in 2023, Telecel Group took over Vodafone Ghana's 70% majority stake, while the Ghana government maintained its 30% shares (Okine, 2023). Though there has been no official explanation for the exit of Vodafone, the industry report shows that it has been consistently losing market share since 2018. For instance in the mobile voice segment which has the largest industry subscriptions, Vodafone lost market share from about 24% in 2018 to 19% in 2022 (NCA, 2023). Furthermore, there are reports of financing challenges in respect of capital injection for expansion, amidst reported frustrations with government for not contributing its funding quota as the minority shareholder (Okine, 2023).

Being providers of digital technology, the telecom operators are at the forefront of its consumption as well. This is evident in their service provision processes and complaints resolutions. For instance, popular basic services such as, purchase of airtime, password reset and sim change do not require a visit to the office and can be done either through self-service, USSD or a call to the contact centre. They also have various company apps to facilitate a number of frontend transactions. Similarly, options are available for queries and complaints such as, the use of chatbots, social media, website, email and USSD. Resolution of common complaints such as, credit disputes and service failures are analysed and troubleshooted remotely and Momo statements can be requested by USSD. For backend processes, the MNOs have also demonstrated a propensity to embrace emerging technologies. For instance in 2020, an MNO announced a budget of USD 2.5 million to implement AI-based technologies to fight mobile money fraud, a very sore pain point for the sector (Adombilla, 2020).

The telecom operator which participated in the study is among the leaders in the industry (by assets) and is also among the few who have implemented ISR initiatives.

BPO sector

Outsourcing in general refers to the practice of contracting another firm to manage the non-core functions or activities of an organisation, such as IT services. The main reasons for outsourcing, include reducing costs, improving business processes, obtaining access to unavailable expertise and skills, as well as, allowing the organisation to focus on its core capabilities or main business (Henriques de Gusmão & Costa, 2012). While onshore outsourcing uses a domestic provider, offshore outsourcing contracts a provider outside an organisation's country of location.

Business process outsourcing (BPO) also referred to as IT-BPO, involves the outsourcing of business processes which are IT-enabled or have been designed to intensively rely on information

technology (Rouse & Corbitt, 2004; Whitaker et al., 2005). Examples of the wide range of business functions for which organisations have employed IT-BPO include, supply chain management (e.g. warehouse inventory, transportation & logistics); administration (finance, HR, billing, payment); R&D (research & development) and sales, marketing and customer care (e.g. customer acquisition and retention) (Rouse & Corbitt, 2004).

Countries including India, China, Brazil and Philippines are noted for their advanced BPO industries and rank among the top 25 BPO offshore destinations in the world (Sethi et al., 2023).

In Ghana, the BPO industry began in the early 2000s with the pioneering efforts of companies such as, Rising Data Solutions, a Ghanaian owned company, Affiliated Computer Services (ACS) and SupraTelecom, both US-based companies; other companies came up later in the decade (Hewitt Associates, 2006; Hale, 2003;). The early companies offered services such as medical transcription, call center support, telesales and marketing (e.g. lead generation).

Following these pioneering efforts, the Ghana government, taking a cue from the success of countries such as, India, Philippines and Ireland in using BPO as a vehicle for economic growth, hired a consultant, Hewitt Associates, to evaluate the country's BPO readiness (Hewitt Associates, 2006). The study results indicated that though the country had some strengths such as low labour cost, availability of a talent pool of graduates, proficiency in English, political stability, investor friendly policies (tax incentives) and favorable international time zone, there were several areas of deficiencies as well. These included a weak telecom infrastructure in the area of international connectivity which is a critical resource for any IT-enabled outsourcing venture, coupled with high internet prices. Other deficiencies related to a low IT literacy, low level of multilingual foreign language skills and lack of institutional structures and support specifically for BPO. A number of

recommendations came out of the studies, some of which were already in place in one form or another, while others had to be addressed.

Subsequently, some notable events in the sector in the mid-2000s included funding support from the World Bank in 2006, as part of the e-Ghana and ICT/ITES (information technology -enable services) sector development programmes; declaration of BPO as a Presidential Special Initiative; creation of an ITES secretariat to oversee the industry's development; the launch of the Ghana Multimedia Incubator Center to assist BPO start-ups and also equip prospective BPO employees with relevant IT skills; formation of an industry association, the Ghana Association of Software and IT Services Companies (GASSCOM) to coordinate the activities of firms in the sector and promotional activities to woo BPO investors both foreign and local In addition, through the Ghana Free Zones Board and Ghana Investment Promotion Council (World Bank, 2012; Opong, 2013; Ocran & Ntim, 2013).

By 2009 Ghana was ranked the number 1 (one) destination in Africa for BPO business and fifteenth in the world (A.T. Kearney, 2009); the BPO industry was reported to be making \$45 million annually, according to ITES Secretariat (Peacefmonline, 2009).

By 2012, according to a World Bank evaluation, there were about 40 companies registered as members of the IT & ITES(BPO) industry association (GASSCOM) compared to 5 in 2006. Sixteen (16) startups had been incubated and the industry employed 7,476 persons (53% of whom were women); the sector had generated export revenues of \$55 million (World Bank, 2012). BPO activities at this time included call center and HR services. For instance, Teletech (South Africa), and Exceed (Ghana) were running call centers services for some of the telecom operators, while Infonality was handling payroll functions also for an MNO (World Bank, 2012). There were a number of other companies engaged in other activities such as, medical transcription by Mary

Greenslade IS and telecom VAS services by Comviva (Hewitt Associates, 2006; World Bank, 2012). The country’s ranking in the AT Kearney evaluation for 2014, was 29th in the world (out of 51 countries) compared to 15th (out of 50 countries) and 2nd in Africa after Egypt which was ranked 10th globally (Laudicina et al., 2014). A study published in 2013 which assessed the country’s BPO industry indicated that in spite of the country’s strengths, a lot more was still needed to address the weaknesses earlier identified by Hewitt Associates report, in the area of infrastructure and skills (Oppong, 2013).

Regarding the current state of the industry, at least for the last five years (2018-2023), there is no readily and easily accessible data, either from research studies or local institutional sources such as industry reports by the oversight state agencies. However, internationally, Ghana’s ranking as a choice BPO destination has fallen drastically from its top billing in 2009. For 2023, the AT Kearney report ranks Ghana as 45th (out of 78 countries) in the world compared to 15th in 2009 and 6th in Africa behind Egypt, Morocco, Mauritius and Kenya (Sethi et al., 2023). No explanations are given for the drop, however the criteria for the rankings, which also serve as the factors that influence a company’s choice of a BPO location, is informative. These include, labour and infrastructure cost, available skills and quality of services rendered, infrastructure, business environment and political and social risks. From Appendix C.1, we see a drop in the scores for all the criteria.

Table C.1: Ghana's ranking on the Global Services Location Index

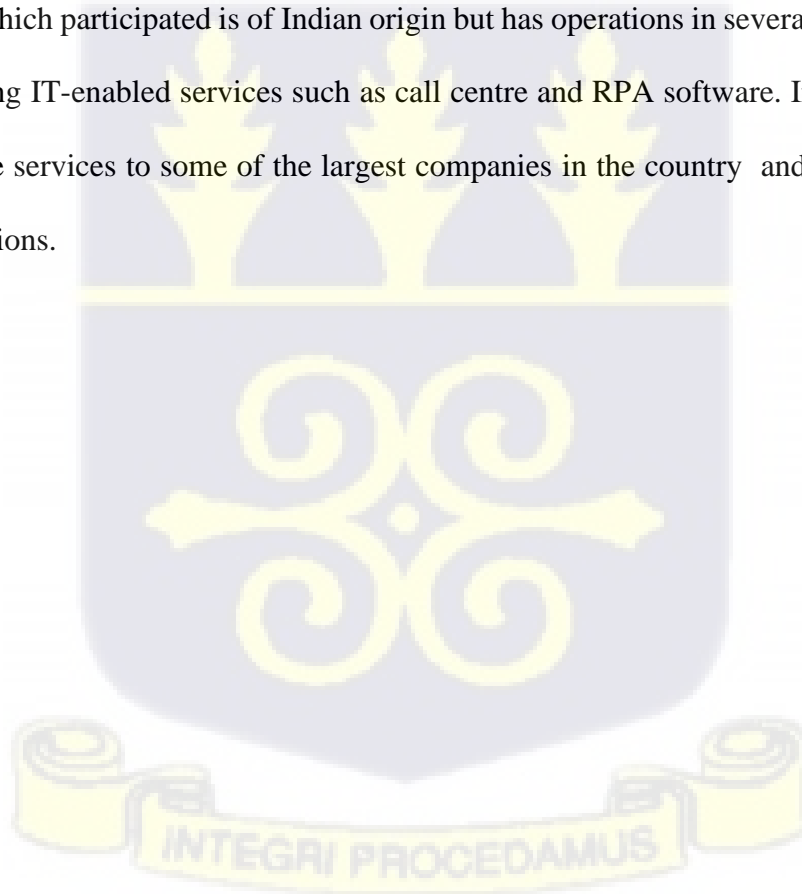
Year	Global Rank	Financial attractiveness score	People, Skills & Availability score	Business environment score
2009	15 (out of 50)	3.26	0.70	1.36
2014	29 (out of 51)	3.35	0.80	1.15

2023	45 (out of 78)	2.80	0.62	0.98
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Source: (A.T. Kearney, 2009; Sethi et al., 2023; Laudicina et al., 2023)

Furthermore, the last five years (from 2018) have seen the country going through some tough post-covid economic crisis as outlined in the first section of this appendix, which provides the country case description. Quite a number of companies have had to either shut down (as seen in the telecom sector) or relocate to locations with more favorable economic conditions. Research is needed to assess the impact of the economic crisis on the BPO industry and also to track the level of government commitment to the growth of the BPO industry since 2006 till date.

The BPO firm which participated is of Indian origin but has operations in several countries around the world offering IT-enabled services such as call centre and RPA software. In Ghana it mainly offers call centre services to some of the largest companies in the country and has implemented ISR in its operations.



APPENDIX D: INTERVIEW DATA ON COMPLEMENTARY ISR

Awareness of ISR

PremBank-D: They came to Platforms to ask, ah with this repetitive job that we do, we have issues here and there right? Do we have any solution that will change the narrative..?. A guy from the department said he heard a lot of good stuff about Microsoft Power Automate. So I said let's draw a process map of what you do in the department and it was drawn.

MulBank-G: At the early stages I was very interested in this technology. I started with some of the software developers I have while we tried to explore. We were able to demo some of the used cases and then we had one or two examples to show to business and then from there we took off. <<>> It wasn't in our strategy in any way. As people who were interested in technology, we went to dig around found interest in it and then showed the used cases. But the bank as a whole has a strategy that has optimizing processes. But the technology RPA was not there.

Top Management Support

PradTel-S: The company is going through a transformation, so we are transitioning from traditional to a digital company. So operational efficiency is one of the key strategic objectives and the RPA initiative falls under operational excellencies.

ROBOT PROFILE

Age

PremBank-D: We implemented them as far as four years ago

RadBPO-P: We have been working on RPA for the last one year

PradTel-D: Almost three years

PradTel-S: If you recall, I said that we started this journey about a year or two

Anthropomorphism

MulBank-G: In terms of humanlike characteristics, we sometimes name our bots in beginning stages and give them avatars. We used to give them funny names because it was exciting and it was our way of marketing; names like R7 robots. But now the organization knows it, so we don't do that anymore but we usually name them by function like the marketing bot.

However, generally, most of the robots deployed in the other four companies who participated in this study, had no names, gender or avatars for their robots. The response below is representative and indicative:

PradTel-B: Currently the robots we use don't have human names; they don't look human. They perform the functions of humans, they only look like humans in terms of intelligence but not a physical look.

In relation to the fourth feature, interactivity, it was reported to be present at and described variously:

PradTel-B: They are very interactive in the sense that when you interrogate it depending on the input it returns results, but not in a chatty manner like it asks you for something and then you respond and then it comes back to you; not in that sense, not really, this is more like a technical response.

NATURE OF COMPLEMENTARITY

Level Of Robotisation (LOR)

High LOR

PradTel-B: So we go in and tell [the robot] that we want you to dial [shortcode] and then it dials it; now we say check balance, it checks it to the end. Now then we give instruction that what you have just done, dialing [shortcode] to checking balance till the very end, now keep on running it. Once we give that instruction we are no longer part of it again; the robot takes over and keeps on doing it until you tell it to stop. They provide you with a report and send it to appropriate people who need them. Our [robot] is able to monitor some of our SDP (service delivery platform), send emails and alert to specific people who are responsible for a specific SDP, so then they go on to take action.

PradTel-MA: Per your explanation, I would say it is high. It is basically end to end. You may get the final work to check if you have to make corrections or everything is fine.[bill validation]

Complementary LOR

Majority of the robotised processes had a complementary LOR as remarked by one of the project managers.

MulBank-G: So there are some bot processes that will require a human to trigger it, or a human will come in the middle to do some parts, and then we have the unassisted or unattended bot start by themselves, do the work, when they are done they send it to the human to verify it.

Specifically, complementarity was reported for activities such as, call center (customer) support, commission calculations & communication, account opening and loan processing and airtime top-up reconciliation.

PradTel-D: So if you're able to feed the robot with the data that it needs within an hour it can give you the feedback and then you have to confirm it and then it will go ahead to send the commissions that are due our agents directly to them.

PremBank-D: Our account opening has 90% , no 60% automation right. There is human intervention but if you look at the process itself yeah we are more like 60%.

PremBank-D: The second one is the loan disbursement. I will say it's also medium; <<>>RPA will also extract the data from the form that you have submitted, if the loan is up to 10,000 Ghana cedis, RPA will go ahead process everything and then hit your account with the money. <<>> Ok, I know that when cash is about 50,000 Ghana cedis upwards, there is human intervention

MulBank-G: The ones [robots] that are attended, once the reconciliation is done, we need to settle the vendor because reports state that yesterday, five customers bought 100 Ghana cedis worth of credit so we have to settle you.<<>> A human being will now pick it up, do the processing and settlement.

The aspiration for companies in respect of the level of robotisation, is to achieve a High LOR, that is, achieving fully automated processes with little human intervention.

PradTel-B: I guess what you want to know is that, have we reached in a stage in my work where our processes are automated and there's no need for human intervention. No, we

are not there yet. A lot of the things we still do manually and yes, we have improved, compared to five years ago. We are more automated now than five years ago, but we are not at the point where human intervention is completely cut off. We are going to get there very soon.

So why are the companies using or adopting a complementary LOR, if they are aspiring to more High LOR. The responses for LOR were analysed once again this time with a critical realist lens, with the aim of identifying relevant structures and mechanisms from the verbatims below to help offer an explanation.

MulBank-G: There are some processes, based on assessment, we would decide that we don't want to do it an end-to-end automation because a human may need to sort of oversee or approve. So it [robot] may do up to some point and leave the human to maybe come and continue and process it and that is usually by design.

Human-Machine Task Allocation

Generally, in line with current thinking (e.g. Zhou et al., 2021) and recommendations (Asatiani et al., 2019), most of the robots for the companies interviewed, were assigned mundane, routine, repetitive, high volume task.

PradTel-S: With the rules-based, you're able to achieve this to remove the mundane activities from the staff so that they can focus on other things.

IndInsure-M: The motivation was simply to automate certain routine tasks that we think can be done easily using the BOTS and more efficiently and quickly. IndInsure-M: The main reason was to automate certain tasks that we were formerly doing manually, and also to work more efficiently looking at the tasks that are repetitive that we can automate; these are the main reasons why we looked into RPAs.

For Visa reconciliations

PremBank-D: When it comes to the Visa reconciliation, I would want to use very high level because it doesn't require any human intervention, the robot picks up the excel file, does the reconciliation and then shares the results with the Visa officer, that is the card operations officer and then that's it. That process is highly automated.

For underwriting

IndInsure-M: Let's say it runs twice in a day, around 12pm it will run the first batch and push all the policies that has been issued into our legacy system, around 6pm or 7pm in the evening it will do another batch. So by the time we come the following day all the policies are in our system and all receipts are issued

For Bill validation

PradTel-MA: What we do first is to request for the tariff book from Marketing, custodians of all products & services. We get the latest tariff book from Marketing by sending an email to them to give it to us. Then based on the latest tariff book we cross check it with samples of the bills that have been shared by IS. On the bill we have executive summary and details. We make sure that whatever is in the details..... the details has to do with individual records [transactions] that were done [by the customer]. So we need to make sure that the accumulation of the usages matches with what is in the executive summary. And also, the correct tax has been applied. By taking them through the manual process, they [robot] also find a way to mimic the same thing. Basically that's what the RPA does now. Once they are done with a particular bill they send an email and a feedback on what they worked on.

For IT quality checks

PradTel-B: So we go in and tell [the robot] that we want you to dial [shortcode] and then it dials it, now we say check balance, it checks it to the end. Now then we give instruction that what you have just done, dialing [shortcode] to checking balance till the very end, now keep on running it. Once we give that instruction we are no longer part of it again, the robot takes over and keeps on doing it until you tell it to stop. They provide you with a report and send it to appropriate people who need them, our [robot] is able to monitor

some of our SDP (service delivery platform) sent emails and alert to specific people who are responsible for a specific SDP so then they go on to take action.

For loan processing

PremBank-D: RPA will also extract the data from the form that you have submitted, if the loan is up to 10,000 Ghana cedis, RPA will go ahead process everything and then hit your account with the money. <<>>Ok, I know that when cash is about 50,000 Ghana Cedis upwards, there is human intervention, they have a COU, credit operations unit.

For account opening

PremBank-D: After completing the form, when the forms are okayed by the front end person and is fine..once it is scanned, it picks every information; that's number one. After validating the information provided, you know there are required fields right? The required fields have extra validation right? They go through extra validation and once it has been KOed (okayd) these data is put into a standby database. What happens is that we have something called a batch run that happens at the end of every working day, during the batch run these new accounts are added, and account numbers are generated. <<>> So within the form that you submit, there is a part where they will ask you, what is your best channel of communication, if it is your email or phone. So here, if it is a phone call, [telephone] numbers are sent to a contact center executive who will call you with the details, but will go through verification before the [account] details are shared with you.

For expense request approval

IndInsure-M: Let's say you want to request something like petty cash. You complete the form and then the BOT will push it through the approval stages until it's completed and then you have your petty cash remitted to you. We use that for various requests that we do, like expenses, payment for goods and services, medical expenses, and any other expenses that we do.

For airtime top-up reconciliations

MulBank-G: It may go into the aggregator's portal, download a report, early in the morning by 6:00am, so it will kickstart, have our own records, try and do the matching and then send a report. You come in the morning it would alert you that these are exceptions, these people haven't received credits or anything. We could have the bot take it to the next level, to do the settlement.<<>> We study a bot and its behaviour to see how it picks up exceptions. Once you let it learn all the exceptions then you can trust it to do the settlement. So, there is a period where you let a human intervene then they [the robots] will be picking up. So, there is a learning period.

For call center agent interactions with customers

RadBPO-P: We are helping our agents to reduce the navigations into different applications; doing some calculations which they had to do mentally; so now the system will do and hence it becomes more accurate because it is already defined in the system.

RadBPO-A: Firstly, to do with the interface, the current solution we have is a blended interface, which has the agent interacting with the customer as long as it has to do with logical decision making. Then the bot takes over and does certain checks with 100 percent accuracy check and speed of answering. It throws those information as the results, then again the agent takes over from there. This is the kind of solution we currently operate with, we don't have end to end solution.

For sales commissions validations

PradTel-R: As a company we giving them commissions based on the work they have done for us. In that context we pay them weekly and monthly. With this used case, the robot comes, calculate all the numbers of customers that a particular vendor registered in that week, multiplied by the [commission] percentage and then gives it to vendor at the end of the week. PradTel-D: So if you're able to feed the robot with the data that it needs within an hour it can give you the feedback and then you have to confirm it and then it will go ahead to send the commissions that are due our agents directly to them.

IMPACT OF ISR

Completion Times

PradTel-MA: Main time to complete is superb compared to humans. Interviewer: Okay so can the robot do a hundred [bill validations] in a day. PradTel-MA: Less than a day, within two or three hours the robot can do it. It is very fast.

Accuracy (or Error Reduction)

PradTel-M: Little to zero errors.

PradTel-MA: With the robotics you cannot tell it to go ahead if the rates are wrong for a particular person; it will flag it if there is a mistake.

Productivity

PremBank-D: [Visa reconciliations] It has really helped the team in the sense that when people come for refund, recharges and all of that, it's not now that they will tell you to go and come, right. Sometimes they take the initiative of even crediting accounts that had, I mean, when the reconciliation was done had issues.

Cost Savings

PradTel-MA: Another thing is with the staff you have to pay overtime aside their salaries but we don't with the robot because it's something you've already paid for. <<>> Secondly I can put reducing risk under cost savings because we right now we have oversight in the bill review than before. Even with that it is also in a way cost savings. If we were mistakenly under billing some people, and this system is available and has helped us recover and bill our customers well, in a way it is cost savings for us. Iit has reduced our risks to some level which is good.

PradTel-M: For cost savings we're doing that calculations based on the overhead. So the time spent in doing these activities we computed that by the average amount paid per hour so based on that we are able to do some calculations on cost savings. We have some significant cost savings as well.

RadBPO-P: We have been working on RPA for the last one year but because it is rule-based any time a system change or product change, it has to be revised. For me it would

be about two to three years. If I were to implement RPA for all calls, then my ROI would be recovered a little sooner so it would depend on company to company,

Unexpected Impacts

The impacts discussed so far are in line with the literature on the benefits of RPA in general (Chugh et al., 2022; da Silva Costa et al., 2022; Kokina & Blanchette, 2019). However there were also some “unanticipated” benefits as similarly reported by Vitharanage et al. (2020). For instance, it was reported that ISR had freed staff from weekend work and also reduced opportunities for staff bill fraud activities

PradTel-MA: Prior to this members had to go to the office on weekends because sometimes the month ends on a weekend therefore the team had to converge at the office and do the validation but once the robot is there, there's no need for anyone to be there.

PradTel-MA: I was also having this school of thought that maybe if a staff knows of a customer, the staff can just tweak that customer's bill so that the customer wouldn't pay that much. But the robots don't know anyone, so it will just go according to what is in the tariff master. Secondly if I was to be doing the validation I'll intentionally pick the bill of a friend, a company that I know. Even though we are underpaying [undercharging] them, I'll still say everything is fine. And no one will check it because RA has validated it. IT will just go ahead and print but with the robotics you cannot tell the robot that when it gets to this person and the rates are wrong, you still go ahead or if they were undercharged, you still go ahead; it will still flag it because everything is configured in the system, not by RA but by the project team.

Employment Security

PradTel-S: There hasn't been any layoffs. There hasn't been any redeployment but now the others will have different things to do so they'll be reassigned to something else not a different department.

Deskilling

Measures for prevention of Deskilling

Interviewer: What some companies have done is, they have documented the failover processes for BCP (business continuity procedures) purposes; when the bots fail even if

the agent has forgotten there is a repository where the agent can go there and keep the procedure working. RadBPO-P: For that there will be certain subject matter experts to be created; not everybody should be part of it. If the system fails, it will be down for a certain time and that time you either wait or reach out to somebody else, but once RPAs are there and it has been there because it is adding value, it does not make sense to go back to manual.

As part of measures to prevent deskilling and maintain task control, Asatiani et al (2019) recommended that, as much as possible, robots should be configured with the same information representations that human workers will use in their supervisory control roles. One company did not support this view, saying that it defeated the logic of optimization

MulBank-G: So, remember the bot was trained on what they [humans] did. There are some instances because of technology we may optimize the process and not do it how they [humans] do it. So, for example, if they [humans] were doing it manually they may have to log on to the system to go and get some information but we do have API's which we can call on and mix into it to call some of the information, which as a human being you may not be able to do that. When that happens, they will not be able to follow that same bot process. Some processes, it's the exact same thing, so they can fall back, but for some processes ...



APPENDIX E: QUESTIONNAIRE ON ISR DEPLOYMENT
INTELLIGENT SOFTWARE ROBOTISATION (ISR) OF WORK IN DEVELOPING
ECONOMY FIRMS: A COMPLEMENTARITY AND CONFIGURATIONAL ANALYSIS
QUESTIONNAIRE

INTRODUCTION

My name is Augustine Osei Yaw Mante, a PhD candidate with the University of Ghana Business School, Department of Operations and Management Information Systems. This study entitled, “**Intelligent Software Robotisation (ISR) of Work in Developing economy Firms: A Complementarity and Configurational Analysis**”, is part of the requirements for the award of my degree.

Objectives and Purpose: The study investigates the automation of work processes using intelligent software robot technologies such as, robotic process automation (RPA) and artificial intelligence (AI). The three main objectives are to advance our knowledge on the decisional, implementation and coping elements related to the deployment of these technologies. The ultimate purpose is to develop some theory-based guidelines to aid developing economy firms in the deployment of these technologies.

This questionnaire is intended to collect data on the elements that influenced the decision to implement the AI-RPA robots in developing economy firms.

Duration and Procedures: The questionnaire takes between thirty (30) to forty-five (45) minutes to complete.

Much as your responses are essential for the study, you are under no obligation to participate and you are free to either decline or opt-out at any time during the interview, and there will be no adverse consequences. It is therefore taken that, your completion of the interview indicates your voluntary participation. Furthermore, you are assured that, the data gathered is intended for academic purposes only.

I can be contacted via email at aoymante@st.ug.edu.gh and on the phone number, +233 24430 3818.

DEMOGRAPHIC INFORMATION

Please tick [✓] where appropriate and fill in the blanks where appropriate

(i) Age (years)

18 – 24 25 – 34 35 – 44 45 – 54 55+

(ii) Gender

Female

Male

(iii) Education Level

- Junior High School Senior High School Tertiary

(iv) Which department of your company do you work in? _____

(v) What is your job role? _____

(vi) Number of Years with the company

- 1 – 4 5 – 9 10 -14 15 – 19
- 20+

(vii) In what capacity have you been involved with AI-enabled RPA (robotic process automation) in your company?

(Tick as many that apply)

- Procurement Technical support
- Decision support Testing
- Decision-maker

Other _____

Please tick [✓] where appropriate using a 5-point Likert scale indicating your level of agreement to the statement made where:

1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree

Statement	1	2	3	4	5
This is a sample statement with 3 = “Neutral” selected as a response AI-RPA robots are very efficient			✓		

Statement	1	2	3	4	5
A. TECHNOLOGICAL DIMENSION					
ANTHROPOMORPHISM (the human-likeness of AI-RPA robots and its role in the decision to deploy them) It is important for an AI-RPA robot to have					
1. a gender (male or female)					
2. an avatar (a human-like image/representation) on the PC screen					
3. an interactive capability via speech or text					
4. a friendly personality					
TECHNOLOGY AVAILABILITY (the ease of finding a suitable AI-RPA robot and its role in the decision to deploy them) When looking for an AI-RPA robot the following are important considerations					
5. <i>awareness</i> about the robot's functions and its benefits					
6. adequate <i>range</i> of robot features to determine its usefulness					
7. availability of adequate credible vendors/suppliers					
8. user feedback from an active user community for product reviews, referrals, support					
TECHNOLOGY ACCESSIBILITY (the ease of actually acquiring AI-RPA robots and its role in the decision to deploy them) The following are important considerations when actually acquiring an AI-RPA robot					
9. affordable price					
10. easy to technically deploy, understand, use and maintain					
11. fits with processes to be robotised and easy to install with existing IT systems					
12. possible to make adjustments in response to changing operational conditions					
B. ORGANISATIONAL DIMENSION					
SIZE (the extent of the volume and value of a firm's operations and its role in the decision to deploy AI-RPA robots) In relation to a company's size, the following are important considerations in the decision to implement AI-RPA robots:					
13. <i>financial strength</i> to deploy the robots					
14. impact of the robots on increasing or maintaining <i>market share</i>					
15. impact of the robots on the <i>number of employees</i> (staff reduction, redeployment or recruitment freeze for cost savings)					
16. impact of the robots on efficient coordination of the company's <i>scope</i> of operations (volume of products & services, related processes, transactions & activities in number of branches, divisions, departments)					
ORGANISATIONL STRUCTURES (the internal characteristics of a firm and its role in the decision to deploy AI-RPA robots) When implementing AI-RPA robots, it is important for a firm to have the following internal features					
17. skilled human resources (e.g., developers, system integrators)					
18. an organisational culture supporting change & innovation					
19. management support for innovation					
20. change management structures					

Statement	1	2	3	4	5
21. Internal technology infrastructure to support the AI-RPA robots (equipment, policies & IT leadership)					
22. organisational goals which align with the deployment of AI-RPA robots					
C. ENVIRONMENTAL DIMENSION					
INDUSTRY CHARACTERISTICS (features of the industry in which the firm operates and its role in the decision to implement AI-RPA robots) In relation to a firm's industry, the following are important considerations in the decision to implement AI-RPA robots					
23. competitive pressure – (having AI-RPA robots helps the firm to be as current as others who have them or stay ahead of those who don't have it)					
24. industry standards and awards (having AI-RPA robots helps the firm to meet industry standards to win awards and enhance its reputation)					
25. industry associations which pursue the interests of member-companies (e.g., provide advocacy with government, legal support, training)					
26. financial support available from government & financial institutions					
27. labour union activities in relation to protecting employees' jobs from the impact of AI-RPA robots					
TECHNOLOGY INFRASTRUCTURE (the physical technological systems in a firm's location and its role in the decision to implement AI-RPA robots) The availability of the following technology infrastructure in a firm's environment, is important in a firm's decision to implement AI-RPA robots					
28. stable electricity supply					
29. affordable, fast and reliable broadband connectivity					
30. a vibrant data ecosystem – adequate appropriate data & use cases, data centres, cloud computing services					
31. cybersecurity provisions (by service providers and security agencies to forestall breaches which could pose risks to all stakeholders)					
REGUALTIONS (the various legal requirements governing business operations in a firm's location and its role in the decision to implement AI-RPA robots) The presence of the following regulations will influence companies in their decisions to implement AI-RPA robots					
32. laws on responsible and ethical deployment of AI-RPA robots to prevent adverse socio-economic impacts (e.g. discrimination, job losses)					
33. laws on data privacy protection, ensuring confidentiality of customers data and guarding against their improper use					
34. tax laws which encourage or inhibit the deployment of AI-RPA robots (e.g., tax exemptions for robot deployments or punitive taxes to compensate for robot-related job losses)					
35. a national development agenda promoting the adoption of emerging technologies like AI-RPA robotisation					
D. ADOPTION OF AI-RPA robots Facets of the decision to deploy AI-RPA robots					

Statement	1	2	3	4	5
36. I commend the decision to deploy AI-RPA robots in my company					
37. I will recommend the use of AI-enabled RPA to staff of my company					
38. I will support the deployment of AI-RPA robots in my company.					

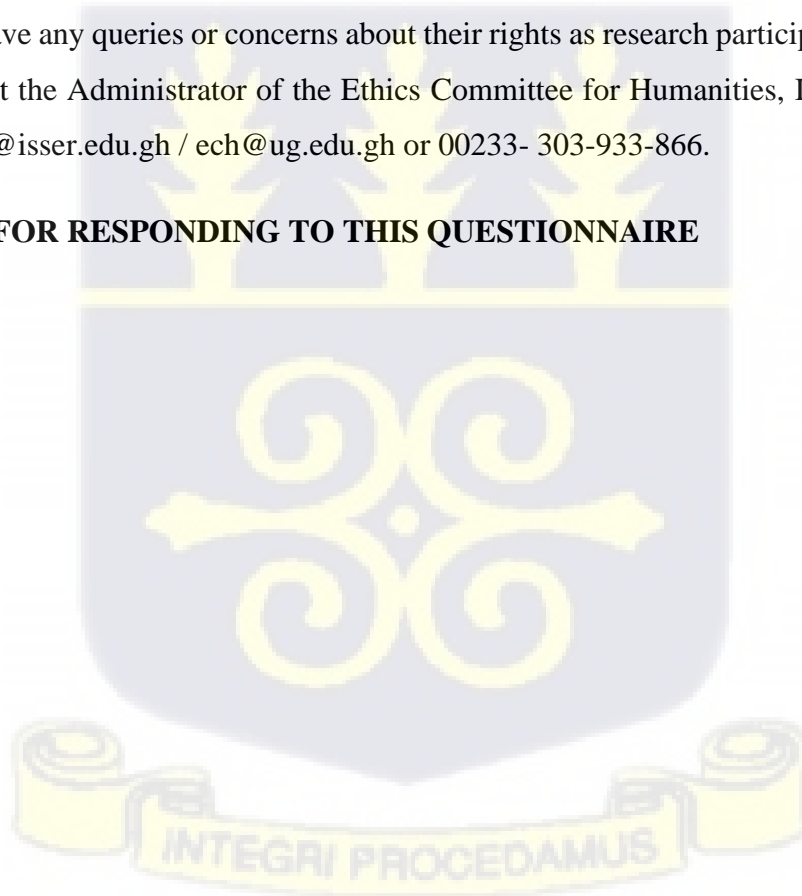
ASSURANCE

The University of Ghana assures participants that the information provided will be used solely for academic purposes and the confidentiality of the data will be protected. Furthermore,

participants will be presented with the findings of the study before it is published.

If participants have any queries or concerns about their rights as research participants in this study, they may contact the Administrator of the Ethics Committee for Humanities, ISSER, University of Ghana at ech@isser.edu.gh / ech@ug.edu.gh or 00233- 303-933-866.

THANK YOU FOR RESPONDING TO THIS QUESTIONNAIRE



APPENDIX F: QUESTIONNAIRE ON EMPLOYEES' ISR COPING STRATEGIES

INTELLIGENT SOFTWARE ROBOTISATION (ISR) IN DEVELOPING ECONOMY FIRMS - COPING STRATEGIES

QUESTIONNAIRE

INTRODUCTION

My name is Augustine Osei Yaw Mante, a PhD candidate with the University of Ghana Business School, Department of Operations and Management Information Systems. This study entitled, “**Intelligent Software Robotisation (ISR) of Work in Developing economy Firms: A Complementarity and Configurational Analysis**”, is part of the requirements for the award of my degree.

Objectives and Purpose: The study investigates the automation of work processes using intelligent software robot technologies such as, robotic process automation (RPA) and artificial intelligence (AI). The three main objectives are to advance our knowledge on the decisional, implementation and coping elements related to the deployment of these technologies. The ultimate purpose is to develop some theory-based guidelines to aid developing economy firms in the deployment of these technologies.

This questionnaire is intended to collect data on how workers cope with the introduction of AI-RPA robots in their work environments in developing economy firms.

Duration and Procedures: The questionnaire takes between thirty (30) to forty-five (45) minutes to complete.

Much as your responses are essential for the study, you are under no obligation to participate and you are free to either decline or opt-out at any time during the interview, and there will be no adverse consequences. It is therefore taken that, your completion of the interview indicates your voluntary participation. Furthermore, you are assured that, the data gathered is intended for academic purposes only.

I can be contacted via email at aoymante@st.ug.edu.gh and on the phone number, +233 24430 3818.

DEMOGRAPHIC INFORMATION

Please tick [✓] where appropriate and fill in the blanks where appropriate

(i) Age

19 – 24 25 – 34 35 – 44 45 – 54 55+

(ii) Gender

Female Male

(iii) Education Level

Primary Education Junior High School Senior High School
 Tertiary Other _____

(iv) Which department of your company do you work in? _____

(v) What is your job role? _____

(vi) Number of Years with the company

1 – 4 years 5 – 9 years 10 -14 years 15 – 19 years
 20+ years

(vii) In what ways do you use or rely on AI-enabled RPA (robotic process automation) in your work?

(Tick as many as are applicable)

Data processing & analysis Reports generation/writing
 Decision making Customer service delivery

Other _____

Please tick [✓] where appropriate using a 5-point Likert scale indicating your level of agreement with the statement made where:

1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree

Statement	1	2	3	4	5
This is a sample statement with 3 = “Neutral” selected as a response AI-RPA robots are very efficient			✓		

E. LEVEL OF ROBOTISATION (LOR)

LOR addresses the degree to which an AI-RPA robot has control, independent of human action, in robotisation operations. This section assesses if the LOR is high or complementary

Statement	1	2	3	4	5
The Intelligent software robot (ISR) implementation in my company has the following features					
39. the human operator has little control over the processes used by the AI-RPA robots to execute a job					
40. the human operator shares control with the AI-RPA robots over the processes used to execute a job					
41. the human operator has a restricted time to stop the AI-RPA robot's actions (e.g., only in cases of emergency)					
42. the human operator must approve some critical actions by the AI-RPA robot and has ample time to stop it when required					
43. the AI-RPA robot executes a job from finish to start with little input from the human operator					
44. the AI-RPA robot executes a job from finish to start with appropriate input from the human operator					
45. the AI-RPA robot decides if it must engage the human operator during execution of a job and on completion					
46. the AI-RPA robot and human operator engage at appropriate levels during execution of a job					
47. the AI-RPA robot executes a job and only informs the human if it is asked					
48. the AI-RPA robot is required to inform the human operator when it completes a task					
F. APPRAISAL OF LOR					
<i>Appraisal here addresses the user's assessment of the level of AI-RPA robotisation as a threat or opportunity for their career and personal lives</i>					
Regarding the ISR implementation in my company, I think:					
49. the future of my job is not secure, as my role may no longer be needed					
50. it offers a chance to advance my future career prospects (e.g., earn a promotion, allowances, or salary raise)					
51. my efficiency could be affected because I usually struggle to become competent with new technology					
52. I can acquire new skills and be more efficient in my work					
53. the use of AI-RPA robots conflict with my values on preserving the relevance & dignity of human labour in the workplace					
54. it offers a chance to assist others who usually find it difficult to cope with new technology at work					
55. the fulfilment of my personal goals is in danger (e.g., in relation to my finances, family, etc)					
56. I can put into practice my values & beliefs that technology like ISR can be useful for socio-economic advancement					
G. COPING STRATEGIES					
<i>Coping strategies address how users adapt to the level of AI-RPA robotisation</i>					
To cope with the ISR implementation in my company, I will consider the following					
57. undertake <i>only</i> the initial company required training and handle <i>only</i> tasks <i>within</i> that training scope					

Statement	1	2	3	4	5
58. undertake the initial company required training and seek help from others whenever I need to work <i>beyond</i> that training scope					
59. seek <i>further</i> advance training to become very knowledgeable on AI-RPA robots to handle a wide range of tasks <i>beyond</i> the initial training scope					
60. take advantage of any customisation features, to <i>adjust the AI-RPA robot</i> configurations to my comfort					
61. be content in enjoying whatever benefits the AI-RPA robots bring in making my work easier					
62. push for an <i>adjustment of my job procedures</i> to help me work comfortably with the AI-RPA robots					
63. stick strictly to my assigned role with the AI-RPA robots					
64. do nothing (training, robot or work adjustments) and stay hopeful that I will be exempted from working with the AI-RPA robots					
65. avoid working with the AI-RPA robots by asking for a reassignment to non-robot related tasks					
66. offer to be the go-to person in my department/section to assist on issues related to AI-RPA robot					
67. work with the AI-RPA robots only when compelled to do so					
68. spend extra time using the AI-RPA robots to become a power user					
69. look for employment in a new company where my <i>current skills</i> will be more useful					
70. look for employment in a new company where I can achieve my <i>career & personal goals</i>					

ASSURANCE

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THANK YOU FOR RESPONDING TO THIS QUESTIONNAIRE

**APPENDIX G: INTERVIEW SCHEDULE FOR NATURE OF
COMPLEMENTARITY**

**INTELLIGENT SOFTWARE ROBOTISATION (ISR) OF WORK IN DEVELOPING
ECONOMY FIRMS: A COMPLEMENTARITY AND CONFIGURATIONAL ANALYSIS**

SEMI-STRUCTURED INTERVIEW SCHEDULE

INTRODUCTION

My name is Augustine Osei Yaw Mante, a PhD candidate with the University of Ghana Business School, Department of Operations and Management Information Systems. This study entitled, “**Intelligent Software Robotisation (ISR) of Work in Developing economy Firms: A Complementarity and Configurational Analysis**”, is part of the requirements for the award of my degree.

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This interview seeks to collect data on the implementation dimension and examines the nature of the deployment done, its impact and the related governance arrangements.

Duration and Procedures: The interview schedule takes a minimum of 30 minutes and a maximum of 1 (one) hour to complete. The interaction will be audio recorded together with vital handwritten notes where necessary. The transcripts will be provided to participants for review and comments before data analysis commences.

Much as your responses are essential for the study, you are under no obligation to participate and you are free to either decline or opt-out at any time during the interview, and there will be no adverse consequences. It is therefore taken that, your completion of the interview indicates your voluntary participation. Furthermore, you are assured that, the data gathered is intended for academic purposes only.

I can be contacted via email at aoymante@st.ug.edu.gh and on the phone number, +233 24430 3818.

A. PROFILE OF RESPONDENTS

- a) Gender
- b) Department
- c) Job Role

- d) Years with company
- e) Association with the I-RPA robots

B. ORGANIZATIONAL CONTEXT

1. Background on the initiative to deploy AI-RPA robots
 - a) What were the business motivations for the decision to deploy the robots?
 - b) What are the business expectations from the deployment of the robots?

C. PROFILE OF THE AI-RPA ROBOTS

2. Attributes

- a) Age: how long have robots been implemented?
- b) Intelligence: are they intelligent and if so, what makes them so?
- c) Human-likeness: to what extent do they have human-like characteristics e.g. name, human look, interactivity, personality?
- d) Functions: give a broad view of their capabilities.

3. Areas of deployment

- a) In which areas of the business' operations have the robots been deployed (e.g., customer service, marketing)?
- b) What tasks have the robots been assigned to do (e.g., emails management, monthly report preparation)?

D. COMPLEMENTARITY

4. Nature of the robotisation

For the jobs involving the use of AI-RPA robots,

- a) Would you say the *level of automation/robotisation* is high, complementary or low and why?
- b) For each of the processes where the AI-RPA robots have been deployed, describe the *process flow charts* used to execute the *assigned tasks* (without divulging any sensitive or confidential information)

5. Impact of the robotisation

What have been the impacts of the AI-RPA robots on:

- a) Completion times
- b) Accuracy and error reduction
- c) Productivity
- d) Cost savings
- e) Employee (i) layoffs; (ii) redeployments; (iii) recruitment freeze
- f) Deskilling: where there are system outages or failures, are humans able to fully take over the process that was automated?

E. AI-RPA ROBOT GOVERNANCE

6. Governance arrangements

Confirm, (without any sensitive or confidential details), if there are processes, procedures and policies in place for the following, in relation to AI-RPA robots governance:

- a) Business case which provides an alignment of the software robotisation with business objectives
- b) Selection of business processes to be robotized
- c) Tool & vendor selection
- d) Deployment guidelines & standards for configuring, testing, deployment
- e) Access management
- f) License management
- g) Vendor management
- h) Repository of reusable codes
- i) Training
- j) Monitoring & Maintenance

CONCLUSION

a) Assurance

The University of Ghana assures participants that the information provided by the respondents will be used solely for academic purposes and steps will be taken to protect

the confidentiality of the data. Furthermore, participants will be presented with the findings of the study before it is published.

If participants have any queries or concerns about their rights as research participants in this study, they may contact the Administrator of the Ethics Committee for Humanities, ISSER, University of Ghana at ech@isser.edu.gh / ech@ug.edu.gh or 00233- 303-933-866.

- b) Has the interviewee any questions for the researcher about the interview?
- c) Thank the interviewee for their time and participation



APPENDIX H: ETHICAL CLEARANCE



UNIVERSITY OF GHANA
ETHICS COMMITTEE FOR THE HUMANITIES (ECH)

P. O. Box LG 74, Legon, Accra, Ghana

My Ref. No: ECH.043/23-24

November 01, 2023

Augustine Osei Yaw Mante
Department of Operations and
Management Information Systems
University of Ghana
Legon

ETHICAL CLEARANCE
(ECH 043/ 23-24)

The Ethics Committee for the Humanities (ECH) conducted a full board review and approved your protocol titled:

**INTELLIGENT SOFTWARE ROBOTISATION (ISR) OF WORK IN DEVELOPING
COUNTRY FIRMS: A COMPLEMENTARITY AND CONFIGURATIONAL ANALYSIS**

PRINCIPAL INVESTIGATOR: AUGUSTINE OSEI YAW MANTE

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

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

This certificate is valid until October 31, 2024. You are required to submit annual reports for continuing review.

Please accept my congratulations.

Yours Sincerely,

Professor C. Charles Mate-Kole
ECH Chair

Cc: Dr. Eric Afful-Dadzie, Department of Operational and Mgt. Info. Sys., UG

APPENDIX I: RELATED RESEARCH OUTPUT FROM THE THESIS

Conference Papers

Mante, A. O. Y., Afful-Dadzie, E., Boateng, R. & Afful-Dadzie, A. (2024). Coping with Intelligent Software Robotisation: A Configurational View. Thirtieth Americas Conference on Information Systems (AMCIS 2024), Salt-Lake City, USA.

Boadi, C., Ashong Elliot, M. A., Annan-Nonoo, P., Afful, E. A. F. & **Mante, A. O. Y.**, Kolog, E. A. (2022). Competitive Intelligence Capabilities of Social Media Analytics for Value Creation. Twenty-Eighth Americas Conference on Information Systems (AMCIS 2022), Minneapolis, USA.

Mante, A. O. Y. (2021). A Distributed Cognition View of Knowledge Work Automation Practices in Ghana's Telecommunications Sector: The Case of MTN Ghana. 2nd UG-Carnegie Scholars Network & PADA International Research/Mentorship Conference, Accra, Ghana.



