THE KEY 4IR SOFT SKILLS FOR THE RAIL SECTOR

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ABSTRACT

The Fourth Industrial Revolution (4IR) has brought about significant advancements in technology that have impacted various industries, including the railway sector. This paper explores the implications of the 4IR for the railway industry and identifies the essential soft skills that rail organisations need in order to thrive in this era. A systematic literature review (SLR) was conducted to establish a theoretical foundation, followed by a survey administered to professionals in the rail sector to prioritise the identified soft skills. Comparative methods were employed to analyse the survey data and to determine the relative importance of the 4IR soft skills. The findings revealed a range of key soft skills, such as adaptability, critical thinking, and change management, in which it is crucial that railway professionals excel in the 4IR era. The paper discusses the significance of these soft skills and their potential impact on rail organisations, and provides recommendations for fostering their development. This research contributes to a more nuanced understanding of the soft skills that are necessary for the railway sector's successful adaptation to the 4IR.

OPSOMMING

Die Vierde Industriële Revolusie (4IR) het aansienlike vooruitgang in tegnologie meegebring wat verskeie nywerhede, insluitend die spoorwegsektor, beïnvloed het. Hierdie artikel ondersoek die implikasies van die 4IR vir die spoorwegbedryf en identifiseer die noodsaaklike sagte vaardighede wat spoororganisasies nodig het om in hierdie era te floreer. 'n Sistematiese literatuuroorsig (SLR) is uitgevoer om 'n teoretiese grondslag te vestig, gevolg deur 'n opname wat aan professionele persone in die spoorsektor gedoen is om die geïdentifiseerde sagte vaardighede te prioritiseer. Vergelykende metodes is aangewend om die opnamedata te ontleed en om die relatiewe belangrikheid van die 4IR sagte vaardighede te bepaal. Die bevindinge het 'n reeks sleutelsagte vaardighede aan die lig gebring, soos aanpasbaarheid, kritiese denke en veranderingsbestuur, waarin dit van kardinale belang is dat spoorwegpersoneel uitblink in die 4IR-era. Die artikel bespreek die belangrikheid van hierdie sagte vaardighede en hul potensiële impak op spoorwegorganisasies, en verskaf aanbevelings om hul ontwikkeling te bevorder. Hierdie navorsing dra by tot 'n meer genuanseerde begrip van die sagte vaardighede wat nodig is vir die spoorwegsektor se suksesvolle aanpassing by die 4IR.

1. INTRODUCTION

The South African rail transport sector plays a crucial role in facilitating the movement of passengers and freight across the country. It encompasses both regional and suburban commuter services for passengers, as well as the transportation of various types of goods and commodities using specialised freight wagons [1]. However, like many industries, the rail sector is not immune to the advancements of the Fourth Industrial Revolution (4IR), which is characterised by the integration of advanced technologies into traditional industries and the transformation of work processes [2].

The 4IR is driven by technological trends such as artificial intelligence, the Internet of Things (IoT), and robotics, and it is reshaping industries worldwide, including those in South Africa [3]. The rail sector is embracing these technologies to enhance safety, efficiency, and customer experience through initiatives such as predictive maintenance, smart railways, autonomous trains, and improved service delivery [4]. The impact of the 4IR on the rail sector is expected to be profound and transformative [3].

As the rail sector evolves with the adoption of 4IR technologies, it becomes crucial to consider the implications for the workforce. The 4IR is not just about technology; it profoundly affects the way in which work is performed and the skills that employees require. New job roles will emerge while others may become obsolete. The workforce needs to be empowered with the necessary skills to navigate the 4IR successfully. While much attention has been given to the development of hard skills (technical skills specific to a field) for the 4IR, there is a notable gap in research concerning the soft skills required in this era. Mabe and Bwalya considered soft skills significantly more important than hard skills in South Africa for the 4IR, but noted the need for further studies to understand global skills that are pertinent to the 4IR [5].

Soft skills are defined as the attitudes, innate traits, behaviours, and abilities that enable individuals to navigate their environments effectively, work well in teams, achieve optimal performance, and attain their goals [6]. They encompass personal attributes and interpersonal abilities that are critical for success in the workplace. In the rail sector, combining hard skills with soft skills is essential for creating a highly skilled workforce that is capable of designing, developing, and maintaining rail systems that incorporate 4IR technologies, while also building strong relationships with stakeholders and effectively managing the challenges of digital transformation [7].

This paper aims to fill the research gap by identifying and prioritising the key 4IR soft skills that are required in the rail sector. By conducting a systematic literature review and survey, insights from industry professionals were gathered to understand the importance of soft skills in the context of the 4IR and their relevance to the railway industry. The findings should contribute to enhancing the rail sector's preparedness for the 4IR, guide organisational development strategies, and inform training initiatives to equip the workforce with the necessary skills to thrive in this transformative era.

2. THEORETICAL BACKGROUND

2.1. Railway in South Africa

Railway transport in South Africa is governed by the Department of Transport (DoT). The National Railway Safety Regulator Act of 2002 [8] defines 'rolling stock' as "a vehicle that is able to operate on a railway, irrespective of its capability of independent motion". For the purpose of this paper, rolling stock refers to locomotives, carriages, wagons, coaches, or any other vehicle used on a railway, encompassing all of the assets that are relevant to maintenance. The terms 'trains' or 'train sets' are used interchangeably in the context of public transport to describe a group of carriages, wagons, or coaches that transport passengers or freight.

While South Africa boasts the best rail infrastructure on the African continent, the rail transport sector has experienced a decline in recent years. To counteract this decline, the South African government plans to invest R900 billion in transportation infrastructure by 2027 [9].

Contrary to the global trend of railway growth, rail transport as a commuter service in South Africa has been diminishing. The Passenger Rail Agency of South Africa (PRASA) attributes this decline to increased vandalism, lack of maintenance contracts, compromised passenger safety, and unreliable services. In a difficult economic environment, commuters often opt for more reliable transport options, as even a few hours of missed work can significantly impact their income [10].

The COVID-19 pandemic further exacerbated the situation, severely limiting the movement of people throughout South Africa. Public transport, including trains, was significantly affected by lockdown regulations [11]. Metrorail, a PRASA subsidiary, reported a decline in train trips from 1.2 million in 2009/10 to an anticipated 505,000 in 2019/20. Similarly, the number of passengers decreased from 634 million to 147 million during the same period. The long-haul rail service, provided by Mainline Passenger Service, witnessed a decline from 6,604 trips in 2009/10 to 1,155 trips in 2019/20, with passenger numbers falling from 3 million to 276,400 [10].

PRASA finds itself at a critical juncture, facing significant problems and customer expectations that have yet to be fully met. To address these issues, PRASA has formulated strategies and developed a 'back-on-track rescue plan' that is both comprehensive and costed [12]. Working in conjunction with the National Treasury, PRASA plans to allocate R42.1 billion to implement its commuter rail recovery plan. According to the National Treasury's 2022 budget review, this intervention is expected to increase the total number of passenger trips provided by Metrorail from 69 million in 2021/22 to 358 million by 2024/25 [13].

These interventions are part of numerous community development initiatives in the medium-term expenditure framework (MTEF). The focus is on improving access to housing, basic services, and affordable public transport, and fostering spatial transformation and urban development.

2.2. Railway skills required for the 4IR workforce

Preparing the workforce for the 4IR requires the development of both hard and soft skills. Hard skills such as coding, software development, and robotics are essential for leveraging 4IR technologies. In addition, soft skills such as communication, problem-solving, critical thinking, and adaptability play a vital role in 4IR jobs. As technology advances, collaboration, teamwork, and adaptability become increasingly valuable. Employers are recognising the significance of soft skills and prioritising them in their hiring processes. This shift may necessitate changes in education delivery, emphasising skills development and lifelong learning [5].

In the context of the 4IR, it is crucial to address the digital divide and to ensure the accessibility and equitable distribution of technology's benefits. Efforts should be made to provide opportunities for under-represented groups to enter and thrive in technology-related fields. As new technologies are developed and implemented, diversity and inclusivity must be prioritised. This could be achieved by promoting equal access and opportunities, as well as fostering a supportive and inclusive environment for all individuals [5].

The rail industry is experiencing rapid changes globally, driven by the 4IR. Automation technologies, such as driverless trains and smart ticketing, are being implemented, potentially leading to changes in the rail workforce. Certain rail-related jobs may be adversely affected by the 4IR. Train drivers, for example, may face changes or even complete elimination of their roles as automation technologies progress. Train guards could see their jobs evolve into new safety requirements, while information points and ticketing offices may become less common through digitalisation. Similarly, there may be a decrease in the number of staff supervising ticket barriers as paper-based tickets disappear [14]. On the other hand, the 4IR will create new job opportunities in the rail industry. Jobs such as big data analysts, cybersecurity experts, climate change experts, and specialists in AI, IoT, and digitilisation will be in demand. These roles require a skilled workforce, which highlights the importance of skilling and re-skilling the existing rail workforce. Collaboration among African companies could facilitate the sharing of ideas, experiences, and resources to meet the demand for new jobs [15].

The 4IR is based on information and communication technology as well as on the convergence of the physical and virtual spheres, which enables the development of new products and services, reduces transport and communication costs, and simplifies logistics and global supply chains. This technological advancement necessitates a qualified workforce, starting from primary education and moving through to vocational high schools and universities, where training in coding, software, and robotic technology becomes crucial [15]. According to the World Economic Forum (WEF) report, *The future of jobs*, the 4IR brings uncertainties about future professions. It predicts that 65% of primary school students' future professions are still unknown. However, it also anticipates an increased demand for data analysts, programmers, software developers, and information security analysts. While automation and job displacement are concerns, the report suggests that the 4IR may create 97 million new jobs by 2025, many of which require currently scarce skills [16].

While technical skills are critical for effectively designing and maintaining rail systems that incorporate 4IR technologies, soft skills are also essential to build strong relationships with stakeholders and to manage the challenges of digital transformation. While studies examining the technical or hard skills that are necessary for the 4IR are abundant in the literature, research focusing on the soft skills that are required for 4IR in the rail sector is sparse. To unearth the soft skills required for that sector, this paper used a systematic literature review, which is presented in the ensuing sections.

3. METHODOLOGY

This section presents the methods used in this study to identify and prioritise the 4IR soft skills that are relevant to the rail sector.

3.1. Systematic literature review

The systematic literature review (SLR) method was employed as a protocol-driven and quality-focused approach to collate, review, and synthesise available scholarly studies and publications pertaining to the specific topic of interest. The SLR approach enabled the integration of relevant studies to answer questions about the key 4IR soft skills in the rail sector.

3.2. Survey

Following the SLR, a list of key 4IR soft skills was generated, serving as the foundation for the subsequent stages of the methodology. To prioritise the identified soft skills, a survey was designed and administered to professionals and practitioners in the rail sector. The questionnaire encompassed various questions that were designed to obtain respondents' views on which soft skills were most critical for the rail sector, as well as which ones could be effectively developed into training modules. The survey also sought to identify any gaps in the current training programmes for the rail industry and to gather suggestions for improving them.

The questionnaire was divided into three sections. The first focused on biographical information, and aimed to profile each survey participant; the second section focused on assessing the as-is state of the rail sector; and the third section focused on providing the rail experts with the opportunity to rank the soft-skills. To design and conduct the web-based survey, the Stellenbosch University survey administration system (SUrvey.sun.ac.za) was used. To optimise the response rates, the questionnaire was presented to participants in five pages, as recommended by [17].

3.3. Best-worst scaling (BWS) method

To rank the soft skills, the best-worst scaling (BWS) method was used, and the questions regarding the soft-skills were posed in the questionnaire in a way that allowed the use of the BWS method. The BWS is a survey-based method for measuring the relative importance of or preference for a set of items or attributes [18]. In a BWS survey, respondents are presented with a series of choice sets, each containing a subset of items. Respondents are asked to choose the 'best' and 'worst' item from each set, based on their personal preferences. By analysing the choices made by respondents across multiple choice sets, researchers can calculate the relative importance of each item or attribute. BWS has been widely used in various research fields, including marketing, psychology, and economics, and has been shown to be a powerful tool for understanding consumer behaviour and decision-making [18].

By employing a systematic methodology that combines a literature review, survey administration, and statistical analysis, this study effectively addresses the objective of identifying and prioritising the 4IR soft skills. The sections that follow delve into further details of the methodology and its outcomes, providing a comprehensive analysis of the study's findings.

4. RESULTS AND DISCUSSION

This section encompasses the presentation and discussion of the results obtained through the three methods used in this study. By combining the results and discussion in the same section, the flow of conversation is facilitated while also adhering to the limitations of the paper. This approach ensures that the paper maintains a concise and focused structure without exceeding its specified limitations.

4.1. Systematic literature review

To identify the key soft skills required in the rail sector in the context of the 4IR, an SLR was conducted. It followed a well-defined process, including formulating a clear research question, identifying relevant studies, appraising their quality, and summarising the findings. By employing this systematic approach, the study aimed to provide a comprehensive understanding of the soft skills that professionals in the rail

industry needed to navigate the challenges and opportunities brought about by the 4IR. The SLR process and the emergent 4IR soft skills are presented in this section.

4.1.1. The SLR process

According to [19]–[21], a systematic literature review should be based on a clearly formulated question, identify relevant studies, appraise their quality, and summarise the findings. The criteria of the SLR is captured by the stepwise framework presented in Figure 1. According to the framework, the SLR follows four steps, which are presented in this section.

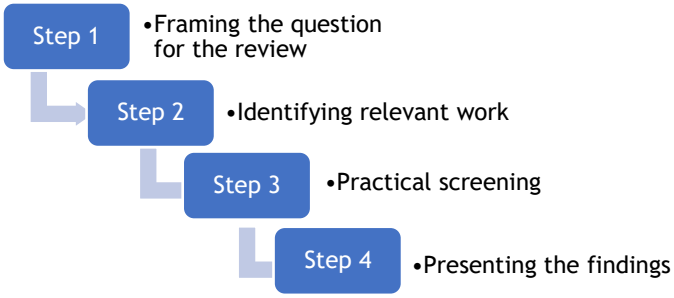

Figure 1: The SLR framework

The first step of the SLR framework involves formulating a well-defined research question, which serves as a guiding principle in conducting the literature search. In the present investigation, the SLR question was formulated as follows: *What are the key 4IR soft skills for the rail sector?*

The literature search was devised to assess a comprehensive range of literature areas and document types through an exploration of five databases, namely Google Scholar, Web of Science, Scopus, Science-Direct, and ProQuest. While additional databases could have been used, time constraints necessitated limiting the search to those five databases. This decision proved appropriate, as an increase in the number of databases being searched resulted in a surge in duplicate findings. The results of the SLR are reported in a systematic manner to include the steps that were followed, using the PRISMA (preferred reporting items for systematic reviews and meta-analyses) diagram in Figure 2.

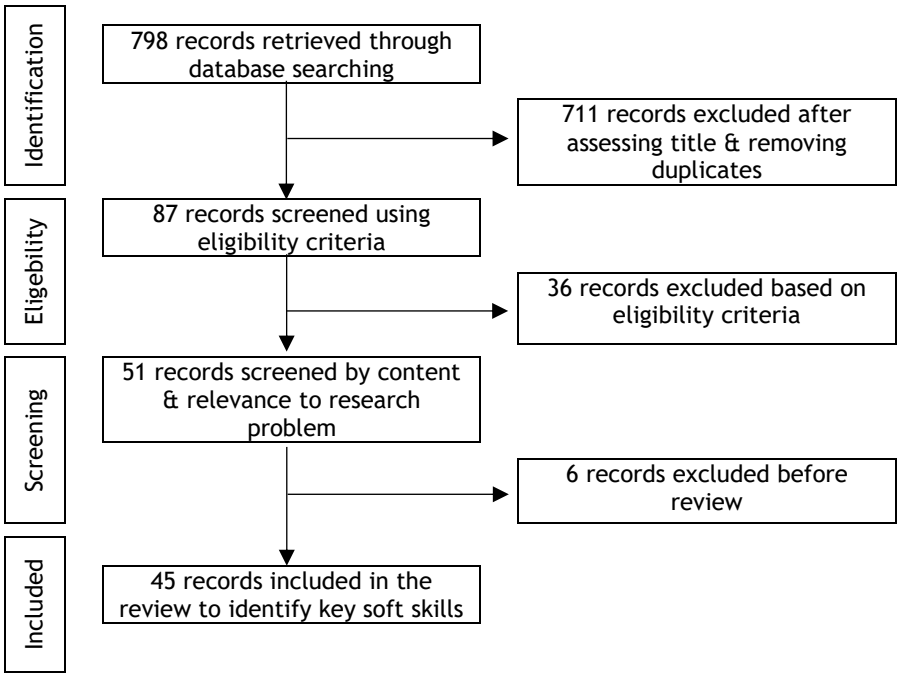

Figure 2: PRISMA showing the flow of information through the SLR

Practical screening eliminates articles from the search results returned by the databases, based on explicitly defined criteria. During the practical screening, the returned search results were screened on the basis of the study's content, publication language, period, and the type of publication in which it appeared [22].

The final step of the SLR entailed presenting the findings obtained from the review process; this is presented in the next section.

4.1.2. 4IR soft skills for rail

The railway sector is undergoing significant transformations as it embraces the 4IR and integrates advanced technologies into its operations. To thrive in this evolving landscape, professionals in the rail industry must possess a range of soft skills that complement their technical expertise. These soft skills enable individuals to navigate complex challenges, adapt to changing circumstances, and collaborate effectively with stakeholders. The 11 soft skills that emerged from the SLR process are presented in Table 1.

Table 1: 4IR soft skills for rail, and their citations

Soft skills	Citations
Complex problem solving	[23], [24], [25], [26]
Critical thinking	[27], [28], [29], [30], [31]
Creativity	[32], [33], [34]
Time management	[35], [36]
People management	[37], [38]
Negotiating skills	[39], [40], [38]
Communication	[37], [39], [41]
Emotional intelligence	[42], [43], [44], [45], [46], [47]
Change management	[48], [40], [49], [50]
Adaptability	[23], [51], [52]
Collaboration/teamwork	[39], [53], [54], [55], [56]

Table 1 presents the 11 soft skills required for the rail sector in the context of the Fourth Industrial Revolution. Each soft skill is listed in the left column, and the corresponding citations for the supporting research and references are provided in the right column. These citations serve as sources for further exploration and in-depth understanding of each skill's relevance and importance in the rail industry's adaptation to the 4IR. Each soft skill is explained in a separate paragraph below.

Complex problem solving (CPS) is a critical soft skill in the rail sector. It involves the ability to analyse intricate situations, generate and evaluate multiple solutions, and collaborate effectively with others [23], [24]. CPS is particularly valuable in an industry like rail, where complex problems and systems are commonplace. Professionals with CPS skills can apply advanced analytics to solve intricate rail problems, contributing to improved efficiency and profitability [26].

Critical thinking is the capacity to think logically, understand the logical connections between ideas, and effectively solve problems [27], [28]. In the rail sector, critical thinking skills are vital for professionals to adapt and thrive in the 4IR. They enable individuals to analyse problems from different angles, identify potential solutions, and make informed decisions that are based on evidence and logic. Moreover, critical

thinking facilitates the evaluation of information, the identification of risks, and the development of strategies to mitigate them, all of which are crucial in the rail industry [31].

Creativity is highly valued in the rail sector, as it fosters innovation and the generation of unique and valuable concepts [32], [33]. With the rapid changes brought about by the 4IR, creativity becomes essential in developing new transportation systems, innovative railway designs, and cutting-edge technologies [34]. Furthermore, creativity promotes employee engagement, a positive workplace culture, and personal growth, enabling individuals to adapt and benefit from the transformations of the 4IR [51].

Time management is a vital soft skill in the rail sector, as it enables professionals to work efficiently, prioritise tasks effectively, and meet deadlines [35], [36]. In the fast-paced and constantly evolving 4IR environment, employees must be able to adapt quickly to changing priorities, multitask, and handle competing demands on their time [51], [34]. Effective time management contributes to increased productivity, reduced stress levels, and improved job satisfaction [36].

People management is critical for the rail sector's success in the 4IR. Leaders must focus on enabling workers to prosper and to adapt to the changes brought about by technological advancements [37]. Skilling and re-skilling workers requires effective management practices, lifelong learning initiatives, and the development of negotiation skills [57]. Leaders play a key role in fostering a culture of continuous learning and development, ensuring employees have the necessary tools and resources for ongoing growth [38].

Negotiation skills are essential for effective communication and conflict resolution in the rail sector [39], [40]. They enable professionals to address the competing interests and conflicting priorities of the various stakeholders involved in the implementation of 4IR technologies. Negotiation skills allow for finding mutually beneficial solutions, securing funding, establishing partnerships, and resolving disagreements within and outside the organisation [39]. They are vital for navigating complex and rapidly changing situations, facilitating collaboration, and building productive relationships [38].

Effective communication is a foundational soft skill in the rail sector, particularly in the context of the 4IR. It ensures clear and concise expression of ideas, fosters relationships with stakeholders, and promotes project success [39]. Additionally, communication involves active listening, allowing individuals to understand the perspectives and needs of others, provide constructive feedback, manage difficult conversations, and engage in collaborative problem-solving [37]. Effective communication skills enhance employee engagement, motivation, and alignment with organisational success [37].

Emotional intelligence (EI) plays a significant role in the 4IR workplace, enabling individuals to manage their own and others' emotions, guide their thinking, and take appropriate actions [44]. EI encompasses self-awareness, self-regulation, empathy, and social skills [44]. In the rail sector, EI is crucial for navigating the ethical challenges arising from new technologies, promoting innovation, and fostering positive relationships and collaboration [46]. Training programmes can help to develop EI skills, enhancing individuals' adaptability and success in the 4IR [47].

Change management is essential in the rail sector's 4IR journey, ensuring successful adaptation to new technologies and practices [48]. Following Kurt Lewin's change management model, organisations must unfreeze the status quo, implement changes effectively, and refreeze the new state to make it permanent [48]. Effective change management requires creating a sense of urgency, addressing resistance, and embedding new behaviours and processes in the organisational culture [48]. Adapting to change becomes crucial to survival and growth in the 4IR [40], [49], [50].

Adaptability is a vital soft skill in the rail sector's 4IR transition [23], [58], [59]. Professionals must be able to adjust to changing circumstances, learn new skills, and embrace new technologies and processes [51]. Adaptability enables rail workers to navigate the complexities of 4IR implementation, work with new stakeholders, and respond swiftly to market and regulatory changes [51]. It is a personal attribute that empowers individuals to respond positively to challenges and opportunities, fostering resilience and continuous growth [52].

Collaboration is crucial for successful 4IR implementation in the rail sector, enabling effective teamwork, knowledge sharing, problem solving, and innovation [39]. Cross-functional collaboration brings together employees from different departments to work towards shared objectives, ensuring alignment and knowledge exchange [54]. Collaboration with external stakeholders such as technology vendors and

government agencies helps organisations to stay aligned with best practices and emerging technologies [53], [54]. Collaborative problem solving combines diverse perspectives and expertise to address complex challenges efficiently [56]. Collaboration fosters innovation by leveraging collective expertise to drive improvements in rail systems and operations [55], [56].

In conclusion, the rail sector's transition into the 4IR demands a comprehensive set of soft skills to complement technical expertise. These eleven soft skills equip professionals in the rail industry with the abilities required to thrive in the rapidly evolving 4IR landscape and to contribute to the sector's success.

4.2. Survey

A comprehensive survey was conducted among rail experts to gain insights into critical soft skills for the rail sector that were identified through the systematic literature review. The survey aimed to rank the importance of these skills and to assess their potential for the creation of effective training modules. It also sought to identify gaps in existing training programmes and gather suggestions for improvement. The questionnaire consisted of three sections: biographical information, 4IR readiness assessment, and ranking of soft skills.

4.2.1. Biographical information

The survey conducted in this study gathered biographical information from participants, including their rail sub-sector, organisation size, role, and experience. A total of 136 rail personnel were invited to take part in the survey, resulting in a response rate of 43%, with 59 participants providing their valuable insights. Figure 3 presents the list of the participating organisations, showing the diverse range of entities that contributed to the survey data.

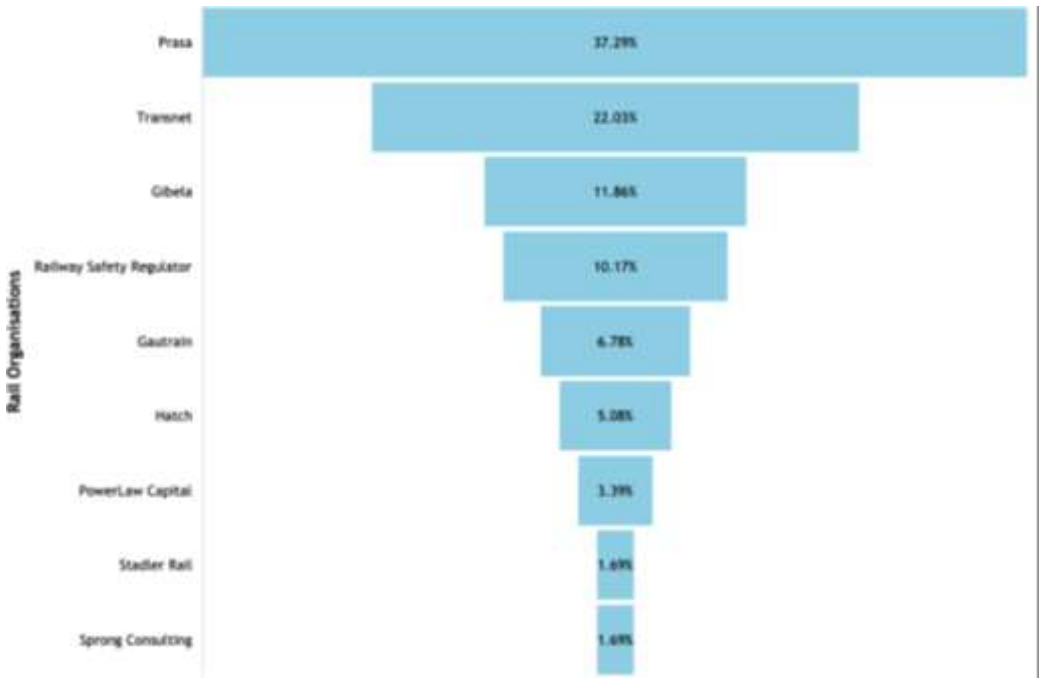

Figure 3: Percentage of participants per organisation

The survey participants were largely composed of employees from PRASA and Transnet, which is in line with their status as the primary rail players in South Africa. Figure 4 below shows the respective rail subsectors of the participants and their roles.

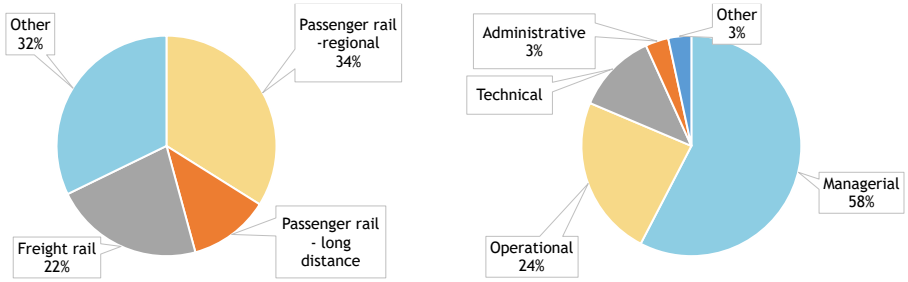

Figure 4: The rail subsectors of the participants and their roles

The data suggests that the 22% of participants who identified as working in freight rail were likely employed by Transnet, while the majority of passenger rail participants were likely from PRASA and Gautrain. The majority of the participants were managers; they included all types of managers such as project managers, operations managers, and department managers.

4.2.2. Rail sector readiness assessment

The readiness assessment in this study aimed to evaluate the participants' preparedness for the 4IR and their perception of its impact on the rail industry. The assessment included a set of twelve questions in the questionnaire. Participants were asked about workforce planning in their organisations, revealing a lack of conducted workforce planning for the 4IR in many organisations.

This section of the questionnaire also explored the development of new jobs to accommodate 4IR changes and the problem of perceived job insecurity. The findings indicated that a significant number of organisations were not developing new jobs, and a lack of agreement on perceived job insecurity. Assessing the readiness to implement technology revealed that implementation plans for existing technology were somewhat undefined, and implementing 4IR technologies was anticipated to be a major challenge. Participants also identified the existence of issues related to digitalisation in South Africa, with a need to pay attention to implementation strategies. The importance of implementing 4IR technologies in rail, particularly in areas such as maintenance and customer support, was deemed very important.

Furthermore, exploring the effectiveness of technology adoption workshops and training in the rail sector indicated a significant lack of focus on soft skills, highlighting the need to establish relevant training programmes. Participants believed that the few soft skills workshops that were provided were somewhat successful, but rated the overall setup of training programmes as poor. Finally, participants were asked about their organisations' plans to retain employees in jobs that may become obsolete because of 4IR technologies; the responses leaned toward a small extent of retention.

4.2.3. Ranking 4IR soft skills

The soft skills were ranked using the BWS method, which was implemented through specific questions in the questionnaire. The analysis of the questionnaire data used a mixed model analysis of variance (ANOVA) with the lmer package in R. This comprehensive statistical approach considered both fixed and random effects, allowing for a thorough examination of the data. The mixed model ANOVA provided valuable insights into the relative importance of the soft skills and the variations in perception across different skills. The analysis yielded several BWS score details, including an ANOVA that assessed the overall significance and variability in the soft skills rankings. This analysis identified statistically significant differences in the perceived importance of these skills. The ANOVA table is presented in Figure 5.

	ANOVA type: III Random effects: (1|ResponseID) Degrees of freedom: Kenward-Rogers					
	Sum Sq	Mean Sq	Num DF	Den DF	F value	p value
attribute	661,88	66,19	10	470	21,55	<0.01

Figure 5: Analysis of variance

The ANOVA analysis provides valuable statistical insights into the variation and significance of the rankings of the different soft skills. The sum of squares (Sum Sq) quantifies the total variability observed in the rankings, reflecting the overall differences or variations among the soft skills. The mean square (Mean Sq) indicates the average amount of variability in the data, offering insights into the level of agreement or disagreement among participants. 'Degrees of freedom' represents the level of flexibility and information available for estimation in the analysis, with larger degrees of freedom enhancing the reliability of results. The calculated F value and p value indicate that the observed differences in the rankings are statistically significant, suggesting that the variations are not the result of chance alone. Overall, the ANOVA analysis provides a comprehensive understanding of the significance and patterns of variation in the soft skills rankings.

Another significant measure in the ANOVA table is the mean square (Mean Sq), calculated as 66,9. The mean square provides information about the average amount of variability in the data. In simpler terms, it offers insight into how much the rankings of the soft skills tend to vary from one another on average. A lower mean square indicates that the rankings are relatively consistent and close to one another, while a higher mean square suggests greater variability or differences in the rankings. In the context of the research, understanding the mean square helps to gauge the level of agreement or disagreement among the participants about the ranking of the soft skills. A lower mean square indicates relatively similar rankings among the participants, reflecting a higher level of consensus. Conversely, a higher mean square suggests greater diversity or variation in the rankings, indicating a wider range of opinions and preferences.

Last, the ANOVA table provides information about the degrees of freedom used in the analysis. In this research, the numerator degree of freedom (Num DF) is 10, and the denominator degree of freedom (Den DF) is 470. The degrees of freedom represent the number of independent pieces of information available for estimation in the statistical analysis.

In simpler terms, the degrees of freedom signify the level of flexibility or room for accurately estimating and analysing the data. A larger degree of freedom means having more independent information, which increases the reliability and precision of the results. In this study, having 10 degrees of freedom for the numerator and 470 degrees of freedom for the denominator enables robust and meaningful conclusions to be drawn about the rankings of the soft skills.

The calculated F value is 21.55, which is derived by dividing the mean square by the corresponding error mean square. The F value provides a measure of the significance of the observed variation in the soft skills rankings. In this case, the obtained F value indicates that there is a fair distinction among the soft skills – that is, each skill represents a specific distinct phenomenon or concept. The p value is less than 0.01, suggesting that the observed differences in the soft skills rankings are highly statistically significant. This implies that the variations in the rankings are unlikely to have occurred by chance alone.

An attribute least significant (LS) means graph was used to represent visually the relative rankings of the soft skills, based on the obtained LS means, and is presented in Figure 6. The LS graph offers an intuitive depiction of the data, allowing for easy identification of the consistently highly ranked and poorly ranked skills.

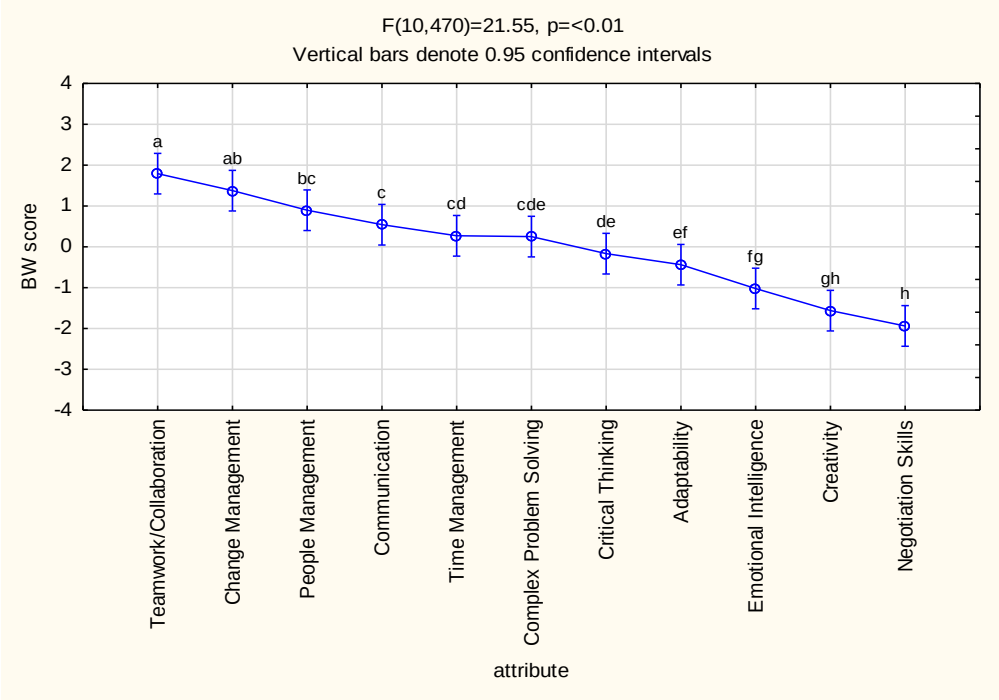

Figure 6: Attribute LS means graph

Figure 6 presents the attribute LS means graph, providing a clear visual representation of the soft skills rankings. The LS means represent the estimated mean values for each skill, reflecting the perceived importance or effectiveness, as assessed by the survey participants.

5. CONCLUSION

5.1. Concluding remarks

The rankings presented in this study should be interpreted as a measure of the relative importance and effectiveness of each soft skill, as assessed by the survey respondents. It is crucial to understand the underlying methodology of the BWS technique to make meaningful interpretations. The lower-ranked skills should not be dismissed as unimportant for the 4IR in the rail sector.

During the survey, participants were presented with choice sets containing a subset of soft skills, and were asked to indicate their perceived importance relative to other skills in that subset. Therefore, the rankings reflect the participants' perception of the relative effectiveness of each soft skill compared with the others. It is worth noting that all eleven skills discussed in this paper are considered important for 4IR in the rail sector. The rankings provide insights into the participants' perception of the effectiveness of each skill in relation to the next. However, when deciding which skills should be developed into training modules, it is important to consider not only the rankings but also the practicality of developing each identified soft skill into a training module.

Taking a comprehensive approach, organisations should consider the interplay and interconnectedness of these skills in the context of the rail sector's needs and goals for the 4IR. The rankings serve as excellent input into deciding which of the soft skills should be developed as training modules. However, the final decisions on the selection and development of training modules should be based on a holistic understanding of the skills required for 4IR success, the specific challenges and opportunities faced by the rail sector, and the practicality of implementation. This comprehensive approach would ensure that the development of soft skills aligns with the specific needs and objectives of the rail industry in embracing the 4IR.

5.2. Recommendations

Based on the findings of the study and the rankings thus obtained, it is recommended that the development of training modules for the following four soft skills be prioritised: change management, teamwork, people management, and communication. These skills were consistently ranked higher by the survey respondents, indicating their perceived importance and effectiveness for the 4IR in the rail sector. However, these four are selected also because they indirectly enhance the remaining seven soft skills, and developing comprehensive training modules for the recommended skills would have a positive impact on the development of the other soft skills as well. By focusing on these four key soft skills, targeted training programmes that address the specific needs of rail organisations' personnel could be created in preparing for the challenges and opportunities of 4IR. The four soft skills recommended for further development as training modules are listed below, and their relationships to other soft skills are briefly highlighted.

- Change management: Change management involves facilitating and guiding individuals and teams through transitions. It requires effective communication to articulate the reasons for change, teamwork to engage and involve stakeholders, people management to address resistance and support employee development, and adaptability to navigate evolving circumstances.

- Teamwork: Teamwork is essential for collaboration, problem solving, and innovation. It involves effective communication to foster open dialogue and shared understanding, change management to adapt to team dynamics and project requirements, people management to leverage individual strengths and build cohesive teams, and negotiation skills to resolve conflicts and reach consensus.

- People management: People management encompasses the leadership, motivation, and development of individuals in an organisation. It requires effective communication to provide feedback and guidance, teamwork to create a supportive and inclusive work environment, change management to address employees' concerns and align them with organisational goals, and emotional intelligence to understand and respond to the needs and emotions of team members.

- Communication: Effective communication is vital for conveying ideas, building relationships, and fostering collaboration. It underpins teamwork by facilitating information sharing and coordination, change management by conveying the rationale for and benefits of change, people management by providing clear expectations and feedback, and negotiation skills by articulating and persuading others to consider different perspectives.

5.3. Future work

One important area for future research is the development of training modules specifically targeting the identified soft skills for the rail sector. While this study has identified the critical soft skills needed in the context of the 4IR, the practical implementation of these skills requires effective training programmes.

Further research could focus on designing and implementing training modules that effectively develop and enhance the identified soft skills in rail professionals. These modules should be tailored to the unique challenges and requirements of the rail industry in the 4IR era. The effectiveness of these training programmes could be evaluated through rigorous methods of assessment and evaluation, measuring the impact on skill acquisition, application, and overall job performance.

5.4. Limitations

While this study aimed to provide insights into the critical soft skills for the rail sector in the context of the 4IR, it is important to acknowledge certain limitations that may impact the generalisability and scope of its findings. First, the survey that was conducted to gather the views of rail experts on the importance and feasibility of the identified soft skills may have been subject to response bias. The sample size of the survey was relatively small because the focus of the study was on rail experts in South Africa, and this could have limited the representativeness of the findings. The survey participants were selected on the basis of their expertise in the rail sector, which may have introduced a certain level of professional bias. Another limitation is the geographic focus of the study: the research was conducted in a specific country, which may have its own unique characteristics and contextual factors that could have influenced the relevance

and applicability of the identified soft skills. The findings may not be directly transferable to other countries with different rail systems, cultural contexts, or regulatory frameworks.

Despite these limitations, this study provides a valuable foundation for understanding the critical soft skills that are required in the rail sector for the 4IR era. The findings could serve as a starting point for further research and practical initiatives aimed at equipping rail professionals with the necessary skills to navigate the challenges and opportunities presented by the 4IR.

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