



International
Labour
Organization



Assessment of 21st Century Skills Across Emerging Sectors

Tourism Sector

Volume 2

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Finally, we extend our heartfelt thanks to the dedicated staff at NIHERST, particularly those in the Science and Technology Statistics Department, for their tireless efforts and commitment in producing this report.

Foreword



Tourism remains one of the most vibrant and multifaceted drivers of Trinidad and Tobago's economic and cultural landscape. This study offers timely insight into the sector's evolution, its untapped potential, and the bold steps needed to amplify its impact in shaping our national identity and global presence.

Conducted with rigor and forward-thinking vision, the study highlights the interconnectedness of tourism with innovation, sustainability, and inclusive development. It reflects our nation's resilience and adaptability — qualities that will be essential as we strive to create authentic visitor experiences while preserving our rich heritage and natural assets. Equally important, the study assesses the skills – technical and the 21st century skills within the context of the Tourism Industry.

As President (Ag) of the National Institute of Higher Education, Research, Science and Technology (NIHERST), I am proud to present this important study. It is a testament to NIHERST's commitment to evidence-based research, strategic foresight, and the belief that tourism is not merely a commercial enterprise but a transformative force for community empowerment and national progress.

I wish to extend sincere thanks to our institutional partner, the International Labour Organization (ILO) for their unwavering support in enabling this series of research studies and in particular this second series which offers a comprehensive study of the Tourism industry in Trinidad and Tobago.

I also wish to commend the researchers and industry stakeholders who made this publication possible. May it inspire collaboration and action among policymakers, entrepreneurs, and citizens alike as we journey toward a thriving, sustainable, future looking tourism industry.

A handwritten signature in black ink, appearing to read "Julie David".

Ms. Julie David
President (Ag.)
NIHERST

Partner Message



The International Labour Organization (ILO) Decent Work Team and Office for the Caribbean is proud to be part of this publication to support Trinidad and Tobago's efforts to transition towards a more diversified workforce.

This report focuses on the Tourism Sector and is part of an impressive wider strategy by the National Institute of Higher Education, Research, Science and Technology (NIHERST) to identify needs and actions for effective skills development in emerging sectors. It offers a timely and insightful assessment of the 21st century skills and STEM competencies shaping the future of this industry.

It would be remiss of me not to highlight that the results presented in this report are based on a NIHERST survey launched with guidance from the ILO Global framework on core skills for life and work in the 21st century and technical advice from Ms. Ilca Webster, Lifelong Learning Specialist at the ILO Caribbean Office.

The ILO commends NIHERST for its targeted approach to enhancing skills anticipation and closing skills gaps for this sector. The tourism sector stands as a cornerstone of innovation and economic growth. Recruiting talent equipped not only with technical expertise but also with the soft and cognitive skills that are often underdeveloped in recent graduates is key to unlocking the full potential of this sector.

This report is more than a snapshot of current challenges; it is a call to action. By embracing its insights and recommendations, stakeholders across government, academia, and industry can work collaboratively to ensure that Trinidad and Tobago not only keeps pace with global trends but leads in shaping a digitally empowered future.

A handwritten signature in black ink, appearing to read "Joni Musabayana".

Dr. Joni Musabayana
Director
ILO Caribbean Decent Work Team and Office for the Caribbean

Executive Summary

The rapid advancement of technology is reshaping the world of work in the tourism sector, demanding that individuals continuously update their knowledge and skills to remain competitive. As automation, digital tools, and data-driven processes become more integrated into tourism, the need for a workforce equipped with both technical expertise and adaptable future-ready skills is growing. International organisations such as the World Bank and the OECD (Organisation for Economic Co-operation and Development) have underscored the importance of STEM (Science, Technology, Engineering, and Mathematics) education in preparing individuals to meet these evolving demands.

STEM education not only builds foundational knowledge on critical disciplines but also cultivates 21st Century Skills - such as problem-solving, critical thinking, collaboration and digital literacy - that are essential for navigating today's innovation-driven economy. These competencies are particularly relevant in tourism, where digital transformation is rapidly transforming traditional practices, driving greater value creation, increasing operational efficiency, improving interconnectivity and promoting sustainable development.

To support this transition, countries like Trinidad and Tobago must invest in education and training programmes that align with the needs of emerging sectors. The *Assessment of 21st Century Skills across Emerging Sectors* study was designed to provide insights into the current and future skills demands in five (5) key industries: Maritime, Tourism, Software Design and Applications, Agro-processing and Aviation. This report - the second in this research series - focuses on the tourism industry, offering evidence-based results to guide policy development and workforce planning aimed at strengthening national capacity and competitiveness in this key industry.

The tourism sector in Trinidad and Tobago has been increasingly recognised as a priority for development. Tourism in Trinidad and Tobago accounts directly for a relatively small percentage of the GDP compared to other Caribbean nations. In 2022, Tourism accounted directly for only 2.8% of the nation's GDP (World Travel & Tourism Council [WTTC], 2023).¹ However, the tourism industry plays a crucial role in providing employment opportunities. The sector generated approximately 20,422 jobs directly in 2022 which represented 3.3% of total employment (WTTC,

¹ World Travel & Tourism Council. *Travel & Tourism Economic Impact 2023*. May 2023

2023). Tourism encompasses various activities ranging from accommodation to entertainment. Well-targeted investment and supportive policies in the local tourism sector can accelerate its growth, increase its contribution to GDP and employment, and serve as a catalyst for inclusive and sustainable development.

The Assessment of 21st Century Skills across Emerging Sectors study examined the labour needs of five (5) emerging industries including tourism. This report presents the key findings from data collected from seventy-seven (77) of the one hundred and seventy (70) tourism establishments surveyed. These businesses were primarily engaged in accommodation; food and beverage; tour operator; travel agency; and entertainment/leisure.

The report begins by highlighting key characteristics of employers in the tourism sector. Collecting data on the characteristics of employers is important to help to contextualise the research findings to better understand the firms operating in the local industry. A higher percentage of establishments had been in operation for 10–19 years (31%), followed by those operating for 30–39 years (19%) and 20–29 years (18%). In terms of employment, 51% of the establishments had less than 10 employees, while 21% employed between 10 to 24 workers. The main economic activity of establishments was Accommodation (48%) followed by Food and Beverage (23%) and Tour Operator (15%).

The study also explored the composition of the workforce, with a particular focus on STEM-related qualifications and occupations. This analysis is critical for identifying current capabilities and future labour needs. The data shows that the industry employed a marginally higher percentage of females (89%) compared to males (87%). In terms of occupational groups, there were more male professionals, technicians and associate professionals, skilled agricultural, forestry and fishery workers, craft and related trades workers, and plant and machine operators, and assemblers while females outnumbered males in the categories of managers, clerical support workers, and service and sales workers.² There was a similar percentage of males and females in elementary occupations.

In terms of qualifications, 48% of the establishments employed individuals with STEM degrees, with the highest concentration (24%) found among Managers. Despite this, the overall number of employees in STEM specific occupations remained low. The highest representation was in Engineering roles followed by

² The occupational groups presented in this report are based on the ILO's International Standard Classification of Occupations (2012) and are further detailed in Appendix I.

Computer Science/IT and Food and Agriculture occupations. The findings reveal that there were more males in STEM occupations than females. These findings highlight both the existing capabilities and the potential gaps in STEM talent within the tourism sector, offering valuable insights for workforce development and policy planning.

The *Assessment of 21st Century Skills Across Emerging Sectors* study also examined the labour market dynamics within the tourism industry, focusing on current and future workforce needs, particularly in relation to STEM occupations. Some of the key findings on job vacancies, recruitment challenges, core skills and the demand for STEM labour are as follows:

Job Vacancies and Recruitment Challenges

An important component of the study was identifying job vacancies and understanding recruitment challenges faced by employers. This data provides insights into labour market gaps – especially in STEM fields - and informs decisions on training, education, and workforce development.

At the time of the survey, job opportunities in the industry were low. Only 27% of the establishments reported vacancies during the survey period. A larger proportion (20%) of employers reported vacancies in non-STEM fields compared to vacancies in STEM fields (8%). The majority of STEM vacancies were in the field of Food and Agriculture, followed by Natural Sciences. In terms of recruitment challenges, employers reported the greatest difficulty filling professional roles, followed by technician and associate professional positions. With regard to STEM occupations, employers faced the greatest hiring challenges in Computer Science/IT (75%), Engineering (67%), and Medical and Health (67%) roles. The most difficult STEM occupation to fill was Food Scientist. The main barriers to filling STEM vacancies included were the lack of work experience among applicants, a low number of applicants with the required skills and a low number of applicants with the required attitude, motivation or personality. The main recommendation employers suggested to overcome problems experienced while filling STEM vacancies was to create more training opportunities for graduates.

Core Skills and Skills Mismatches

The study also assessed the cores skills of the workforce to identify mismatches between employer expectations and employee capabilities. Skills mismatch represents a discrepancy between the skills demanded by employers and the skills individuals possess. This can impact economic growth by restricting workers' access to higher-paying jobs and limiting firms' profitability and productivity.³ The skills examined in this study are based on 19 core skills that are described in Appendix III. The ILO identified these skills as crucial for lifelong learning and adapting to labour market changes. Recognising the fundamental skills needed to reach business objectives and aligning them with the skills of recent applicants and existing employees can facilitate a better understanding of the magnitude and nature of the skills gap.

The majority of employers indicated that all 19 identified skills were important for employees to possess. Among these, the most highly valued were Communication (98%), Collaboration and Teamwork (95%), and Self-Reflection and Learning to Learn (93%). The top three internal drivers of change were people (53%), profit (52%), and technology (19%), with Communication (22%) identified as the most critical skill to address these changes. Externally, the main drivers of change were competition (57%), climate change (30%), and the economy (21%). The most relevant skills to address these external changes were innovation (12%) and communication (12%).

More than half (50%) of employers reported experiencing some level of difficulty in finding social and emotional skills, as well as cognitive and metacognitive skills, among university graduates applying for positions in their establishments. The most difficult skills to find among recent graduates were analytical and critical thinking, conflict resolution and negotiation, and emotional intelligence. Additionally, 58% of respondents indicated that recent graduates were somewhat prepared to work in their businesses, while 21% stated that graduates were well prepared, and another 21% said they were poorly prepared.

³ Productivity is defined as a ratio between the volume of output and the volume of inputs. It measures how efficiently production inputs, such as labour and capital, are being used in an economy to produce a given level of output (OECD 2024)

Regarding existing employees, over half (50%) of employers rated their employees' skill levels as medium or low in 15 of the 19 core skills assessed. The highest-rated skills among employees were communication (54%), creative and innovative thinking (53%), collaboration and teamwork (53%), and planning and organising (52%). These results indicate a clear skills gap in the industry, as there is a mismatch between the skills employers consider essential for achieving business goals and the current capabilities of their workforce. Despite this, 55% of employers reported that the lack of skills among workers did not affect their operations, while 23% disagreed, and 22% did not respond.

Demand for STEM Labour

The study also examined the current and projected demand for STEM labour in the tourism industry, acknowledging that technological innovation is reshaping workforce requirements. During the survey period, the overall demand for STEM-related occupations was generally low among participating establishments. The highest demand was reported in Food and Agriculture occupations, followed by Environmental Sciences, while the lowest demand was observed in the Medical and Health field. The most in-demand jobs at the time of the survey were Web and Digital Interface Designers (18%) and Environmental Scientists (18%). Looking ahead, the top three STEM occupations employers identified as priorities over the next five years, based on the strategic direction of their establishments, were Environmental Scientists (16%), Food Scientists (14%), and Software Developers (11%).

TVET Labour Needs

In addition to STEM, the assessment examined labour needs related to Technical and Vocational Education and Training (TVET). However, the response rate for the TVET section was notably low. It is recommended that assessments focusing mainly on TVET be undertaken to better understand the sector's vocational training requirements.

Technological Advancements in Tourism

A key component of this research is the assessment of technological advancements in the global tourism industry, with a focus on both the challenges and opportunities they present. Emerging technologies such as Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), the Internet of Things (IoT), and Renewable Energy are driving greater efficiency, innovation, and

sustainability across the sector. To remain competitive, tourism establishments must adapt by integrating these technologies into their operations. These global advancements also present opportunities to enhance local tourism services and infrastructure, while simultaneously supporting the growth of STEM careers within the industry.

Policy Relevance and Recommendations

This study serves as a critical resource for shaping national skills policy and supporting the development of a future-ready workforce aligned with Trinidad and Tobago's economic diversification agenda. This publication also captures employers' recommendations on how government, industry and tertiary institutions can work together to strengthen STEM education and the STEM labour force.

Some of the key recommendations from employers include: upgrade education programmes to meet the needs of the industry; introduce more training programmes; increase the number of programmes at educational institutions; and increase awareness of STEM labour in the industry.

In addition to these employer-driven suggestions, the report outlines broader recommendations based on the study's findings. These include: greater alignment of tertiary programmes to the needs of the industry; increasing training opportunities; integrating STEM in the classroom; training STEM educators; promoting STEM education and careers; increasing data collection on the labour market statistics; and strengthening linkages between stakeholders among other recommendations.

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Abbreviations and Acronyms

AI	Artificial Intelligence
AR	Augmented Reality
CBTT	Central Bank of Trinidad and Tobago
CSO	Central Statistical Office
GHG	Greenhouse Gas
GORTT	Government of the Republic of Trinidad and Tobago
ISCO	International Standard Classification of Occupations
ICT	Information and Communication Technologies
ILO	International Labour Organization
IoT	Internet of Things
IT	Information Technology
MoE	Ministry of Education
MSEs	Micro and Small Enterprises
MSMEs	Micro, Small and Medium Enterprises
NIHERST	National Institute of Higher Education, Research, Science and Technology
OECD	Organization for Economic Co-operation and Development
SMEs	Small and Medium Sized Enterprises
STEM	Science, Technology, Engineering and Mathematics
S&T	Science and Technology
SPSS	Statistical Package for the Social Sciences
SDG	Sustainable Development Goal
T&T	Trinidad and Tobago
TVET	Technical and Vocational Education and Training
UNCTAD	United Nations Conference on Trade and Development
VR	Virtual Reality

WEF	World Economic Forum
WTTC	World Travel & Tourism Council
WTO	World Tourism Organization

Introduction

As global tourism rapidly evolves, driven by technological disruption, climate change, and changing traveller expectations, Trinidad and Tobago has a critical opportunity to reimagine its tourism sector as a catalyst for sustainable economic transformation. According to the World Economic Forum (WEF), travel and tourism currently contribute over 10% of global GDP, with the potential to rise to 11.5% by 2034.⁴ This presents a key opportunity for T&T to diversify its economy and position tourism as a driver of innovation and sustainable development. However, capitalising on this potential requires more than traditional tourism offerings. It demands a workforce equipped with STEM skills to meet the demands of a technology-driven and environmentally conscious tourism market. Emerging technologies such as Artificial Intelligence (AI), Virtual Reality (VR), and Renewable Energy are reshaping how the industry operates but local employers report difficulty finding employees with essential competencies like critical thinking, communication, and innovation.

The Assessment of 21st Century Skills in Emerging Sectors project is both timely and strategically significant, aligning closely with the Government of Trinidad and Tobago's 2025 policy priorities. It serves as a critical mechanism for building a future-ready, STEM-empowered workforce, catalyzing economic transformation, and advancing inclusive national development in accordance with the Government's vision for a prosperous and modern Trinidad and Tobago. A core pillar of the Government's Youth Development Policy is its commitment to equipping the next generation with the skills, purpose, and opportunities needed to thrive in an increasingly dynamic and technology-driven global landscape.⁵ In keeping with this commitment, the Government has also signaled its intention to embrace artificial intelligence (AI), digital technology, and new media as enablers of meaningful employment opportunities.⁶

NIHERST, in collaboration with the International Labour Organization (ILO), undertook the Assessment of 21st Century Skills Across Emerging Sectors study from February 2023 to July 2025. The overarching objective of this study is to

⁴ World Economic Forum. <https://initiatives.weforum.org/good-growth-coalition/travel-and-tourism>

⁵ Government Manifesto on Agriculture and Food Security, 2025. <https://uncmanifesto.com/>

⁶ Government Manifesto on Artificial Intelligence, Digital Transformation, New Media and Social Media, 2025. <https://uncmanifesto.com/>

provide accurate data on STEM labour requirements in key industries to assist policymakers in developing effective education, training, and workforce strategies in response to rapid technological advancements. This report presents the research findings from the tourism sector.

As advanced technologies such as Artificial Intelligence (AI) and Virtual Reality (VR) become increasingly integrated into the workplace, the demand for a highly skilled workforce is growing. According to the World Economic Forum's Future of Jobs Report 2025, employers anticipate that 39% of workers' core skills will need to change by 2030. Employer feedback further indicates that technological skills are expected to grow in importance more rapidly than any other skill category, with AI and big data leading the shift, followed by Networks and cybersecurity, and Technological literacy. These technologies can lead to significant disruptions in the tourism workforce, as data from the United Nations World Tourism Organization (UNWTO) reveals that a large proportion of the global tourism workforce is made up of young people, many of whom lack further training or formal qualifications.⁷ Strengthening the skills and competencies of this workforce is therefore essential to ensure they are equipped to thrive in a technology-driven environment. By investing in targeted skills development and training, employers can empower their staff to reach their full potential while enhancing the business's competitiveness, innovation, and long-term sustainability.

STEM skills are essential for workers to adapt to the rapidly evolving work environment driven by technological advancement. This research was undertaken to assess the demand for STEM-related skills and labour within Trinidad and Tobago's tourism sector. It examined existing vacancies and the challenges employers face in filling these roles. The study also provided a comprehensive analysis of the skills required by businesses to achieve their strategic objectives, comparing these demands with the current capabilities of both recent job applicants and existing employees. In addition, it identified key internal and external drivers of change within businesses and the skills needed to respond effectively. The research explored both current and projected demand for STEM professionals and also sought to gather labour market data at the TVET level. Furthermore, it investigated global tourism innovations, the careers emerging from these advancements, and the benefits they offer. Based on the findings, a series

⁷ World Tourism Organization (UNWTO). (December 16, 2022). *The Global Education Forum puts a spotlight on the future of tourism*. <https://www.unwto.org/news/the-global-education-forum-puts-a-spotlight-on-the-future-of-tourism>

of evidence-based recommendations were developed to support policy, education, and workforce planning.

This report is organised into the following sections:

Section 1 describes key aspects of the methodology employed for the study. The following aspects are discussed in this chapter: the objectives of the study; research methods used; questionnaire design; sample design; data collection and limitations; and data processing and presentation.

Section 2 focuses on the characteristics of employers including length of time in operation, employment size and main economic activity performed by businesses.

Section 3 presents data on the characteristics of the workforce. The characteristics assessed in this section are sex, occupational group, STEM qualifications and STEM occupations.

Section 4 introduces the recruitment issues reported by employers in the tourism sector. This section offers data on the number of establishments with current vacancies, the difficulty employers experienced when filling vacancies, and the number of vacancies filled in the last twelve (12) months of the survey period. In addition, the section provides a comparison of vacancies and recruitment issues by STEM and non-STEM fields. Section 4 also offers recommendations from employers on how to overcome difficulties faced during recruitment.

Section 5 presents an assessment of the skills mismatch in the tourism sector. The chapter examines the skills employers identified as important for employees to possess in order to meet strategic goals and objectives. Additionally, an assessment of the skills gaps among recent job applicants, university graduates and existing employees based on the 19 core skills identified in the Global framework on core skills for life and work in the 21st Century is depicted in this section. The section also provides information on the perception of employers in the tourism sector on the preparedness of recent university graduates for work in this sector.

Section 6 examines the demand for STEM workers including current and future demands. The top STEM occupations demanded by the employers based on their strategic plan are also presented in this section.

Section 7 provides some data on TVET needs in the tourism sector.

Section 8 offers recommendations provided by employers on how the government, tertiary education and business sectors can help improve STEM competencies.

Section 9 examines significant technological advancements in global tourism along with key STEM careers linked to these innovations. It also explores the ease and advantages of integrating these technologies into tourism operations. Furthermore, the section highlights the transformation of Japan's tourism sector and examines the technological innovations contributing to the success of this industry.

Section 10 offers general recommendations based on the research undertaken, stakeholder consultations and the results of the industry survey.

Section 11 is the conclusion that reiterates salient points made throughout this publication.

1. Research Design

This section describes key aspects of the survey methodology employed for the Assessment of 21st Century Skills Across Emerging Sectors. The overall methodology followed the guide on Developing and Running an Establishment Skills Survey of the European Training Foundation and the ILO.⁸

This section begins by identifying the objectives of the study. The next aspect discussed is the research method employed for the study. The section also includes a description of the design of the survey questionnaire, briefly presenting key documents that guided the development of the questionnaire. Additionally, the section summarises the sample design and response rate for the survey. The final aspects discussed under this section are data collection, survey limitations, and data processing and presentation

1.1 Objectives of the Study

The objectives of the study are to:

- Provide data on the demand of STEM graduates in emerging sectors
- Provide data on the skills mismatches in emerging sectors
- Provide information to improve the alignment between education and labour market demand
- Provide data to inform policymakers, education specialists, industry and all stakeholders in creating policies to develop the STEM workforce of the country
- Provide data on key areas where scholarships/incentives are needed to encourage students to pursue degrees in these fields
- Collaborate with the public universities to align their programmes to the key STEM areas and to introduce new programmes where necessary
- Provide information to introduce students to relevant STEM careers necessary for growth and development of critical sectors of the economy

⁸ European Training Foundation/European Centre for the Development of Vocational Training/ILO. *Developing and Running an Establishment Skills Survey: Guide to Anticipating and Matching Skills and Jobs Volume 5*. 2017.

1.2 Research Method

The survey employed a mixed methods approach. A questionnaire was designed to collect both quantitative and qualitative data.

1.3 Questionnaire Design

The draft questionnaire was developed based on the objectives of the study and was designed to generate the key information necessary to achieve the objectives. The questionnaire design was guided by existing labour force studies and guides, mainly the ILO's Global Framework on Core Skills for Life and Work in the 21st Century and STEM in TVET Curriculum Guide.

The ILO's Global Framework on Core Skills for Life and Work in the 21st Century was utilised to capture data on the skills of the workforce which included STEM skills. Recognising the importance of core skills for enabling workers to attain decent work and improving living standards, the ILO developed the Global Framework on Core Skills for Life and Work in the 21st Century. The framework was developed after a comprehensive literature review of international and national core skills frameworks and an analysis of the impact of the global drivers of transformative changes on the world of work was undertaken to extract the most important skills necessary to adapt to the future of work. Additionally, several consultations were undertaken to revise these skills into 19 core skills considered essential both for work and life. The Framework identified 19 core skills that were grouped into the four categories shown in Table 1. These are further described in Appendix III.

Table 1: Core skills for life and work in the 21st century

Core skills for life and work in the 21st century			
<p>Social and emotional skills:</p> <ul style="list-style-type: none"> • Communication • Collaboration and teamwork • Conflict resolution and negotiation • Emotional intelligence 	<p>Cognitive and metacognitive skills:</p> <ul style="list-style-type: none"> • Foundational literacies • Analytical and critical thinking • Creative and innovative thinking • Strategic thinking • Problem-solving and decision-making • Self-reflection and learning to learn • Collect, organise and analyse information • Planning and organising • Career management 	<p>Basic digital skills:</p> <ul style="list-style-type: none"> • Use basic hardware • Use basic software • Operate safely in an online environment 	<p>Basic skills for green jobs:</p> <ul style="list-style-type: none"> • Environmental awareness • Waste reduction and waste management • Energy and water efficiency

The survey also utilised the STEM in TVET Curriculum Guide, ILO Women in STEM for Workforce Readiness and Development Programme to gather data on STEM competencies of TVET graduates. The STEM in TVET Curriculum Guide identifies four major domains of STEM competencies that support TVET including STEM knowledge, thinking skills, multiliteracies, and socio-emotional intelligence. These domains are further described in Appendix IV.

1.4 Sample Design

A representative sample of 170 businesses from the tourism sector was contacted to participate in the survey. A survey frame was created using several data sources including the CSO business register. The sector was stratified by sub-sector and size and a sample was generated from each stratum using systematic random sampling. Of the 170 businesses contacted, 77 responded, representing a response rate of 45%.

1.5 Data Collection

1.5.1 Interviewers

Field interviewers were recruited to conduct interviews with employers. These interviewers already had considerable training and experience in conducting labour surveys. They were further trained on the survey objectives and questionnaire. Data collection was undertaken during the period of October to November 2023.

1.5.2 Pilot Study

A pilot study was undertaken using a sample of twenty-four (24) businesses to pre-test the survey instrument to ensure that respondents understood the questions correctly and were able to provide accurate answers. The feedback from the pilot study was used to improve the questionnaire for greater accuracy in responses.

1.6 Limitations of the study

There were several challenges encountered whilst undertaking this study. These include:

- i. Business listing was outdated - The CSO listing was outdated and had to be updated by the project team. It is important that an updated businesses listing is available for future studies. This would save time and ensure greater accuracy of the sampling frame.
- ii. No business listing available for some sectors categorised as emerging – Some emerging sectors, such as Software Design and Applications, are part of a broader sector, so the team had to extract these companies from the overall list. In certain cases, alternative sources were used to compile a list of businesses within these specific sectors. There is a need for up-to-date listings of sectors identified for expansion. This would not only support future

research but also enable the accurate measurement of growth within these industries.

- iii. Low response from industry – A substantial percentage of employers declined to complete the survey, citing several reasons, mainly time constraints. This lack of participation highlights the need to increase the promotion of STEM skills and the importance of STEM workers in driving competitiveness, growth, and sustainability within businesses. It also emphasises the importance of data collection to guide policies that support workforce development, ensuring businesses can meet both their current and future workforce needs.
- iv. Most tourism companies were Micro, Small and Medium Enterprises (MSMEs) and generally recorded low employment and recruitment. This underscores the importance of ensuring employers recognise the value of STEM skills and professions for future growth, while also ensuring that the STEM workforce is aligned with industry needs and accessible to MSMEs.

1.7 Data processing analysis and presentation

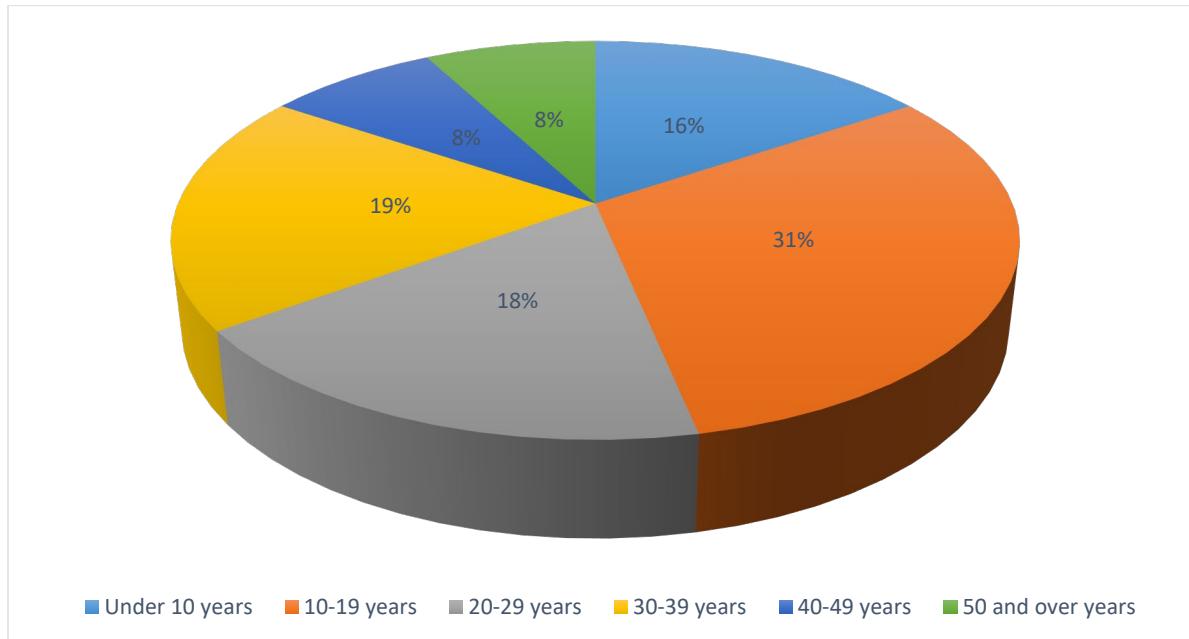
The quality of the data was checked for accuracy. Where there were discrepancies the field interviewer or office staff contacted the respondents for verification. Quantitative and qualitative data was coded and processed on SPSS and Excel. The results of the study are presented in the chapters that follow.

2. Characteristics of Employers

This section presents some key characteristics of employers in the tourism sector of Trinidad and Tobago. The purpose of gathering information on employers' characteristics is to provide context for the findings of the report and to facilitate a better understanding of the survey population. The study focused on employers' longevity, workforce size, and primary economic activity.

The first characteristic of employers presented in this section is the length of time in operation. Figure 1 presents the percentage of businesses in the tourism sector that responded to the survey by the length of time in operation. The data shows that the highest percentage (31%) of businesses were in operation for 10 – 19 years followed by 30 - 39 years (19%), 20-29 years (18%) and under 10 years (16%). The results highlight a mix of established and emerging businesses, suggesting both stability in the industry with ongoing opportunities for expansion and development.

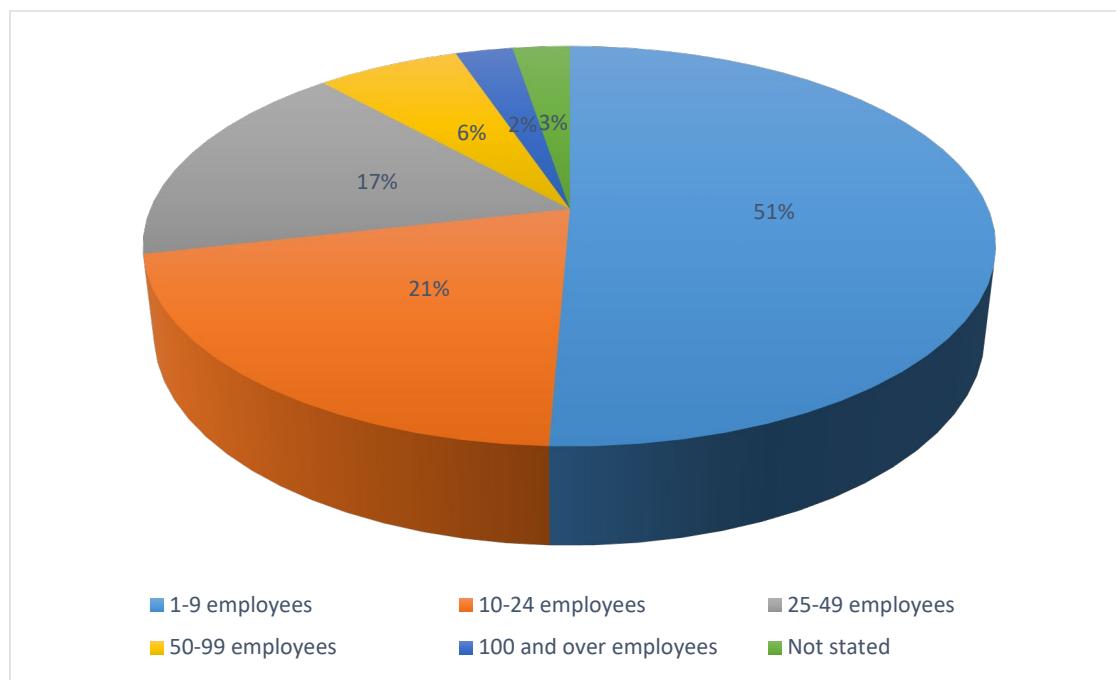
Figure 1: Percentage of establishments by length of time in operation



With regard to employment size, the results show that the tourism sector was largely made up of Micro and Small Enterprises (MSEs). Figure 2 shows that over a half (51%) of the establishments that participated in the survey had less than 10

employees and 21% had between 10 and 24 employees. At the national level, it is estimated that 95% of the businesses in Trinidad and Tobago were Micro, Small and Medium-sized Enterprises (MSMEs), with the vast majority being micro and small.⁹ The high percentage of MSEs within the tourism sector presents both challenges and opportunities for employment, competitiveness and growth. While these businesses are well-positioned to benefit from technological advancements, they may face challenges in attracting STEM talent. Competition from larger companies, which offer more attractive compensation and training packages, can impede MSEs from accessing the key STEM talent necessary for growth and success. The large proportion of MSEs in the tourism sector underscores the need for policies that support smaller businesses by improving access to STEM talent that would help unlock their innovation potential.

Figure 2: Percentage of establishments by employment size



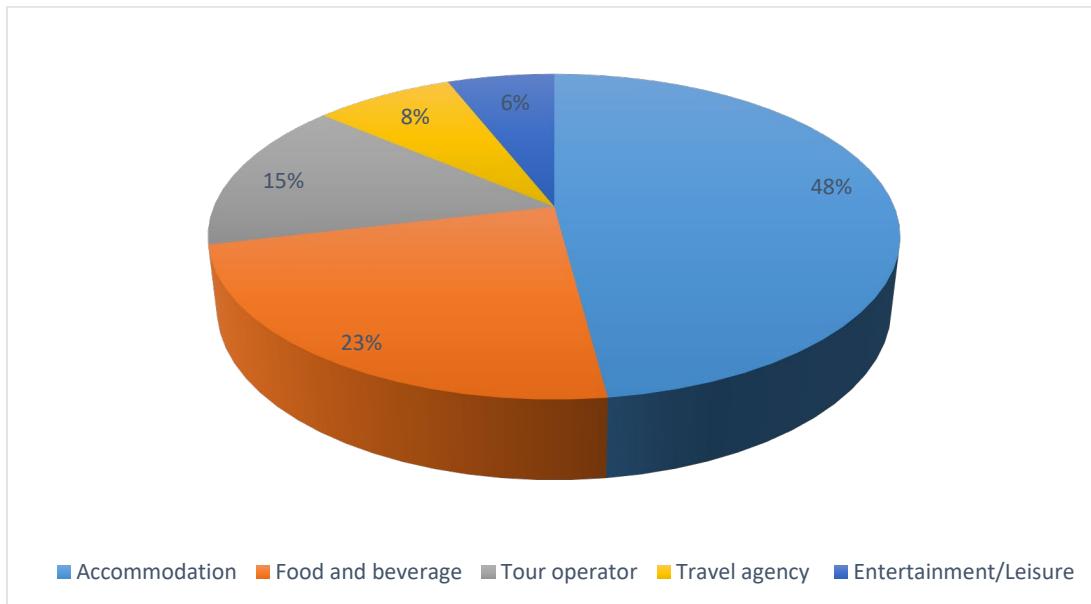
Another characteristic of employers featured in this section is their main economic activity. The activities of the local establishments surveyed were diverse, including accommodation; food and beverage; tour operators; travel agencies; and entertainment. The creative sector, a vital subset of the broader tourism industry, will be examined independently in the future. This approach will provide a deeper

⁹ Central Bank of Trinidad and Tobago. *Research Papers Vol. 3 No. 2. September 2023.*

understanding of the sector's unique contributions and inform the development strategies for its continued growth and development.

Figure 3 presents the main economic activity of establishments that replied to the survey. The largest proportion of establishments was observed in Accommodation (48%) followed by Food and Beverage (23%) and Tour Operator (15%).

Figure 3: Percentage of establishments by main economic activity

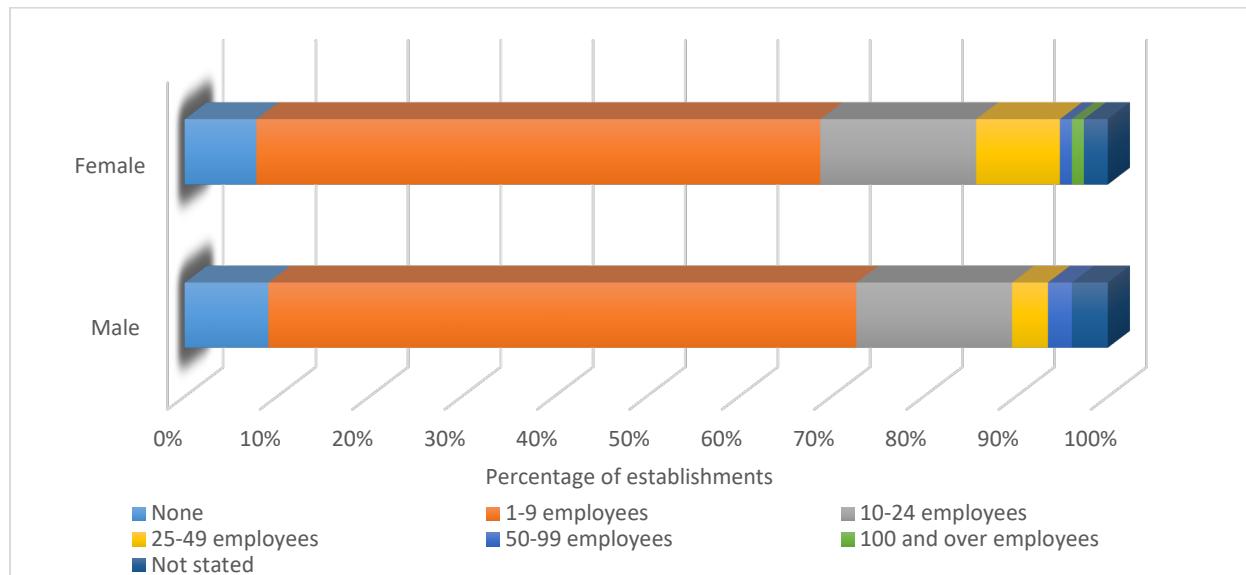


3. Characteristics of the Workforce

Collecting data about characteristics of the workforce is crucial for understanding workforce composition, identifying skill deficiencies, and facilitating effective workforce planning. The attributes of the workforce examined in this section include sex, occupation group, STEM qualifications and STEM occupations.

In terms of sex, Figure 4 shows that the tourism industry employed more females than males. A marginally higher percentage (89%) was recorded for female employment compared to male employment (87%). A further examination of the data shows that a higher percentage (28%) of businesses employed 10 or more female employees compared to 24% in the case of the males. The results indicate a strong representation of women in managerial, clerical and sales roles. As the sector becomes more technology-driven, employers would need to upskill workers to meet the growing demand for ICT-related skills.

Figure 4: Employment size by sex



The workforce was described by occupational groups using the ILO's International Standard Classification of Occupations (ISCO). Figures 5 – 7 show the distribution of the workforce in the tourism industry by occupational group and sex. The data reveals that the largest proportion of establishments employed Managers (90%) followed by Clerical support workers (46%) and Service and sales workers (46%). A smaller proportion of establishments employed workers in Professionals, and

Technicians, and Associate Professionals categories. This suggests that many establishments may lack a workforce with the necessary skills to drive productivity, innovation, and competitiveness in a technology-led environment. As a result, this could lead to gaps in the skills and expertise required to support future growth of the sector and ensure long-term sustainability.

Below is a summary of the key findings across the different job categories.

- Managers:
 - This occupational group was the highest in terms of representation. All of the establishments (90%) that responded to the question employed Managers, with the majority employing 1-9 employees in this category.
 - Females outnumbered their male counterparts in managerial positions; 70% of the establishments had female managers compared to 51% in the case of the males.
- Professionals:
 - Overall, 36% of the establishments employed staff in this category.
 - The number of males (26%) employed in the Professional category was higher than females (22%).
- Technicians and associate professionals:
 - Over one-fifth (23%) of the establishments that responded to the survey had employees under this occupational group.
 - By sex, the percentage of males (17%) was marginally higher than females (16%).
- Clerical support workers:
 - A substantial percentage (46%) of establishments employed clerical support workers.
 - By sex, a larger proportion of females (40%) was employed in this category compared to males (19%).
- Service and sales workers:
 - This occupational group was the joint second highest with clerical support workers in terms of representation. Forty-six percent (46%) of the respondents employed service and sales workers.
 - The percentage (33%) of males employed in this occupational group was less than that of the females (41%).

- Skilled agricultural, forestry and fishery workers:
 - This occupational group represented 14% of the workforce.
 - Males (12%) outnumbered females (1%) in this category.
- Craft and related trades workers:
 - Only 9% of the establishments reported employees in this category and they were all males.
- Plant and machine operators, and assemblers:
 - This was the lowest occupational group with only 7% representation and they were all male employees.
- Elementary Occupations:
 - One-third (33%) of the employers had workers in elementary occupations in their establishments.
 - There was a similar percentage of males (21%) and females (21%) in this category.

Figure 5: Employment by occupational group and sex – both sexes

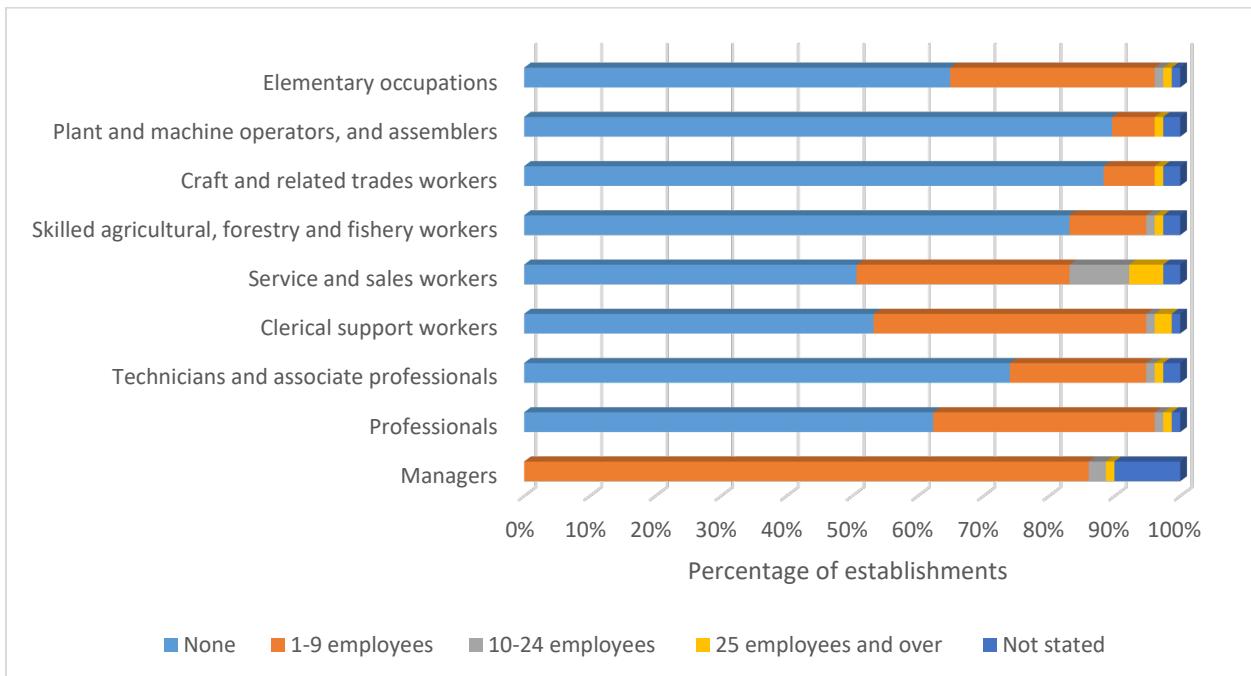


Figure 6: Employment by occupational group and sex – males

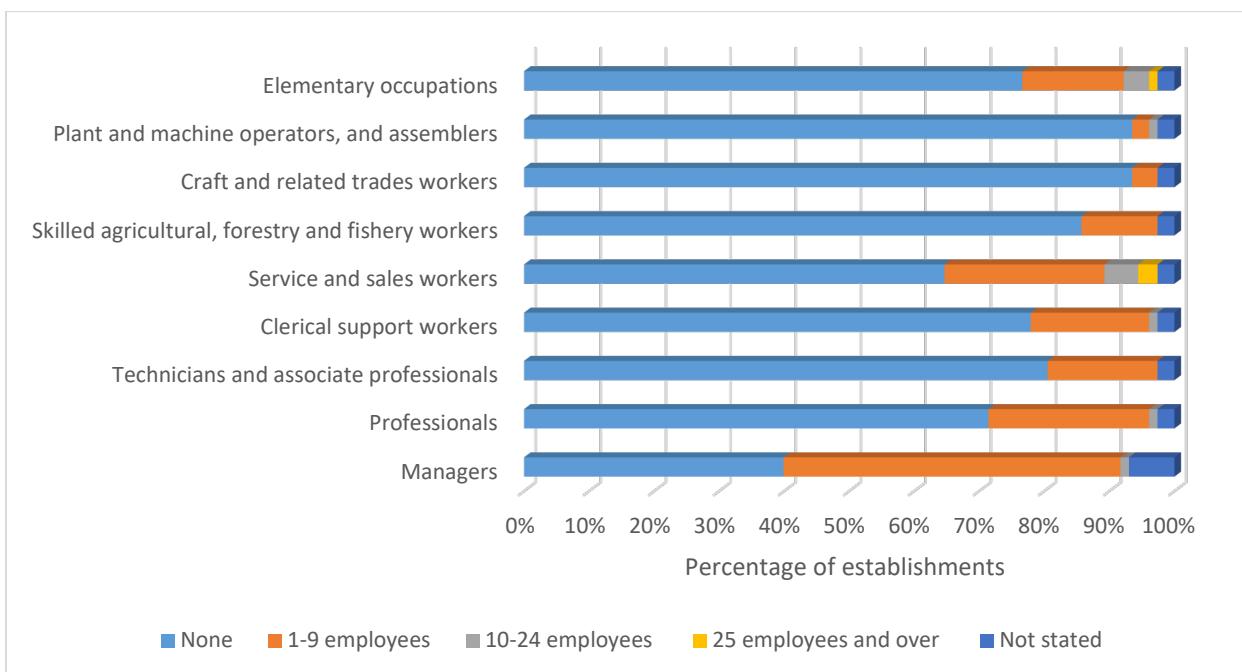
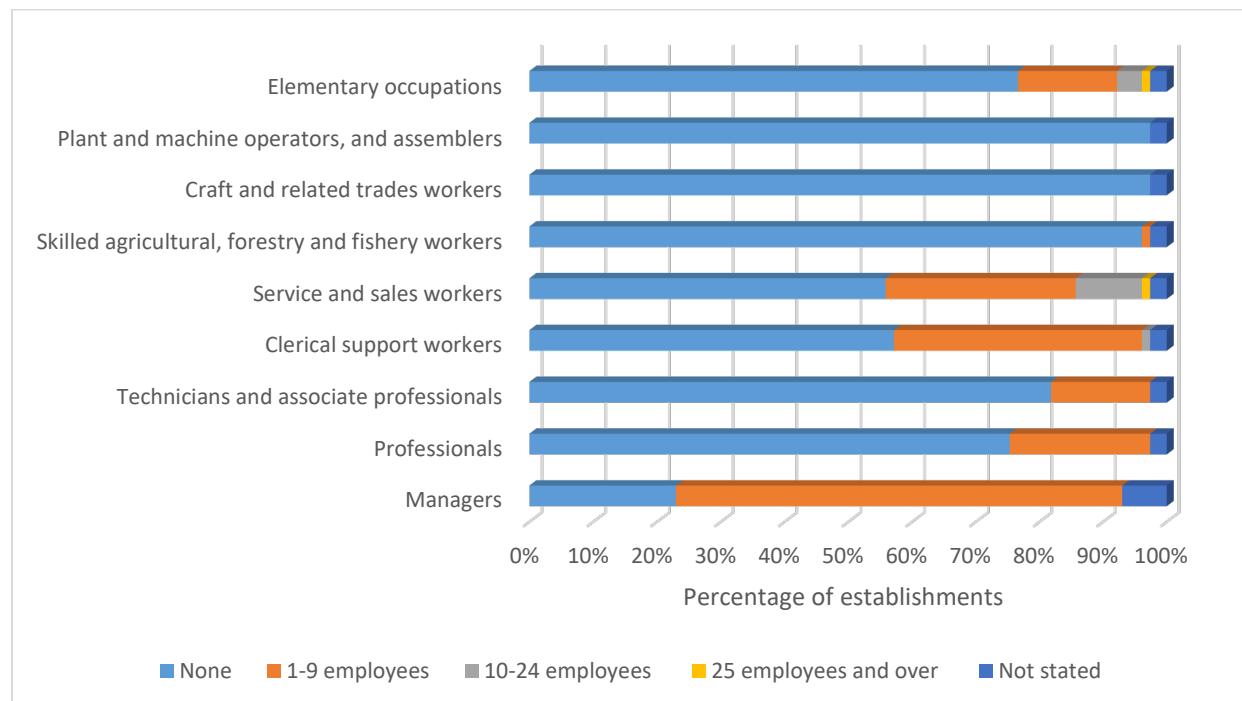


Figure 7: Employment by occupational group and sex – females

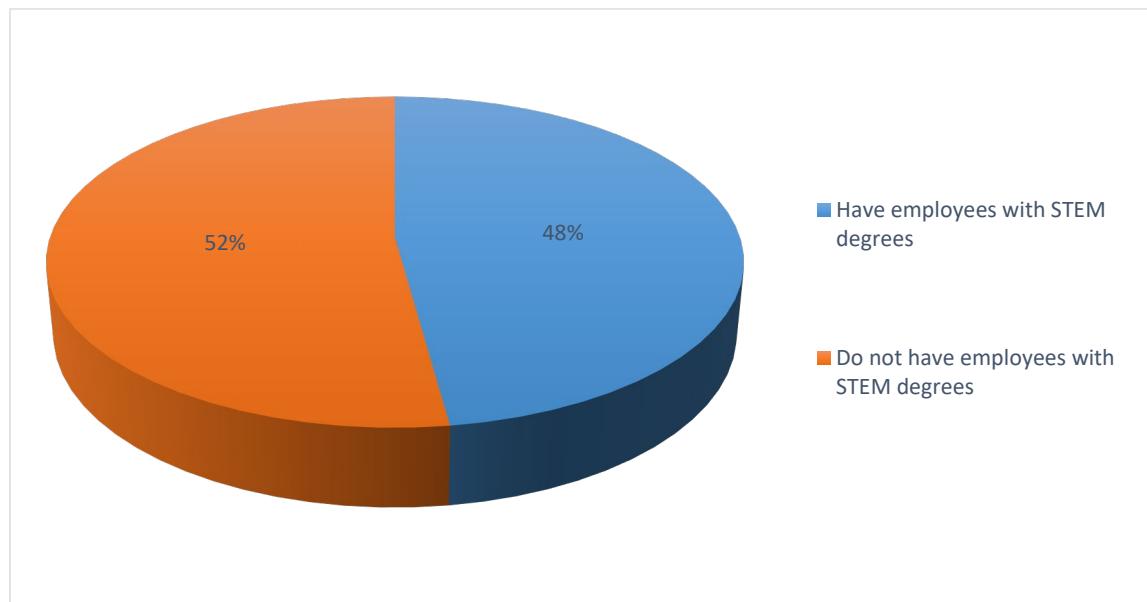


To effectively assess the STEM labour needs within the tourism services sector, it is necessary to first gather data on the current STEM workforce in the industry. This involves determining the overall size of the STEM workforce, as well as analysing key characteristics, such as STEM fields represented, gender distribution, and occupational groups. By understanding the composition of the existing STEM workforce, the gaps or shortages in STEM roles can be identified to help guide strategies to develop a workforce that can meet the evolving needs of the sector.

For the purpose of this study, STEM fields included Natural Sciences; Engineering; Computer Science/IT; Mathematics and Statistics; Food and Agriculture; Medical and Health; and Environmental Sciences.

Figures 8 – 11 summarises key data on employees with STEM qualifications by occupational group and sex. Overall, 48% of the establishments surveyed had employees with STEM degrees while 52% did not (Figure 8). The large proportion of establishments without STEM talent is concerning, given the importance of STEM employees for innovation and sustainable growth. The absence of a skilled STEM workforce could hinder establishments from leveraging new technologies that are crucial for staying competitive in an increasingly technology-driven market. This shortage can lead to broader challenges, including slow economic development and reduced job creation within the sector.

Figure 8: Percentage of establishments with employees with STEM degrees



An examination of STEM academic qualifications among the various occupational groups indicates that, in general, there was low representation of workers holding STEM qualifications within each occupational category (Figure 9). The highest percentage (24%) of STEM degrees was observed among Managers followed by Professionals (15%). All the other job categories had less than 10% of employees with STEM degrees, except for Elementary occupations, which had no STEM qualified employees.

A further review of STEM qualifications by sex shows that a higher percentage (21%) of establishments reported female managers with STEM degrees compared to 17% in the case of male managers (Figures 10 & 11). On the other hand, there was a marginally higher percentage of male Professionals (7%) with a STEM degree compared to female Professionals (5%). In the occupational groups of Technicians and associate professionals (3%), Service and sales workers (3%) and Skilled agricultural, forestry and fishery workers (1%), both sexes who had STEM degrees were equally represented.

Figure 9: Percentage of establishments with employees with STEM degrees by gender and occupational group – both sexes

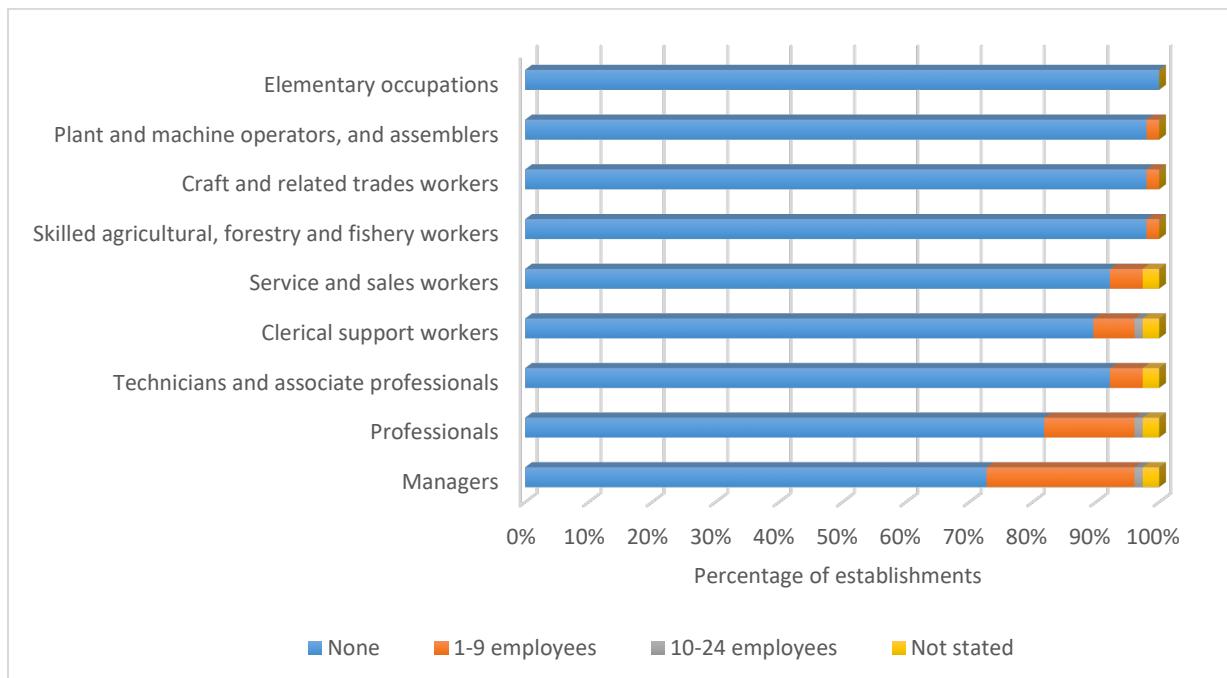


Figure 10: Percentage of establishments with employees with STEM degrees by gender and occupational group – males

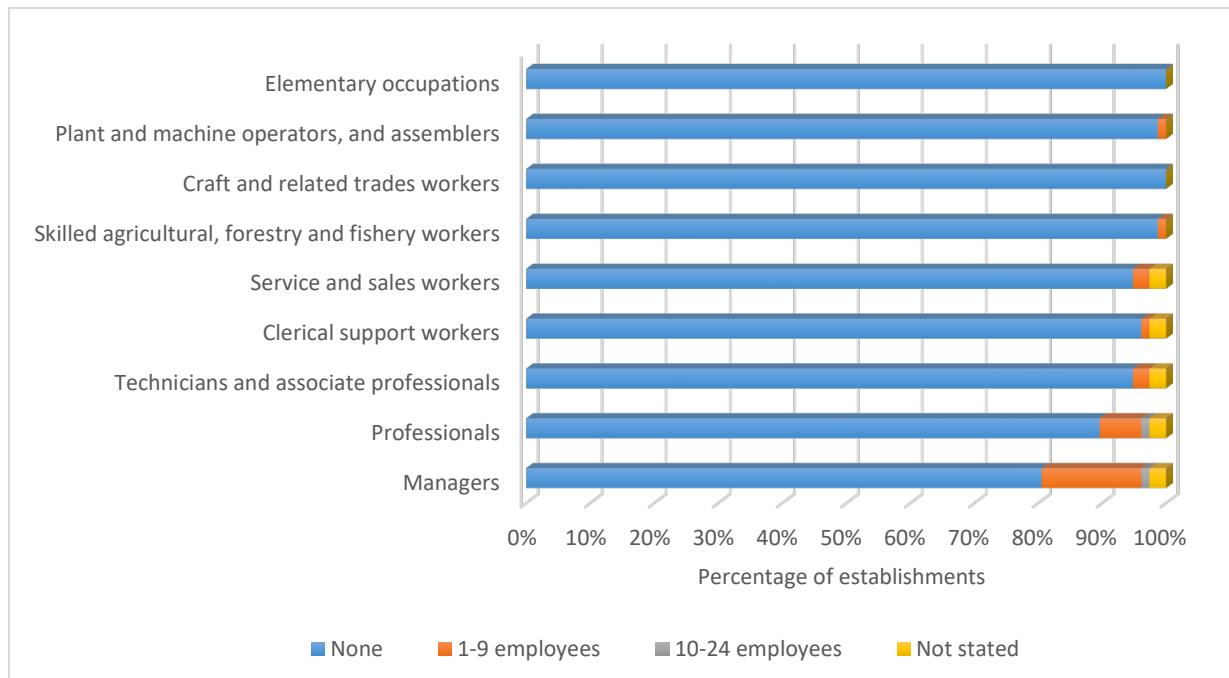
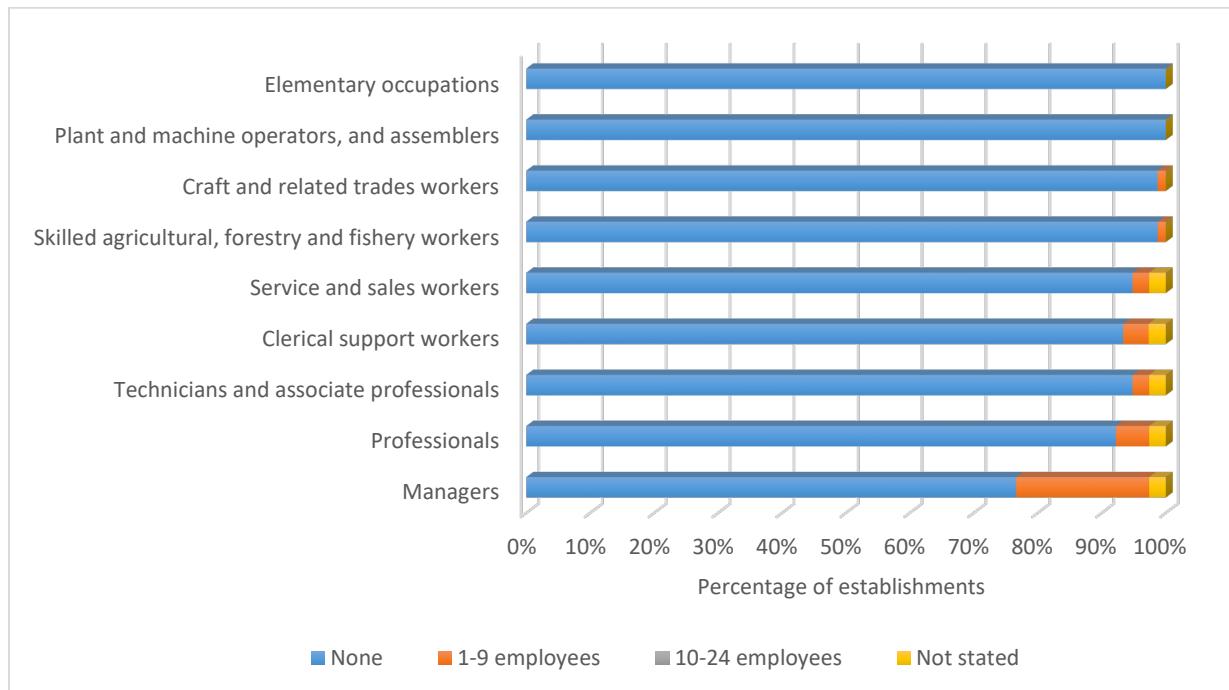


Figure 11: Percentage of establishments with employees with STEM degrees by gender and occupational group – females



In addition to STEM qualification, the report also explored the labour force participation in STEM occupations. For the purpose of this study, STEM occupations consisted of Natural Sciences; Engineering; Computer Science/IT; Mathematics and Statistics; Food and Agriculture; Medical and Health; and Environmental Sciences occupations. In addition, a list of STEM occupations is included in Appendix II. Although educational requirements vary, the survey focused on STEM occupations that required a bachelor's degree or higher.

Figure 12 shows the number of employees in STEM occupation groups within the establishments that participated in the survey. The data shows that the number of employees in each of the STEM occupation group was very low. The highest number of employees was observed in Engineering occupations followed by Computer Science/IT and Food and Agriculture occupations. There were no employees in Mathematics and Statistics occupations.

A review of the number of employees in STEM occupations by sex, shows that there were more males in four (4) of the six (6) STEM occupation groups represented in the industry (Figures 13 and 14). These included Engineering, Computer Science/IT, Natural Sciences and Environmental Sciences. Females out-numbered males in Medical and Health occupations while a similar proportion of male and female employees was observed in Food and Agriculture occupations.

**Figure 12: Employees in STEM occupation group by gender
Both sexes**

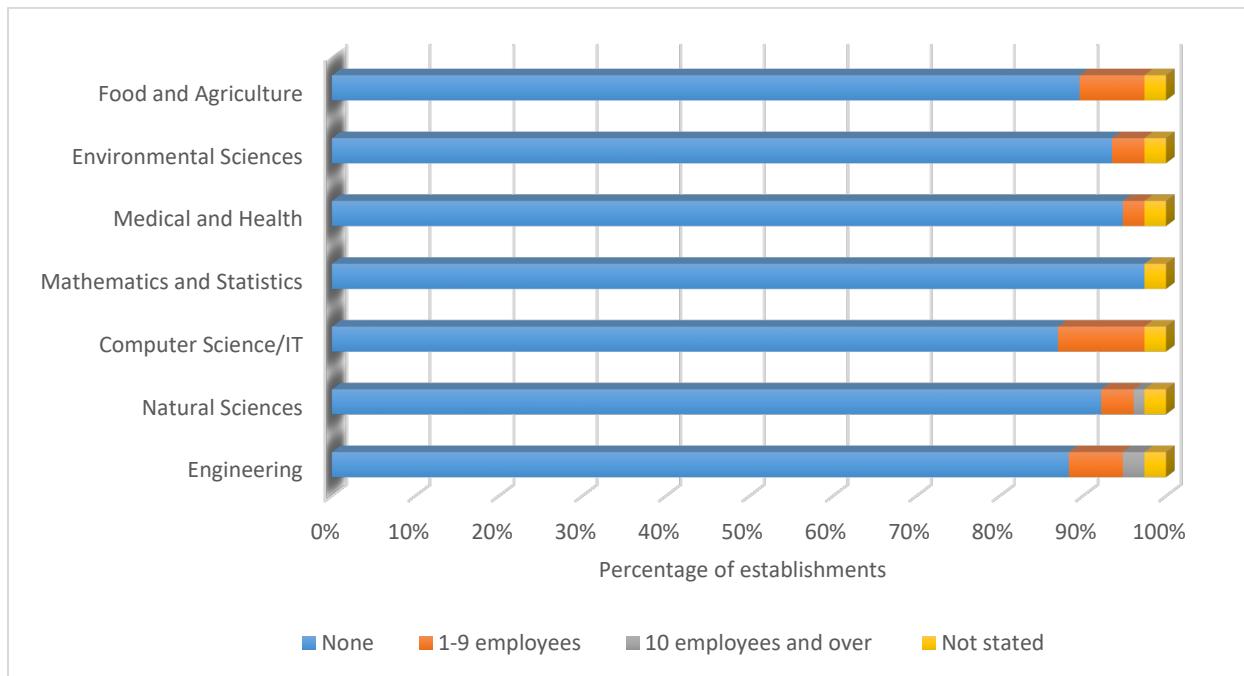


Figure 13: Employees in STEM occupation group by gender – males

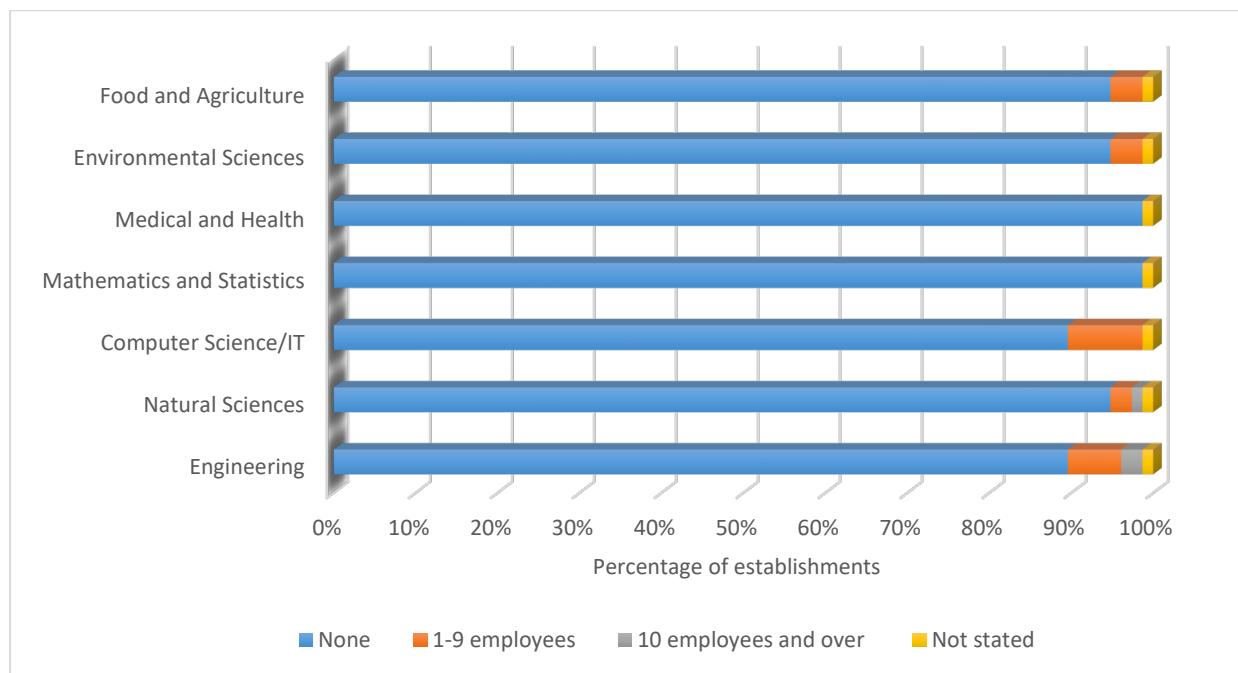
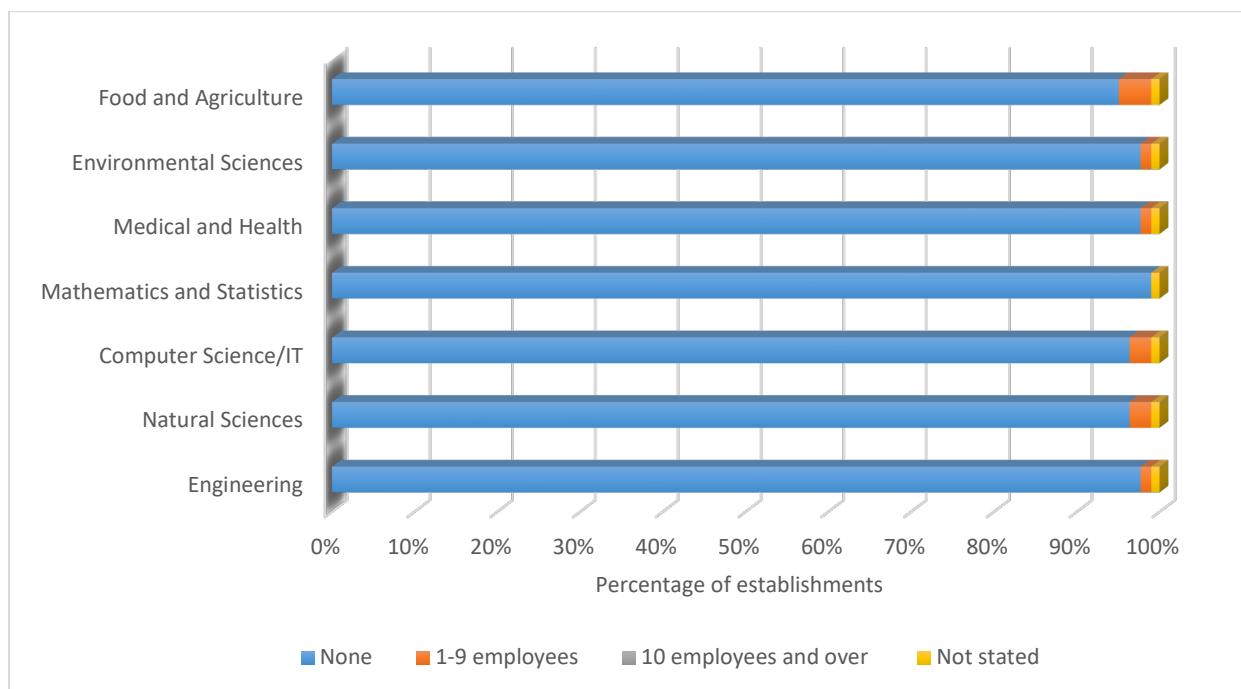


Figure 14: Employees in STEM occupation group by gender females



4. Recruitment and Vacancies

Data on vacancies and recruitment provides valuable insights into employment trends within the tourism industry and identifies the fields that have the most opportunities. This data is particularly important for policymakers, workforce planners, educational institutions, job seekers and students. This section begins by identifying the proportion of employers with job openings, with a particular focus on STEM vacancies, during the survey period. The study considered vacancies across various STEM fields, including Natural Sciences; Engineering; Computer Science/IT; Mathematics and Statistics; Food and Agriculture; Medical and Health; and Environmental Sciences. Furthermore, an analysis was conducted to compare job opportunities in STEM and non-STEM fields in the tourism industry. The section also includes data on the quantity of positions filled by employers in the past twelve (12) months of the survey period and the challenges employers encountered while filling these positions. Moreover, this section offers suggestions from employers on how to address the challenges related to recruitment.

Figure 15 reveals that overall, there was a low number of vacancies in establishments that responded to the survey. A substantially lower percentage (27%) of the establishments reported vacancies during the survey period compared to 68% with no vacancy.

Figure 15: Percentage of establishments with current vacancies

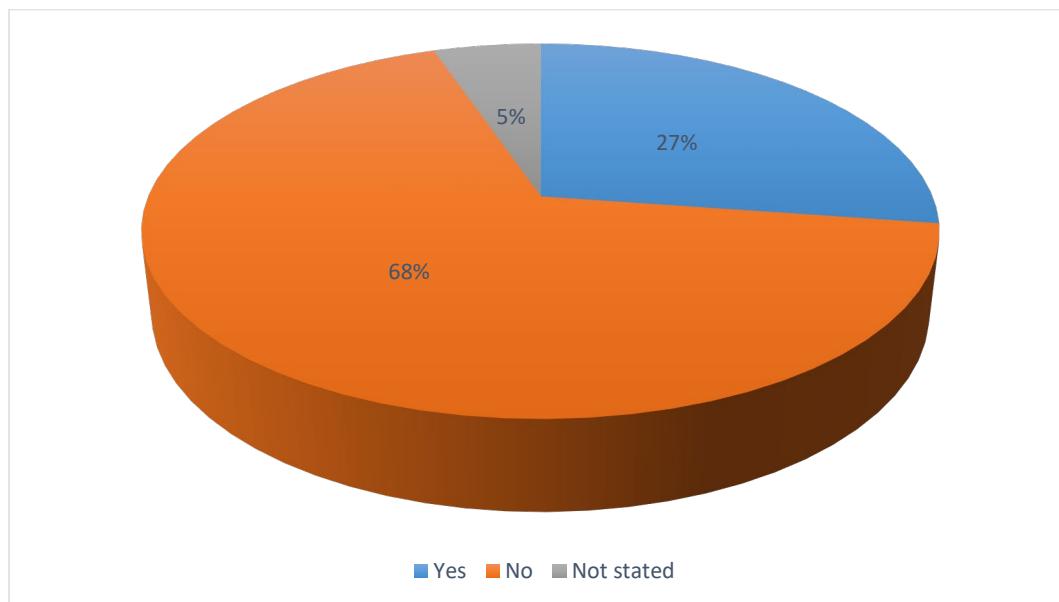


Figure 16 shows the percentage of establishments with current vacancies by STEM and non-STEM fields. The survey results reveal that a larger proportion (20%) of employers reported vacancies in non-STEM fields compared to vacancies STEM fields (8%). In addition, the total number of non-STEM vacancies (50) was significantly higher than the total number of STEM vacancies (7) (Figure 17). This meant that there were more job opportunities in the sector for non-STEM graduates compared to STEM graduates. The low rate of STEM employment in tourism establishments is concerning and may suggest a need for greater awareness and understanding among employers about the critical role STEM professionals will play in future development.

Figure 16: Percentage of establishments with STEM and Non-STEM vacancies

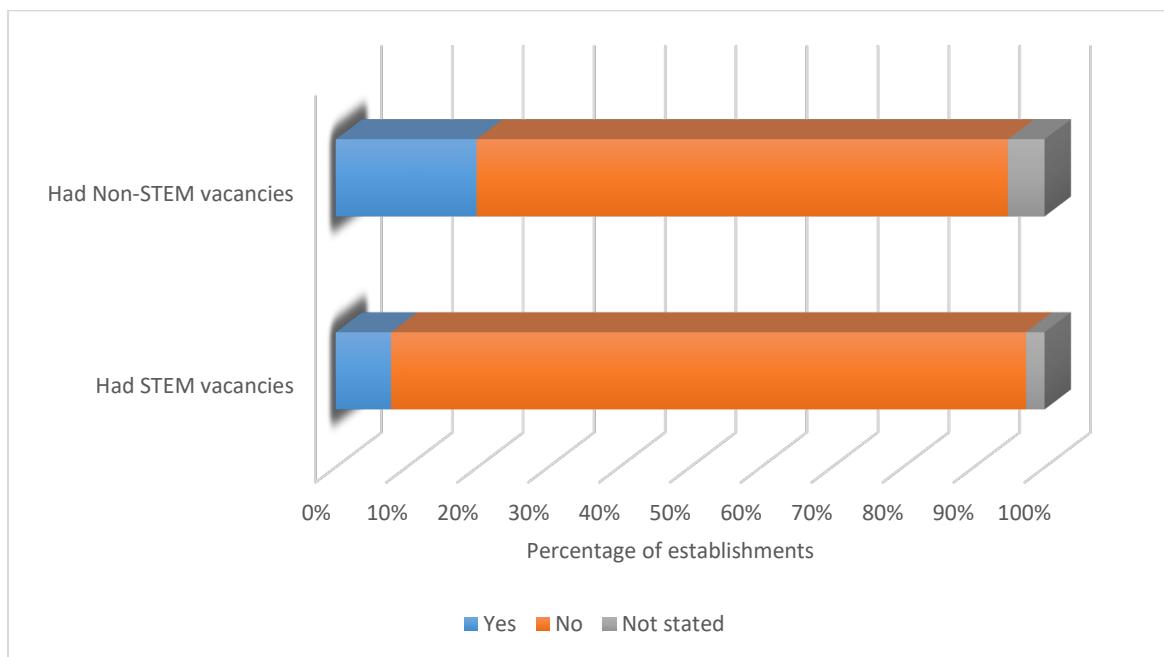
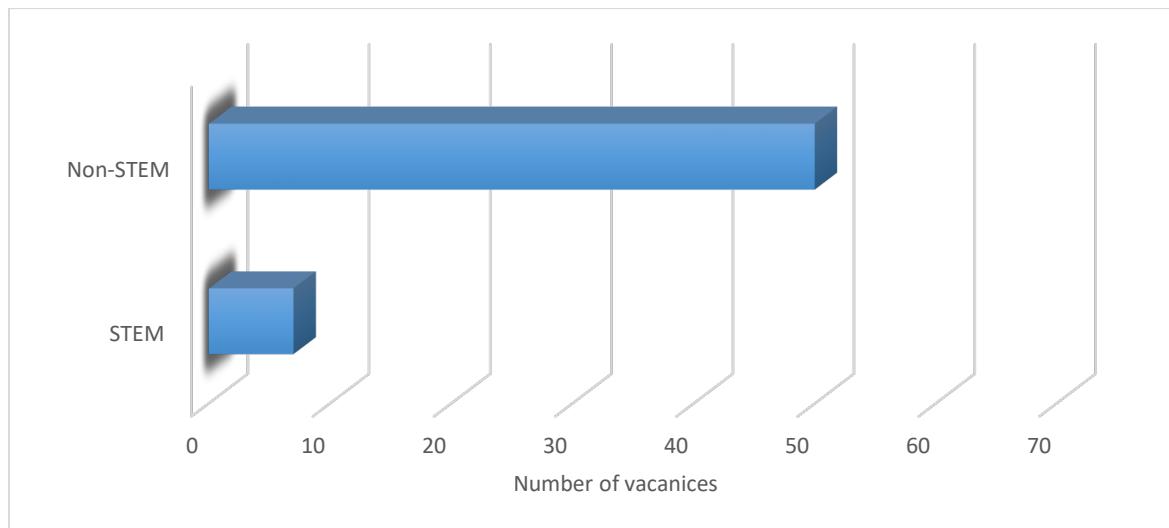
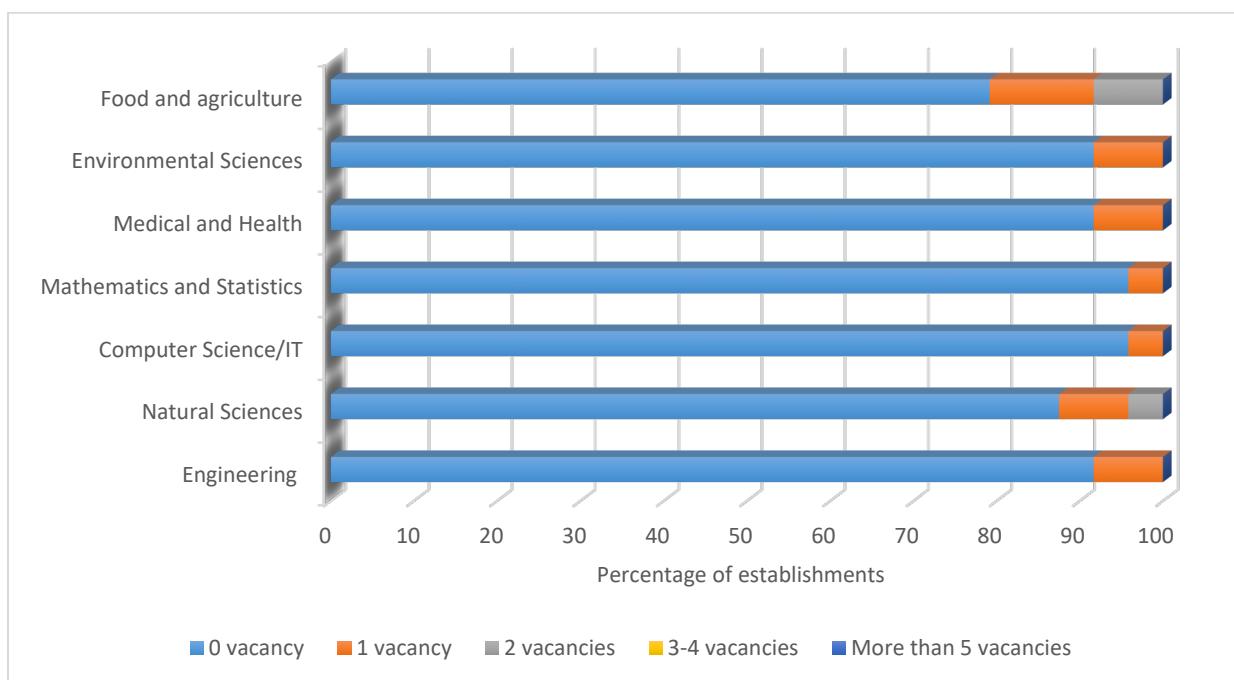


Figure 17: Number of STEM and Non-STEM vacancies



With regard to STEM vacancies, the survey captured data on the number of vacancies within each STEM field. The data shows that a small proportion of employers who participated in the study reported vacancies in each STEM field, with the highest being in Food and Agriculture (21%) followed by Natural Sciences (12%) (Figure 18).

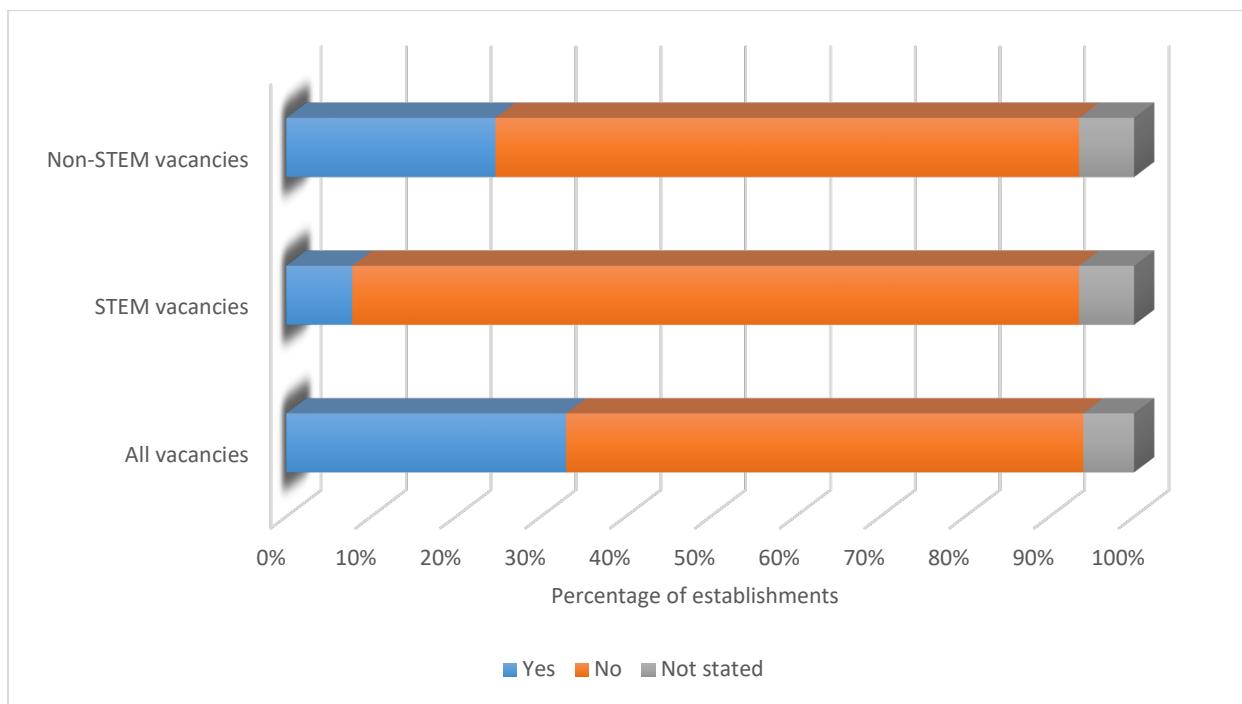
Figure 18: Percentage of establishments by STEM vacancies



In assessing recruitment in emerging sectors, the survey also captured data on the percentage of establishments that filled vacancies over the last 12 months of the survey period and the number of vacancies filled. Additionally, this data was further disaggregated by STEM and non-STEM.

Figure 19 shows that one-third (33%) of the employers reported that they had filled vacancies over the last 12 months while the majority (61%) did not. A further examination of the data by STEM and non-STEM reveals that employers filled a higher percentage (25%) of non-STEM vacancies compared to STEM vacancies (8%).

Figure 19: Percentage of establishments that filled vacancies over the last 12 months



The research also offers data on the challenges employers encountered while filling STEM and non-STEM jobs. Table 2 presents the level of difficulty employers faced when filling STEM and non-STEM vacancies across different job categories. Most employers, in general, did not have any trouble finding suitable candidates for both STEM and non-STEM positions. By occupational group, the highest level of difficulty was recorded for Professionals followed by Technicians and associate professionals. This pattern was also observed for both STEM and non-STEM occupations.

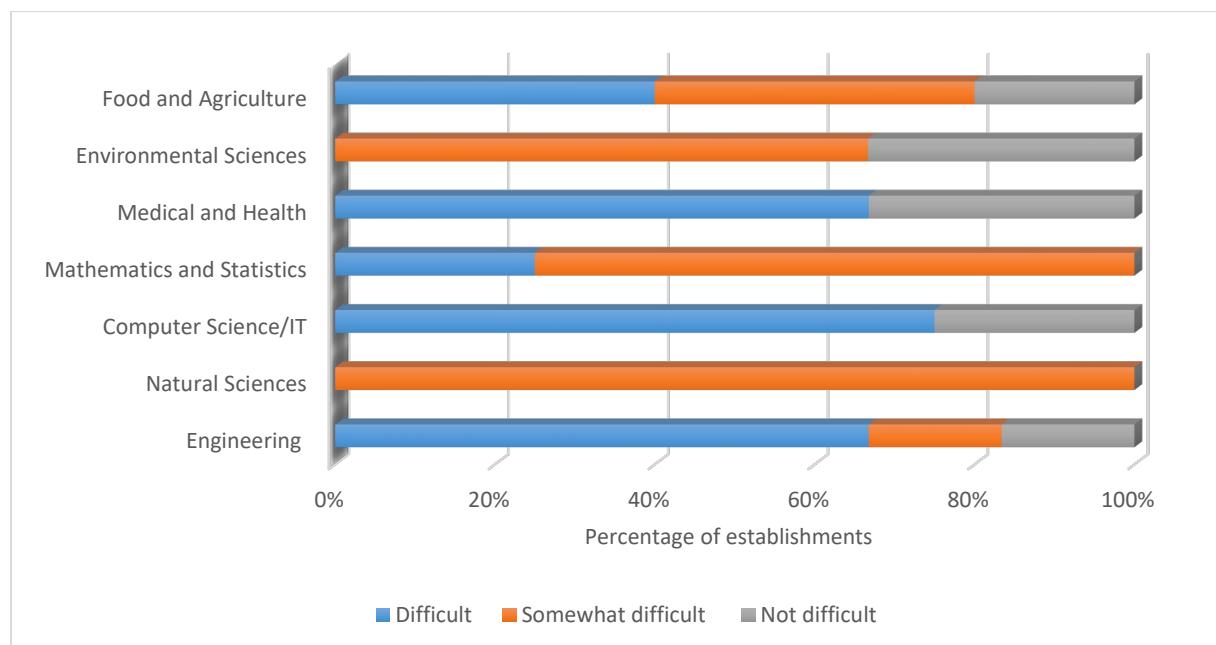
Overall, employers reported more difficulty filling Non-STEM occupations compared to STEM occupations. Table 2 shows that employers found it more difficult to fill non-STEM vacancies in four of the six occupational groups related to STEM occupations. A marginally higher percentage of employers found it difficult to fill STEM vacancies in the categories of Service and sales workers and Plant and machine operators, and assemblers compared to Non-STEM vacancies.

Table 2: Comparison of difficulty experienced when filling STEM and Non-STEM vacancies by occupational groups

Occupational groups	STEM vacancies			Non-STEM vacancies		
	Difficult to fill	Not difficult to fill	Total	Difficult to fill	Not difficult to fill	Total
1. Managers	33	67	100	36	64	100
2. Professionals	44	56	100	53	47	100
3. Technicians and associate professionals	40	60	100	41	59	100
4. Clerical support workers	11	89	100	14	86	100
5. Service and sales workers	33	67	100	26	74	100
6. Skilled agricultural, forestry and fishery workers	0	0	0	31	69	100
7. Craft and related trades workers	0	0	0	9	91	100
8. Plant and machine operators, and assemblers	33	67	100	31	69	100
9. Elementary occupations	0	0	0	20	80	100

A further breakdown of the level of difficulty employers experienced over the last 12 months while filling STEM vacancies in their companies is shown by STEM fields in Figure 20. The highest level of difficulty was observed for Computer Science/IT (75%) followed by both Engineering (67%) and Medical and Health (67%).

Figure 20: Level of difficulty experienced when filling STEM vacancies



The research also focused on the main factors contributing to the challenges employers experienced when filling STEM positions. Figure 21 illustrates the significance of different factors in influencing recruitment using a scale of 1 to 5 with 1 being not significant and 5 being very significant. The most significant factors contributing to the difficulty (ratings 4 + 5) employers experienced while trying to fill STEM vacancies were the lack of work experience (40%), low number of applicants with the required skills (33%) and low number of applicants with the required attitude, motivation or personality (33%). The least significant factors (ratings 1+2) were outdated theory/education that was not applicable to the work environment (72%) and too much competition from other employers (70%).

Figure 21: Significant factors why STEM occupations are difficult to fill

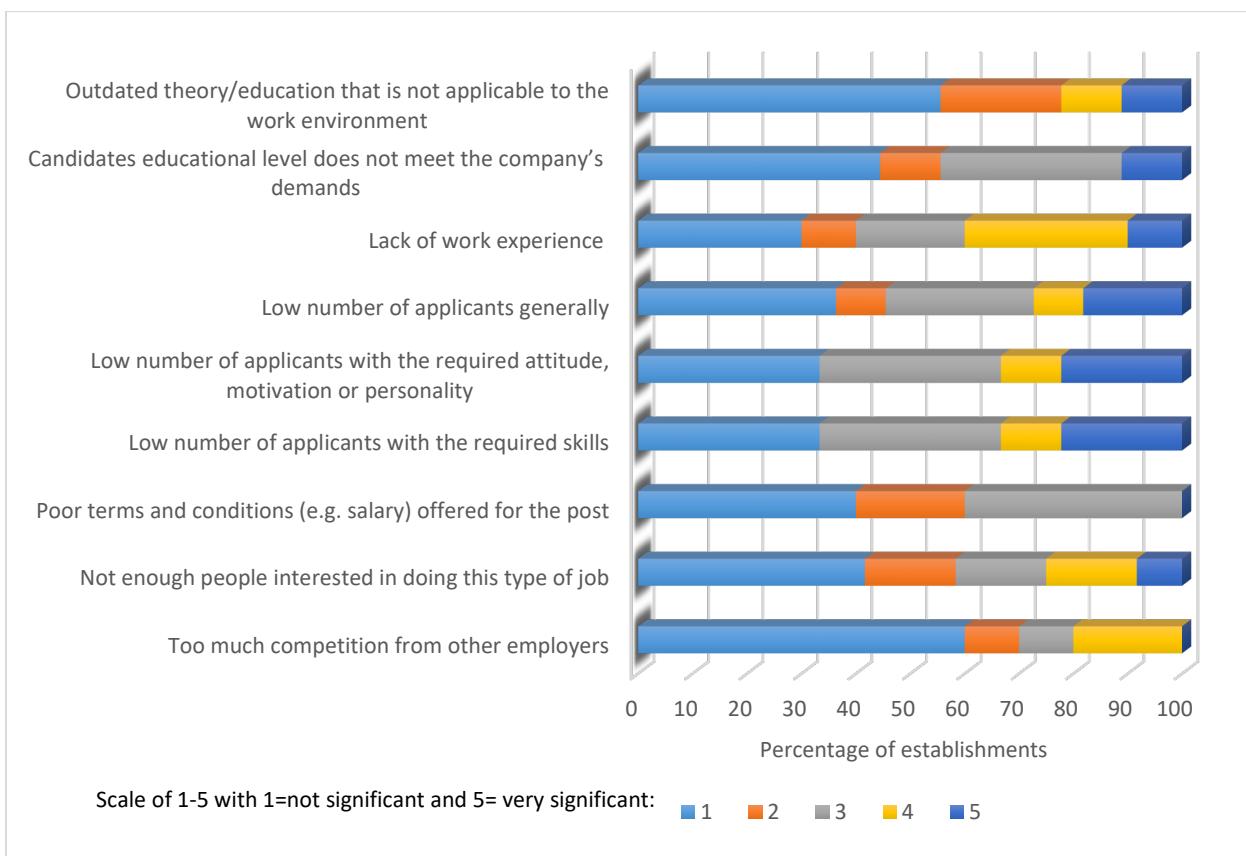


Figure 22 summarises the recommendations employers suggested to overcome problems experienced while filling STEM vacancies. A half (50%) of the employers did not provide a recommendation while approximately one-quarter (26%) recommended creation of more training opportunities. The other recommendations were evenly split with (6%) each, these included: creating effective policies to support training and development of employees; introduce more STEM programmes at TVET level; inclusion of STEM from primary level of education; and more support to regularize employment in the sector.

Figure 22: Recommendations to overcome problems experienced when filling STEM occupations

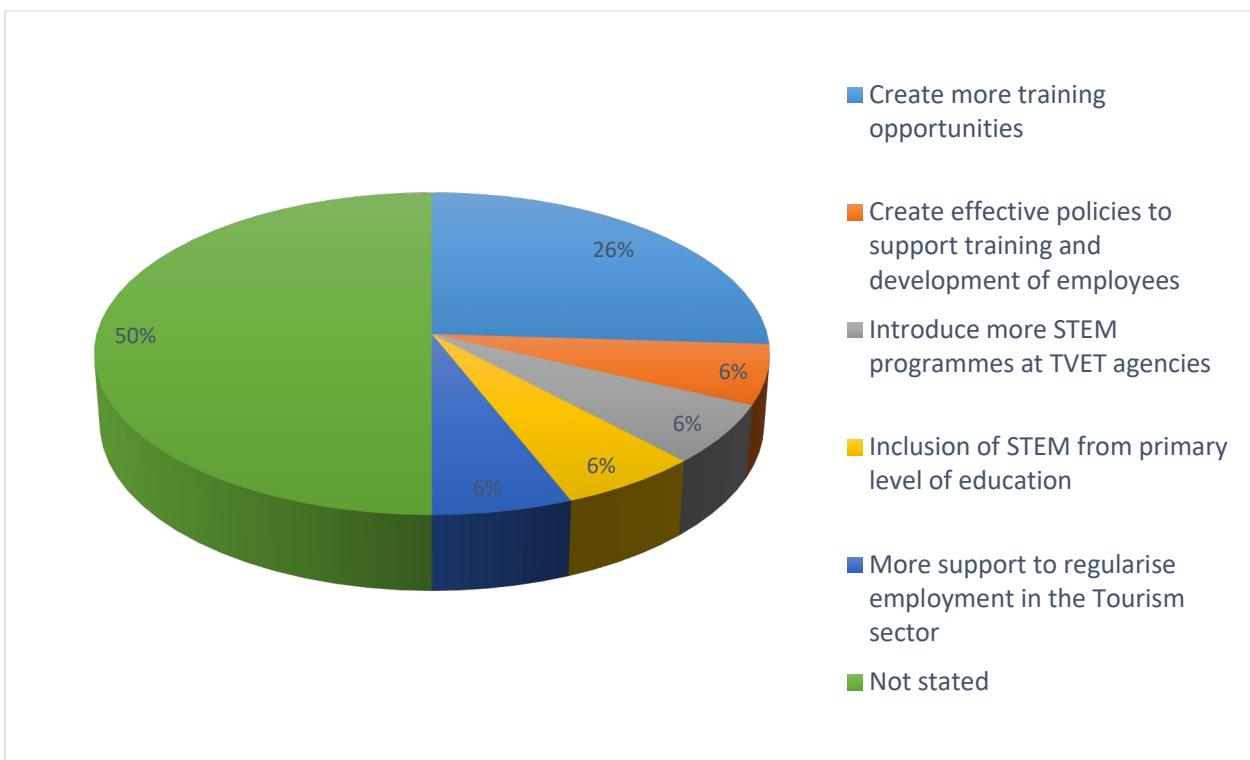
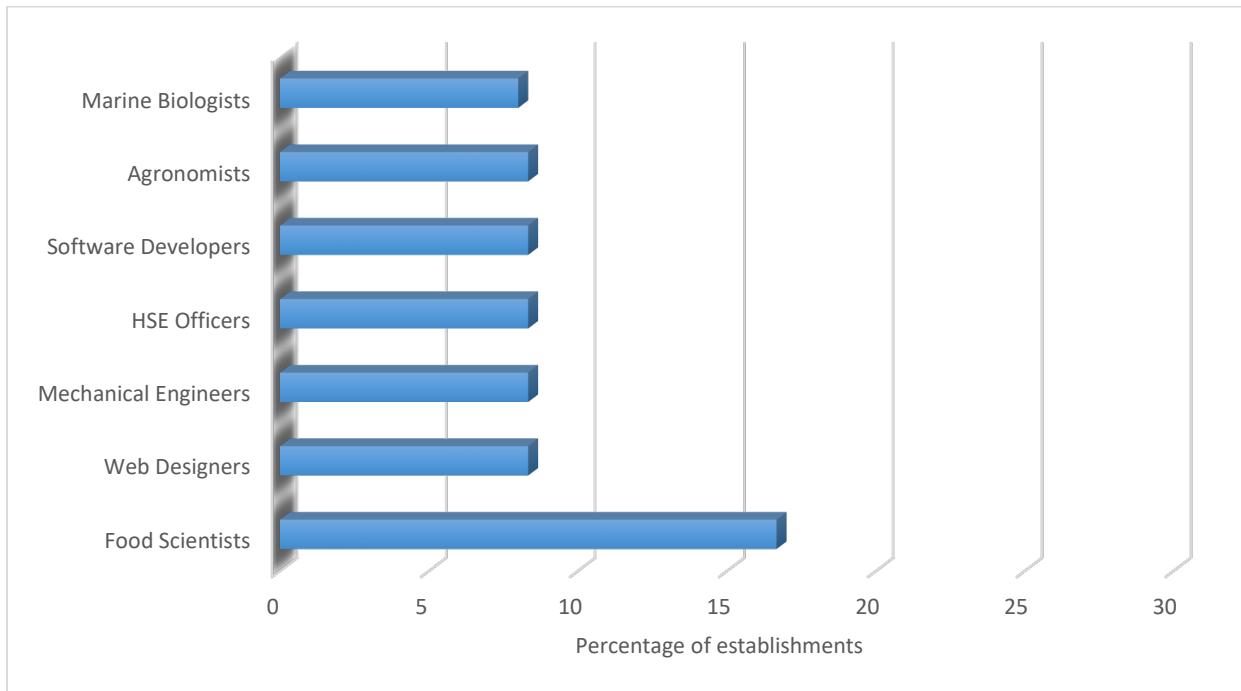


Figure 23 presents the STEM occupations that employers from the tourism sector identified as the most difficult to fill. The most difficult occupation to fill was Food Scientist (17%). The other occupations identified by employers were Agronomists (8%), Software developers (8%), Marine Biologists (8%), HSE Officers (8%), Mechanical Engineers (8%) and Web Designers (8%).

Figure 23: Most difficult STEM occupations to fill



5. Skills Characteristics of the Workforce

Improving skills can benefit for both companies and their employees. Skills development and upgrading impact business by boosting productivity and enhancing competitiveness. Equipping workers with core skills is crucial for enhancing their ability to find and secure better job opportunities, which ultimately contribute to raising their quality of life.

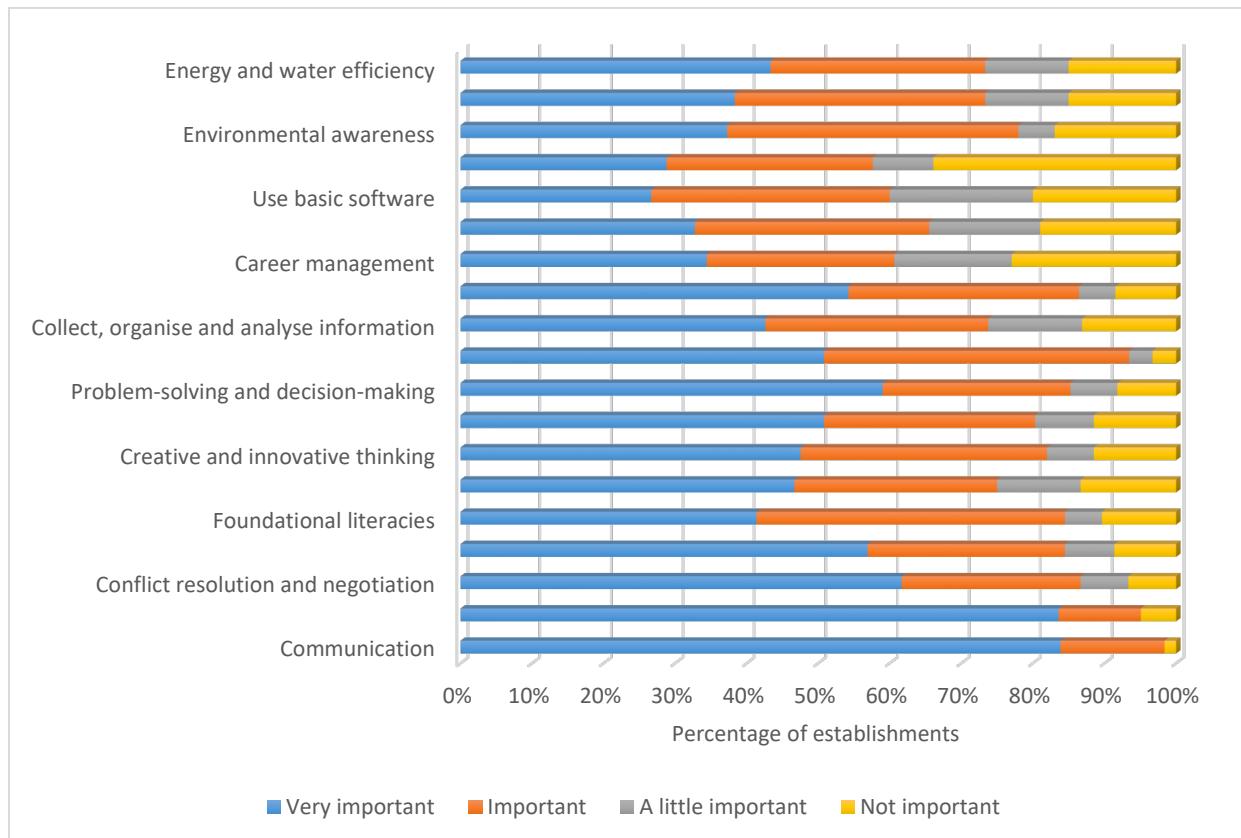
The aim of this section is to evaluate current skills mismatches in the tourism industry sector. This section highlights the skills that employers identified as essential for employees to have in order to achieve organisational goals and objectives. Furthermore, this section provides information on internal and external factors driving change in companies, as well as the necessary skills to address these drivers of change. After identifying the essential skills needed by employers to accomplish business objectives, the skill of recent job seekers and current staff members were identified to determine the level of mismatch between the skills demanded by employees and the skills of potential and current workers. Finally, the section presents information about the perception of employers of the level of readiness of university graduates for work.

5.1 Demand for Skills by Employers

Figure 24 lists the 19 core skills and employers rating on the level of importance for employees to possess these skills in order to achieve the goals and objectives of the business. The majority of employers indicated that it was important (very important + important) for employees to have all 19 skills. The most important (very important + important) skill was Communication (98%) followed by Collaboration and teamwork (95%) and Self-reflection and learning to learn (93%). The skills that received the lowest ratings in terms of importance were Operating safely in an online environment (34%), Career management (23%) and Use basic software (20%).

The lower ratings assigned to basic digital skills: Operate safely in an online environment, Use basic software and Use basic hardware is a matter of some concern given that the fourth industrial revolution represents a fundamental change in the workplace due to the integration of digital technologies. This technological revolution will require efficient and safe use of technology among the workforce.

Figure 24: Employers' rating of skills employees should have to meet business goals



5.2 Drivers of Change and Skills Required

In order to establish what skills were important in the industry for current and future development the internal and external drivers of change were identified along with the main skills required to address each driver.

The internal drivers of change reported by employers are depicted in Figure 25. The main internal driver of change was people (53%) closely followed by profit (52%) and Technology (19%) in a distance third place. Overall, Communication (22%) was viewed as the most important skill to address internal drivers of change followed by marketing (17%) and creativity and innovation (11%) (Figure 26). The following were the main skills identified to address each internal driver:

1. People - Communication (31%)
2. Profit – Communication (20%)
3. Technology – IT skills (31%)

Figure 25: Top internal drivers of change in establishments

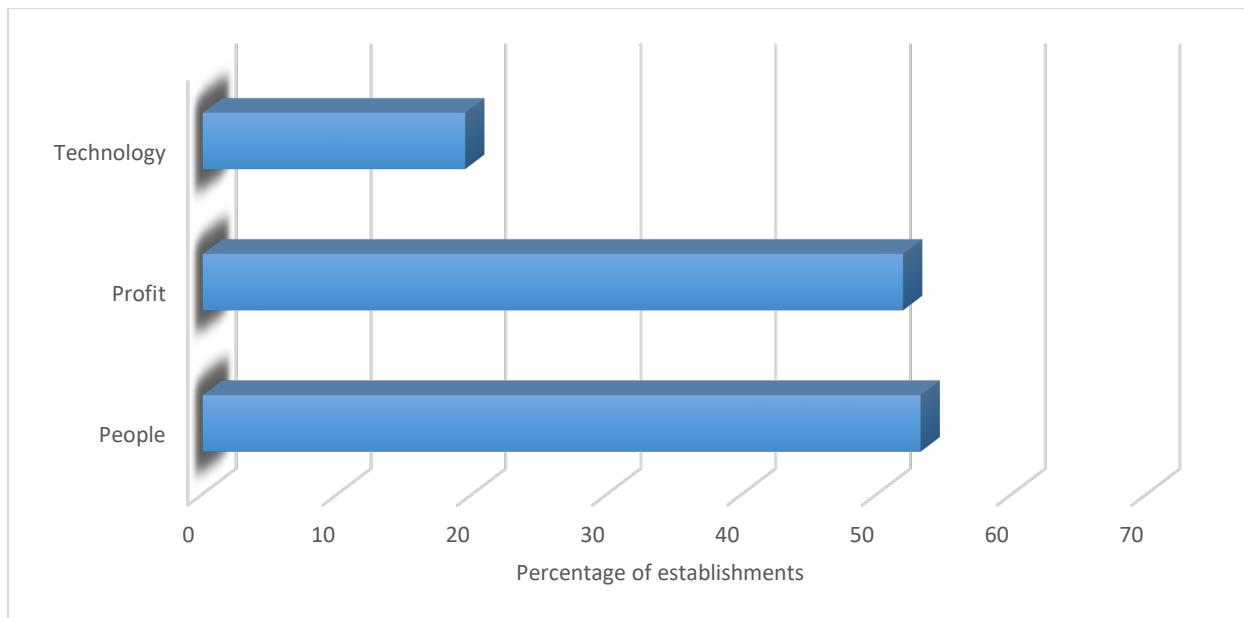
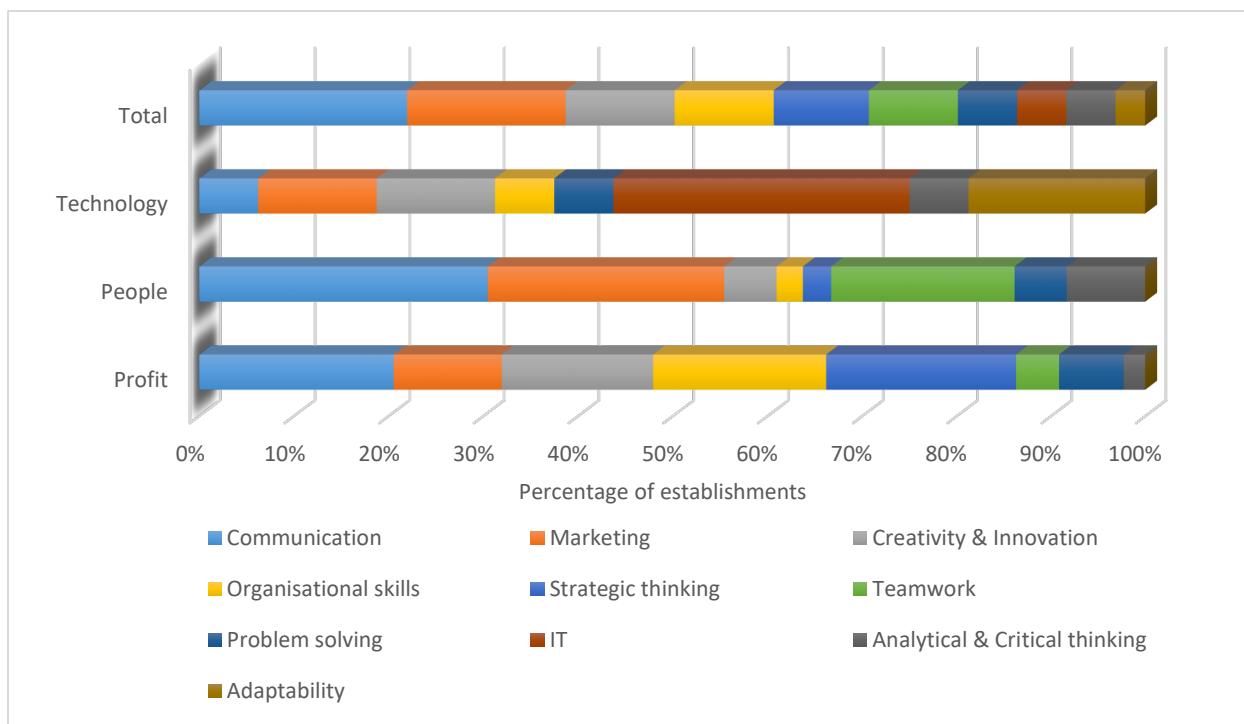


Figure 26: Main skills required to address internal drivers of change



In terms of external drivers of change, employers were asked to list the top two (2) external drivers and the skills required to address these drivers. The survey results

revealed that the top external driver of change were competition (57%) followed by climate change (30%), the economy (21%) and technology (16%) (Figure 27). Figure 28 depicts the skills employers identified as necessary to address each external driver of change. Overall, the top skills recorded were creativity and innovation (13%), communication (13%) and marketing (12%).

It is key to note the low level of importance placed on technology once again, this time in relation to driving business change. The lower rating of technology by employers could be seen as a clear indicator that there is a greater need for more awareness and investment in digital technologies in the workplace. This pattern of responses by employers in the tourism sector underscores the need to prioritise technology in businesses. This will enable businesses to unlock new levels of innovation, efficiency, and competitiveness.

The following were the main skills identified to address each internal driver:

1. Competition – Critical thinking (24%)
2. Climate Change – Environmental awareness (41%)
3. Economy – Organisational skills (33%)
4. Technology - IT skills (45%)
5. Customers - Organisational skills (56%)
6. Crime Communication (25%), Marketing (25%), Adaptability (25%) and Problem solving (25%)
7. Regulations – Risk assessment (67%)

Figure 27: Top external drivers of change in establishments

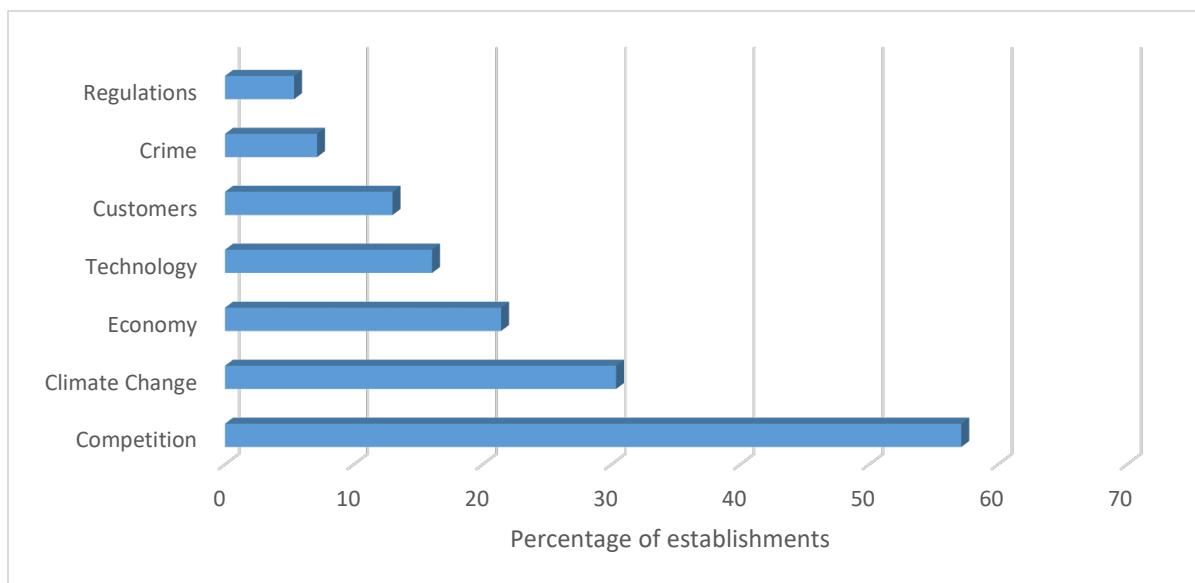
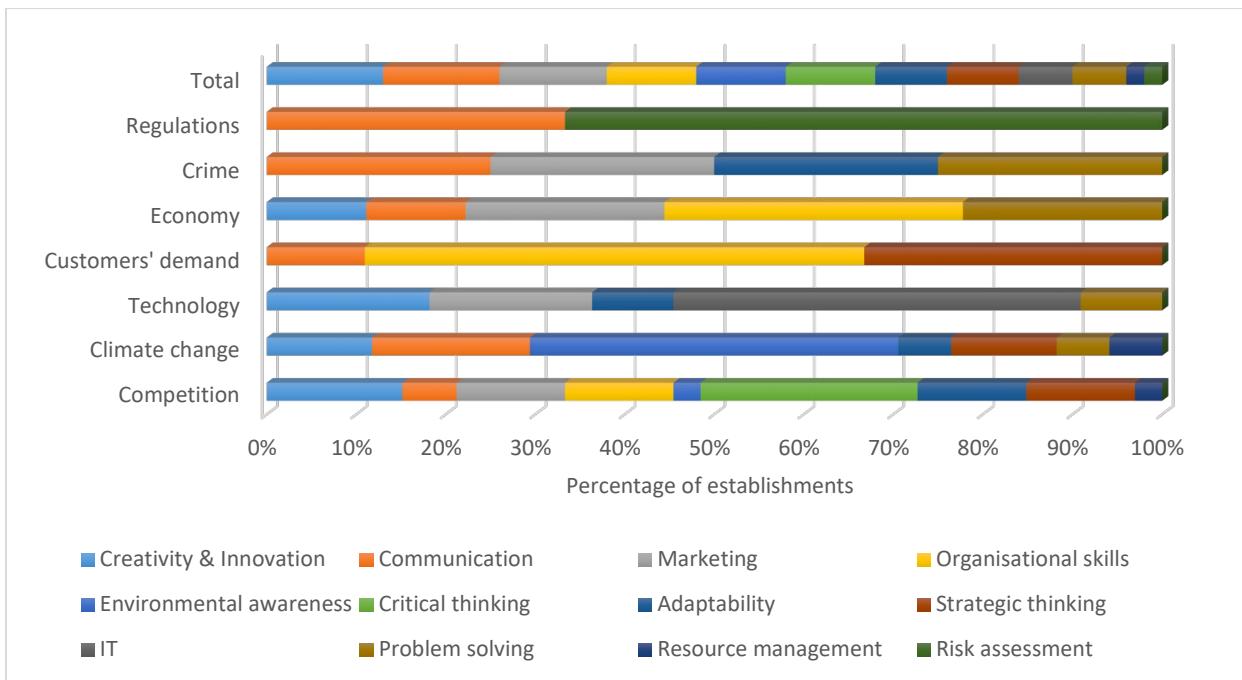


Figure 28: Main skills required to address external drivers of change



5.3 Level of Difficulty Employers Experienced in Obtaining Core Skills from Employees

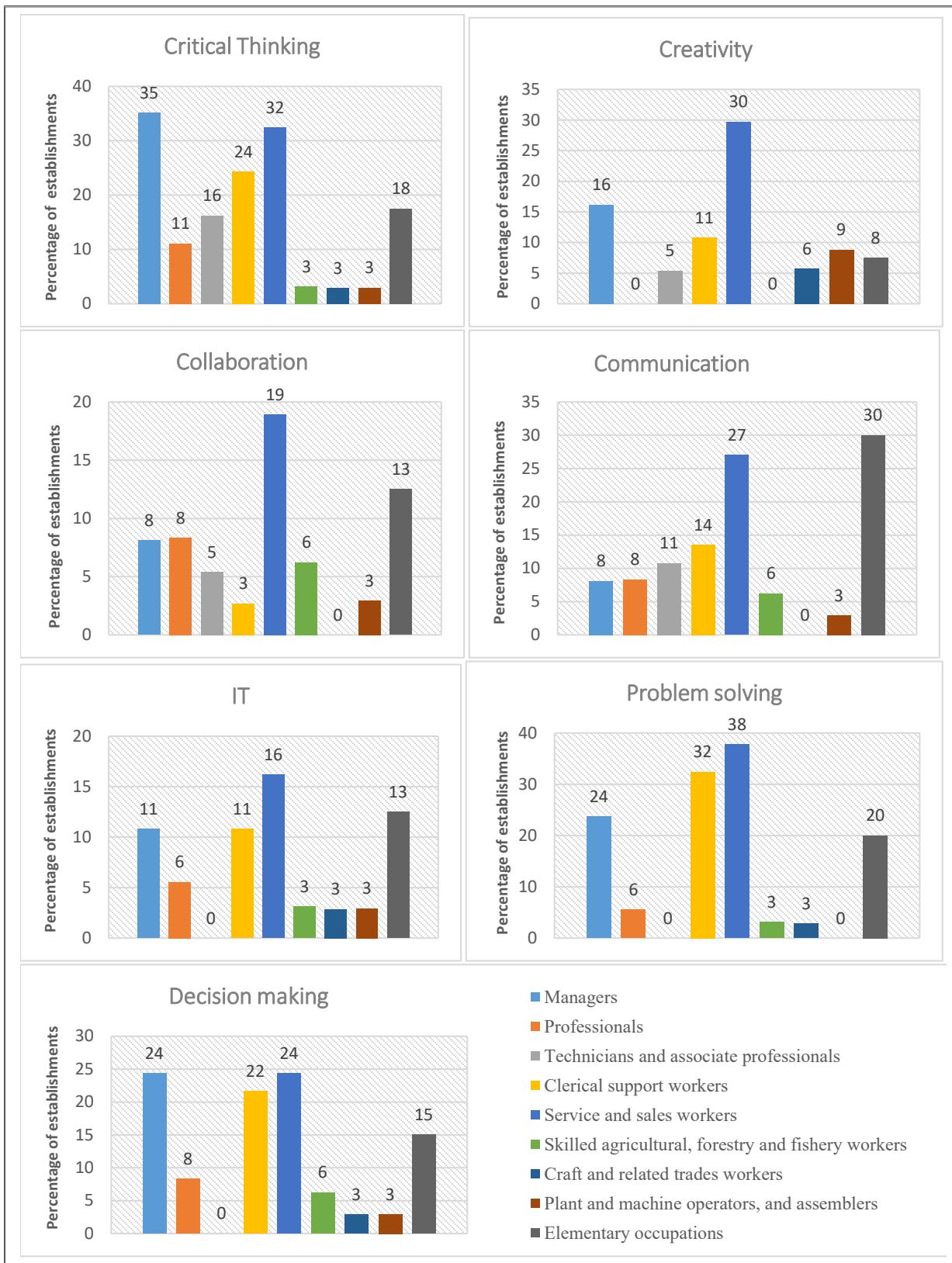
5.3.1 Recent Applicants

Figure 29 shows the percentage of employers who found it difficult to obtain seven (7) key skills from recent job applicants within each occupational group. Generally, the majority of respondents did not find it difficult to obtain the seven selected skills from recent applicants from each occupational group. The skills that recorded the highest level of difficulty were problem solving and critical thinking. The main skills employers found difficult to obtain from each occupational group are outlined below:

- Managers – Critical thinking (35%), Problem-solving (24%) and Decision making (24%)
- Professionals – Critical thinking (11%)
- Technicians and associate professionals – Critical thinking (16%) and Communication (11%)
- Clerical support workers - Problem solving (32%), Critical thinking (24%) and Decision-making (22%)
- Service and sales workers – Problem solving (38%), Critical thinking (32%) Creativity (30%) and Decision making (24%)

- Elementary occupations – Communication (30%), Problem solving (20%) and Critical thinking (18%)
- All other occupational groups - minimum difficulty in obtaining the seven skills identified.

Figure 29: Employers' rating on the difficulty experienced to obtain skills from recent applicants by occupational groups



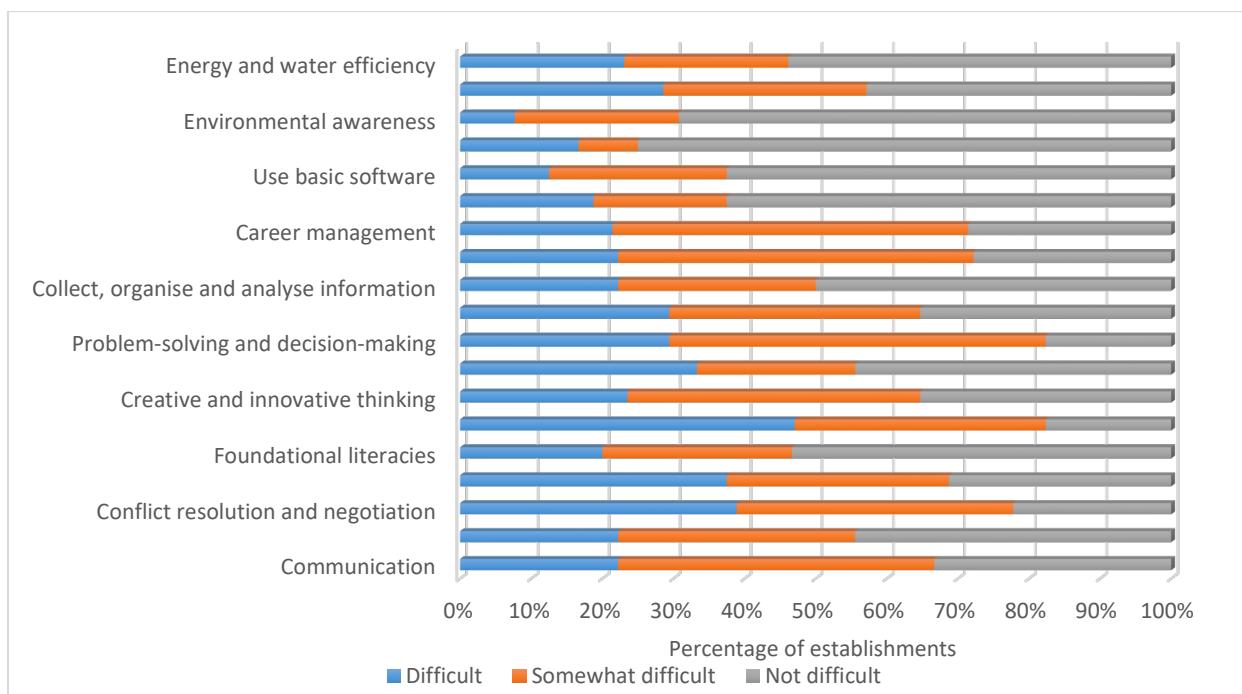
5.3.2 Recent University Graduates Applicants

To determine mismatches between skills demanded by employers and skills possessed by recent graduates, an assessment of the level of difficulty that employers faced in finding key skills among job applicants recently graduated at university level was undertaken. A half (50%) or more of the employers reported that they experienced some level of difficulty in finding the majority of skills listed in Figure 30 among job applications from recent university graduates. The highest level of difficulty was observed for Analytical and critical thinking (47%) followed by Conflict resolution and negotiation (39%), Emotional intelligence (38%) and Strategic thinking (33%).

A half (50%) or more of the employers assigned a rating of somewhat difficult to finding the following skills among recent university graduates: Problem-solving and decision-making (53%), Planning and organising (50%), and Career management (50%).

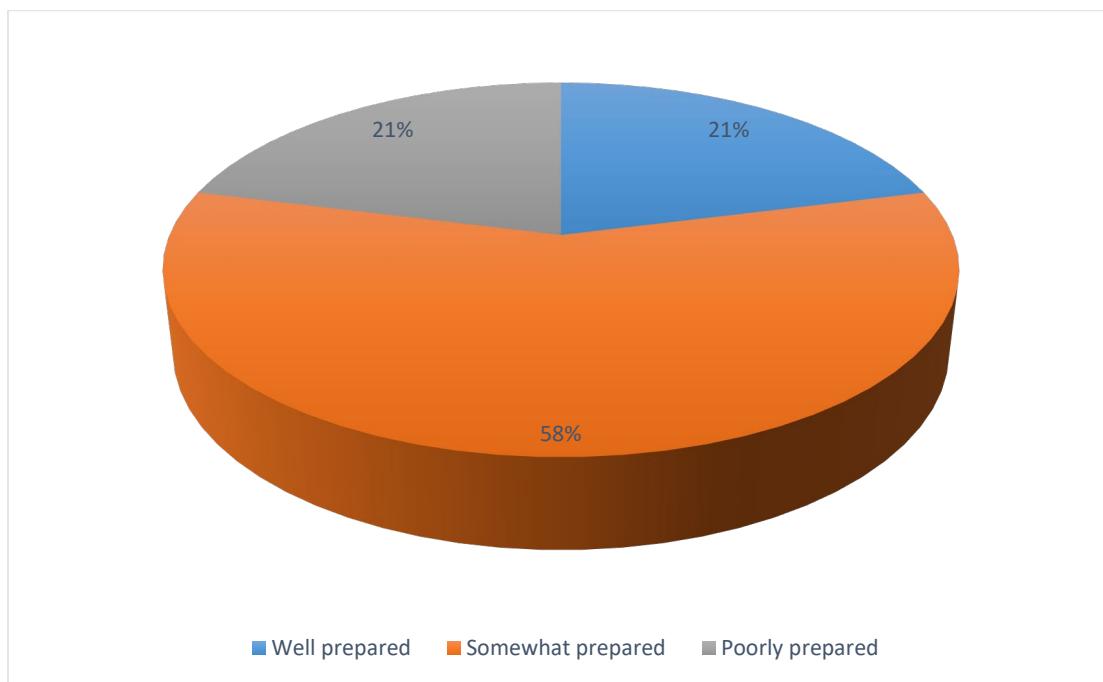
Conversely, employers assigned lower difficulty ratings to finding Basic digital skills and Basic skills for green jobs among recent university graduates.

Figure 30: Level of difficulty employers experienced in obtaining core skills from recent university graduates



The survey also collected data on employers' opinions regarding the readiness for employment of university graduates who have been hired in the past 2 years. The majority (58%) of the respondents reported that recent university graduates were somewhat prepared for work while approximately one-fifth (21%) in each case stated well prepared and poorly prepared. (Figure 31).

Figure 31: Level of preparedness for work among university graduates employed over the last 2 years



5.3.3 Existing employees

Aligning the skills of existing employees with the needs of the business is essential for achieving business objectives. Employers were asked to assess the proficiency of their staff in the 19 core skills. Figure 32 shows that over a half (50%) of the employers rated their employees' level of skills as medium or low (very low + low) in 15 of the 19 core skills. The highest rating (very high + high) was assigned to Communication (54%); Creative and innovative thinking (53%); Collaboration and teamwork (53%); and Planning and organising (52%).

Figure 32: Employers' rating of level of the skills of existing employees

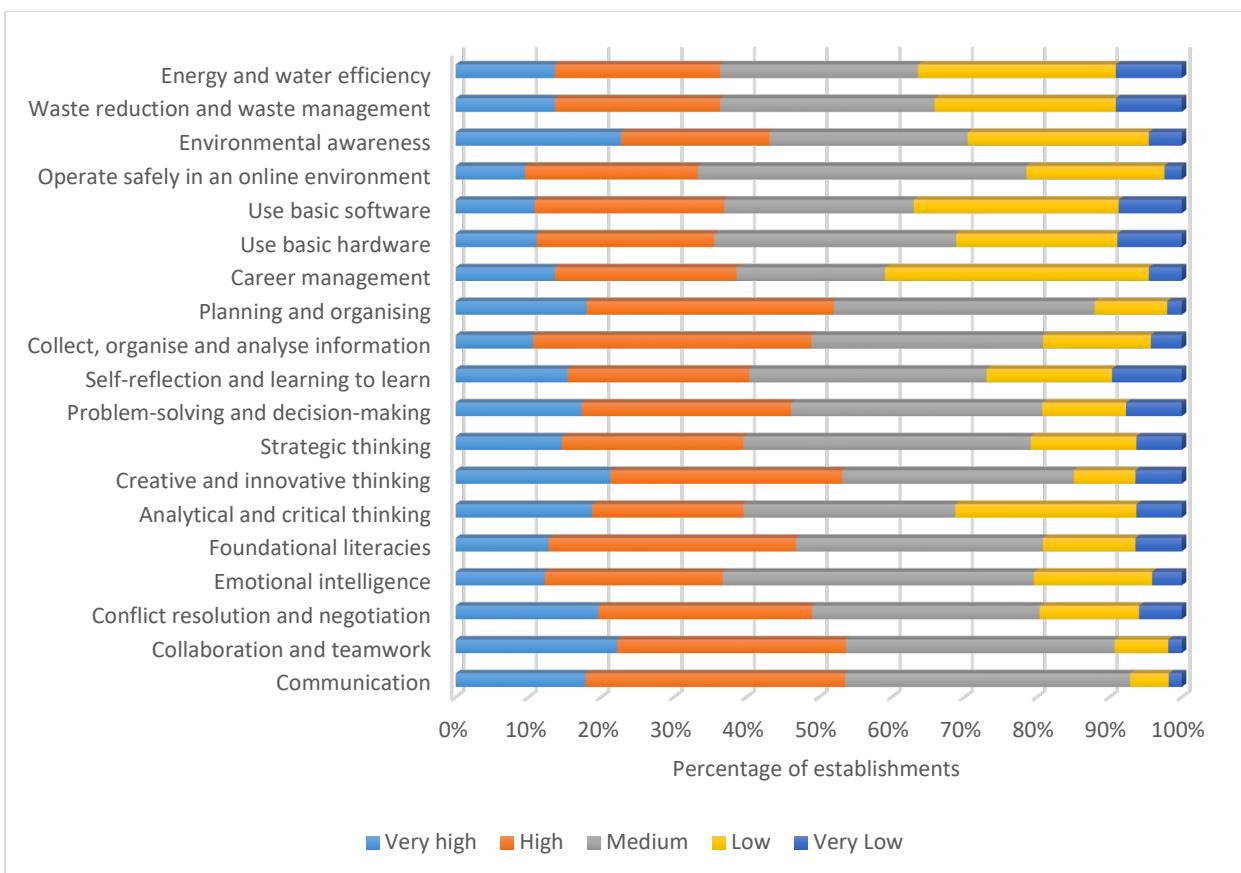
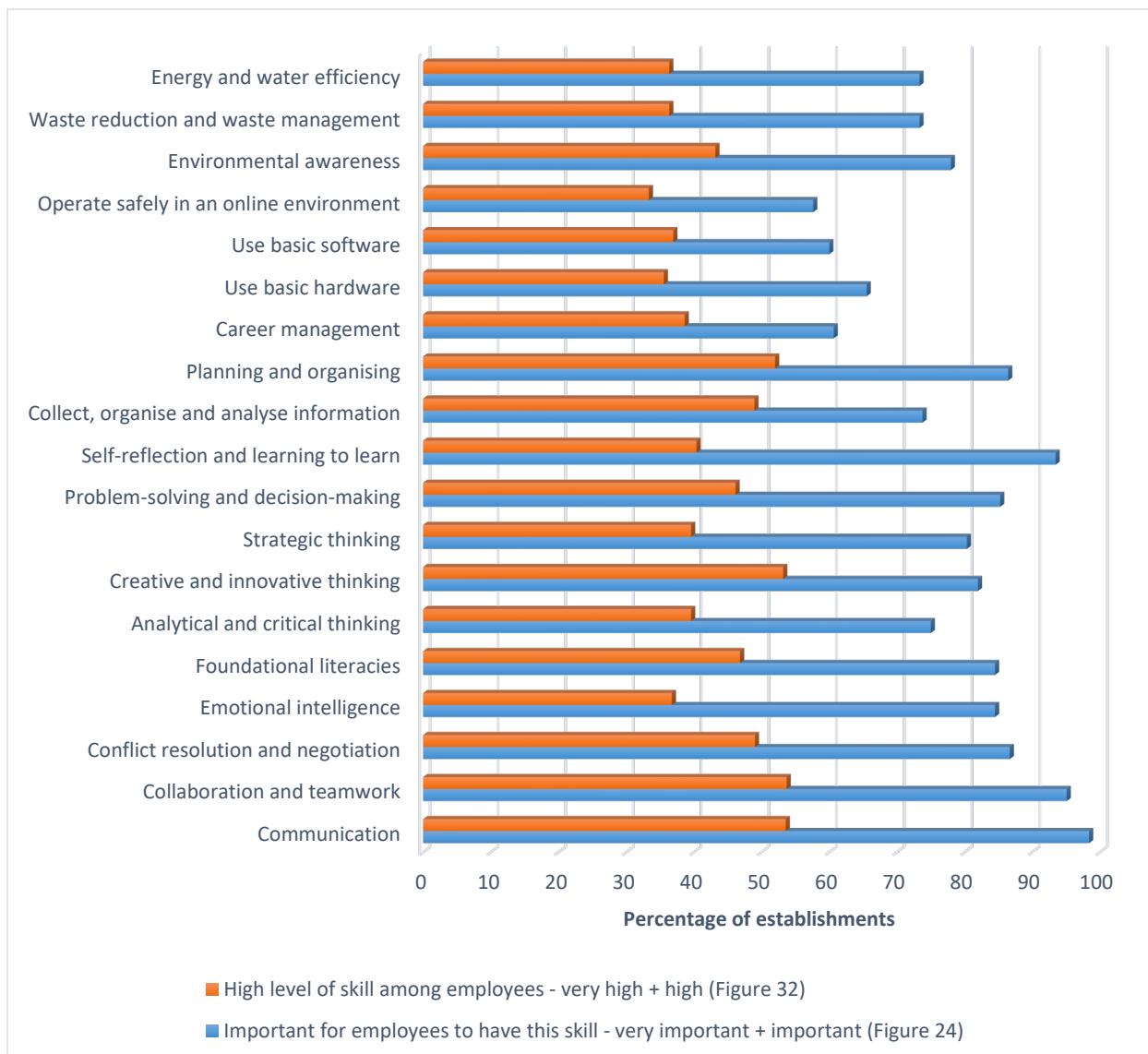


Figure 33 illustrates the skills gap within the industry by comparing the key skills that employers deemed important (very important + important) for meeting business goals (Figure 24) with the actual skill levels of their current employees (Figure 32). The data reveals that the majority of employers reported that it was important for employees to possess all 19 skills to achieve business objectives. However, the percentage of employers who rated the current skill levels of their employees as high (very high + high) across these skills was notably lower. The largest gap was recorded for Self-reflection and learning to learn (53%) followed by Emotional intelligence (47%), Communication (45%), Collaboration and teamwork (41%) and Strategic thinking (40%). This discrepancy highlights the existing gap between the skills employers required to successfully achieve their goals and objectives and the skills their employees currently possessed.

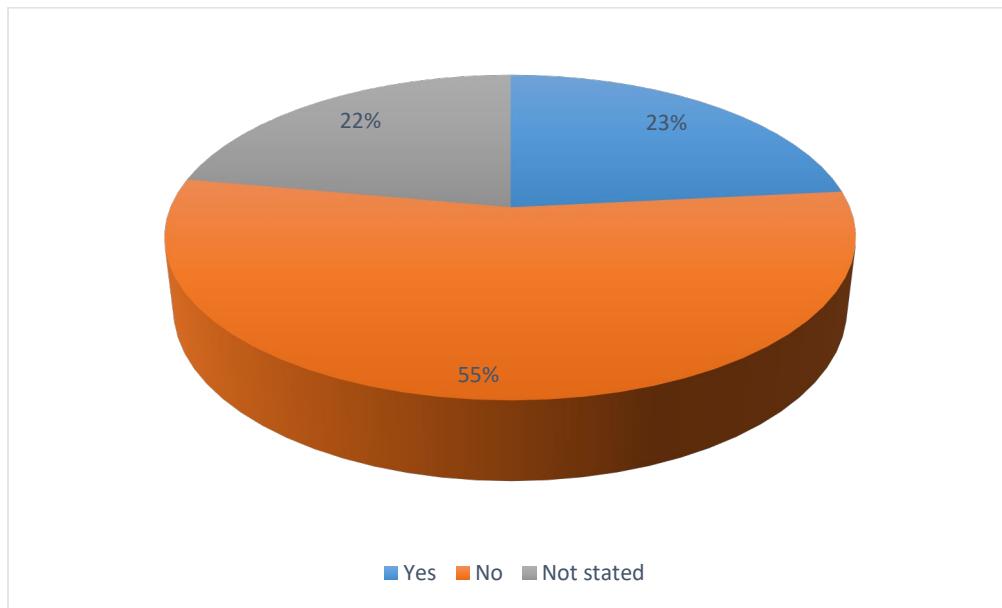
Figure 33: Comparison of employers' rating of skills required to meet business goals and level of the skills among employees



5.4 Impact of skills-shortages on establishments

The lack of requisite skills within the workforce can potentially hinder business operations. However, over half (55%) of the establishments that completed the survey reported that the lack of skills among workers did not affect their operations, while 23% disagreed and 22% did not reply (Figure 34).

Figure 34: Lack of skills among workers affected companies' operation



6. Demand for STEM Labour

An essential part of evaluating the STEM needs of the workforce in the tourism industry involved identifying the present and future need for STEM employees in businesses. Recognising and understanding the present composition of the workforce is crucial for employers and policymakers to create successful policies and initiatives to enhance skills and capabilities within the workforce. Predicting future job demands can assist businesses in adjusting to global transformations that are reshaping economies, workforce compositions, and society as a whole.

Figure 35 shows the current demand for STEM occupations reported by the companies in the tourism industry. The current demand for STEM occupations was generally low within each STEM field. The highest demand was recorded for Food and Agriculture occupations followed by Environmental Sciences occupations. The lowest demand was observed in the field of Medical and Health.

In terms of STEM jobs, the main jobs demanded were Web and digital interface designers (18%) followed by Environmental scientists (11%) (Figure 36).

Figure 35: Current demand for STEM occupations

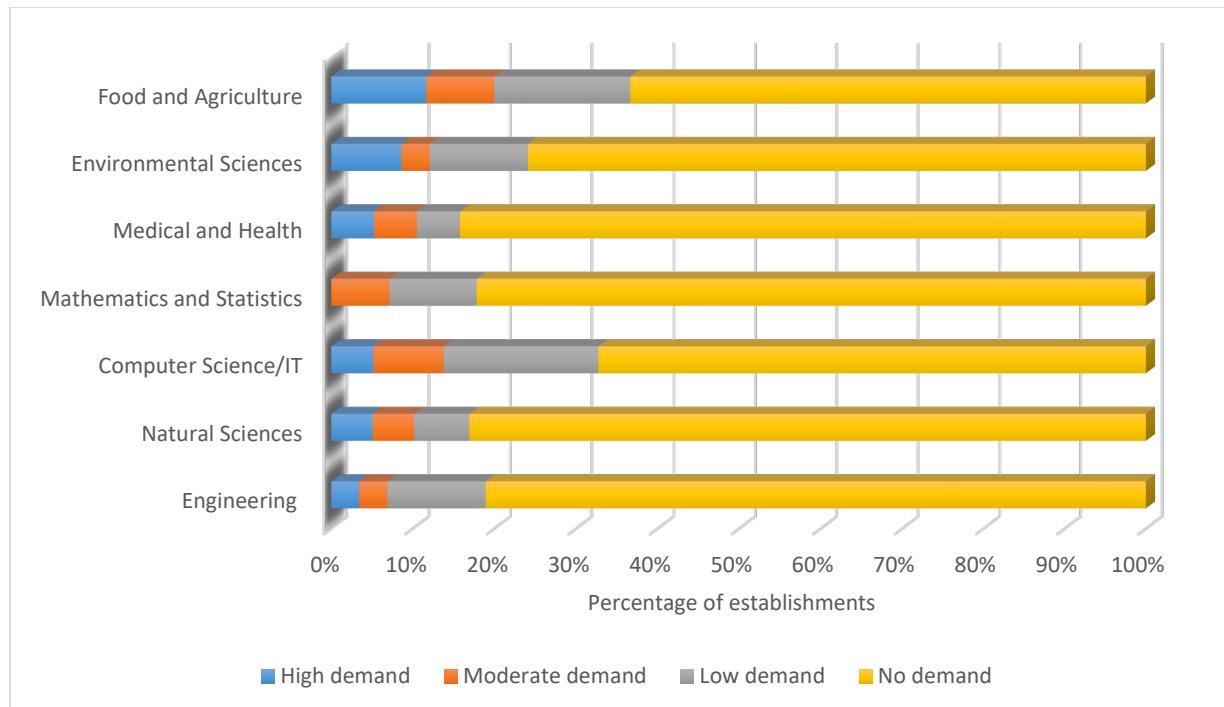
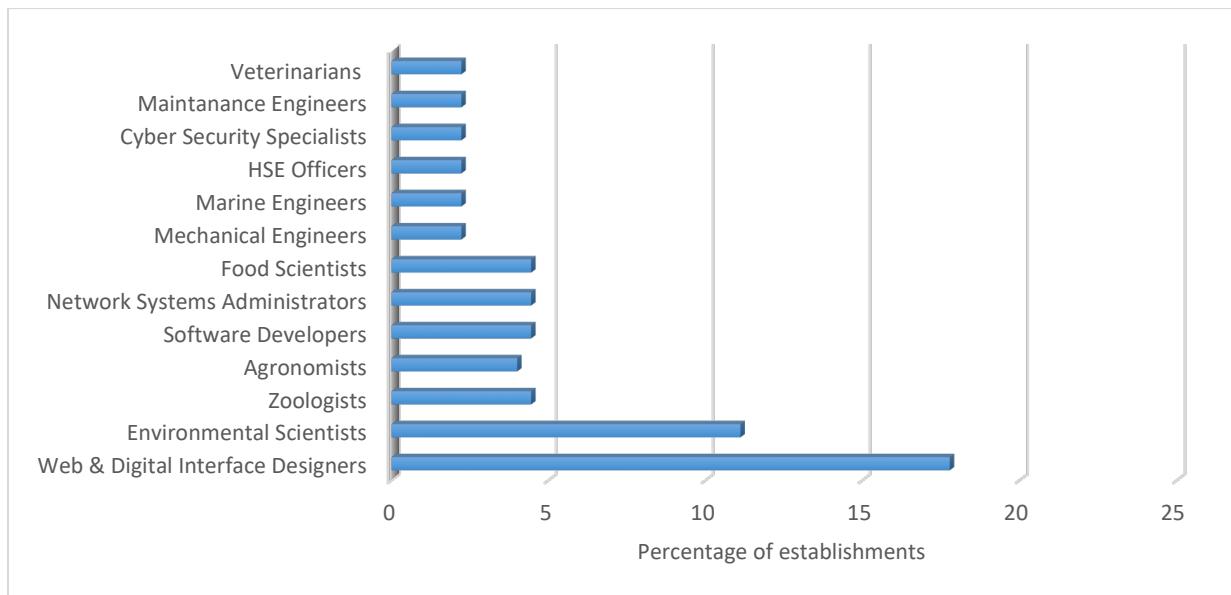
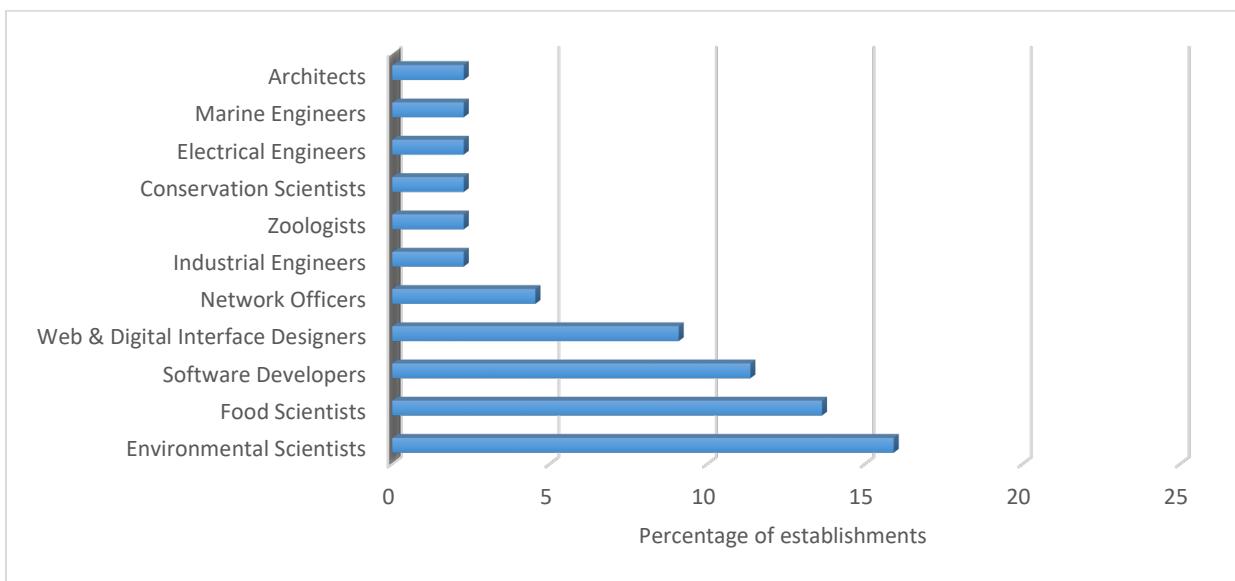


Figure 36: Top STEM occupations currently demanded by establishments



Employers were asked to list the three (3) top STEM occupations for their organisation in the next five (5) years based on the strategic direction of their establishment. The three (3) most important STEM occupations were Environmental Scientists (16%), Food Scientists (14%) and Software Developers (11%) (Figure 37).

Figure 37: Most important STEM occupations for establishments in the next 5 years



7. Technical and vocational education and training (TVET)

As part of the assessment of STEM labour needs in the tourism sector, STEM needs at TVET level were also identified. Generally, the rate of responses registered for the section on TVET was low. The data presented below represents the few employers who responded to this section.

With regard to the level of preparedness for work of TVET graduates employed over the last 2 -3, over three-fifths (62%) of the respondents did not provide an answer (Figure 38). Of the employers who responded to the question, 23% reported that TVET graduates were well prepared (very well prepared + well prepared) while 15% indicated that they were somewhat prepared.

Figure 38: Level of preparedness for work among TVET graduates employed over the last 2 – 3 years

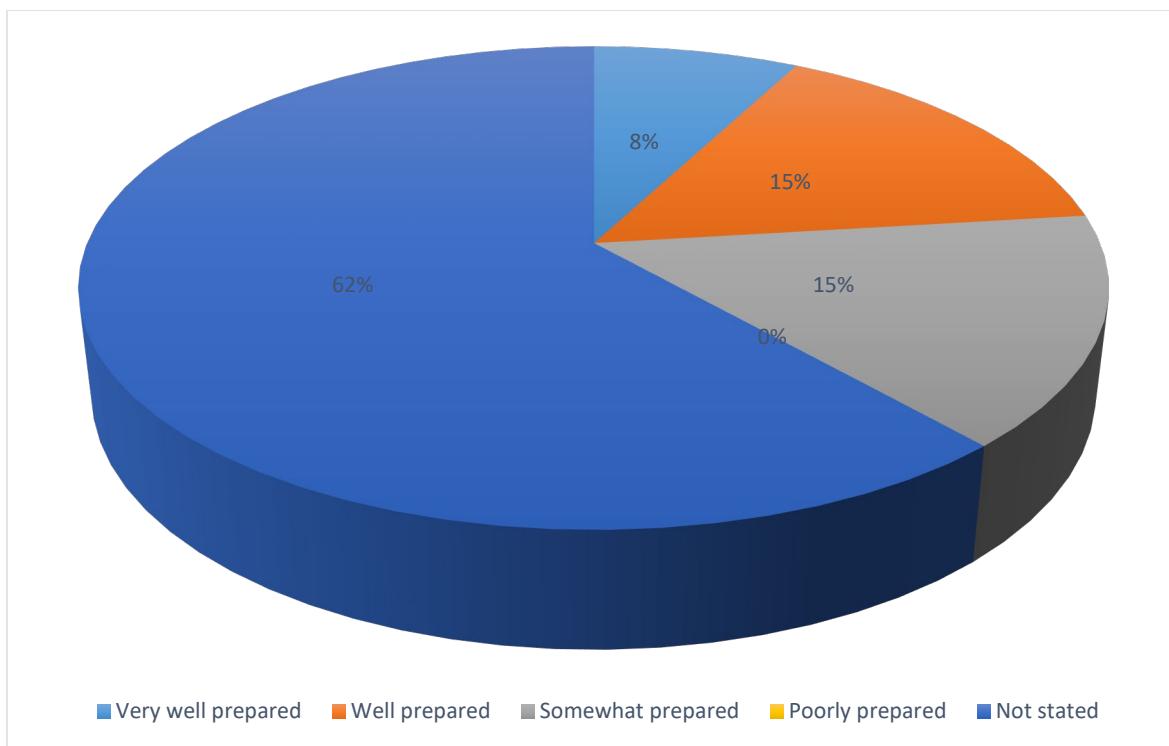


Table 3 presents the level of difficulty employers experienced in obtaining core skills from recent TVET graduates applying for jobs. The survey utilised the STEM in TVET Curriculum Guide that was developed by the ILO Women in STEM for Workforce Readiness and Development Programme to gather data on STEM competencies of TVET workers. This guide identifies four major domains of STEM competencies that support Technical and Vocational Education and Training (TVET), which include STEM knowledge, thinking skills, multi-literacies, and socio-emotional intelligence, involving 25 core skills described in Appendix IV.

A larger proportion of employers did not respond to the question and most employers who responded experienced some or no difficulty in obtaining the 25 core skills from recent TVET graduates who applied for jobs. The highest level of difficulty employers experienced (10%) were in the areas of Transdisciplinary thinking, Leadership, Service orientation, Project management and Glocal mindset (being adaptive to global standards while remaining responsive to local needs).

Table 3: Level of difficulty employers experienced in obtaining core skills from recent TVET graduates applying for jobs

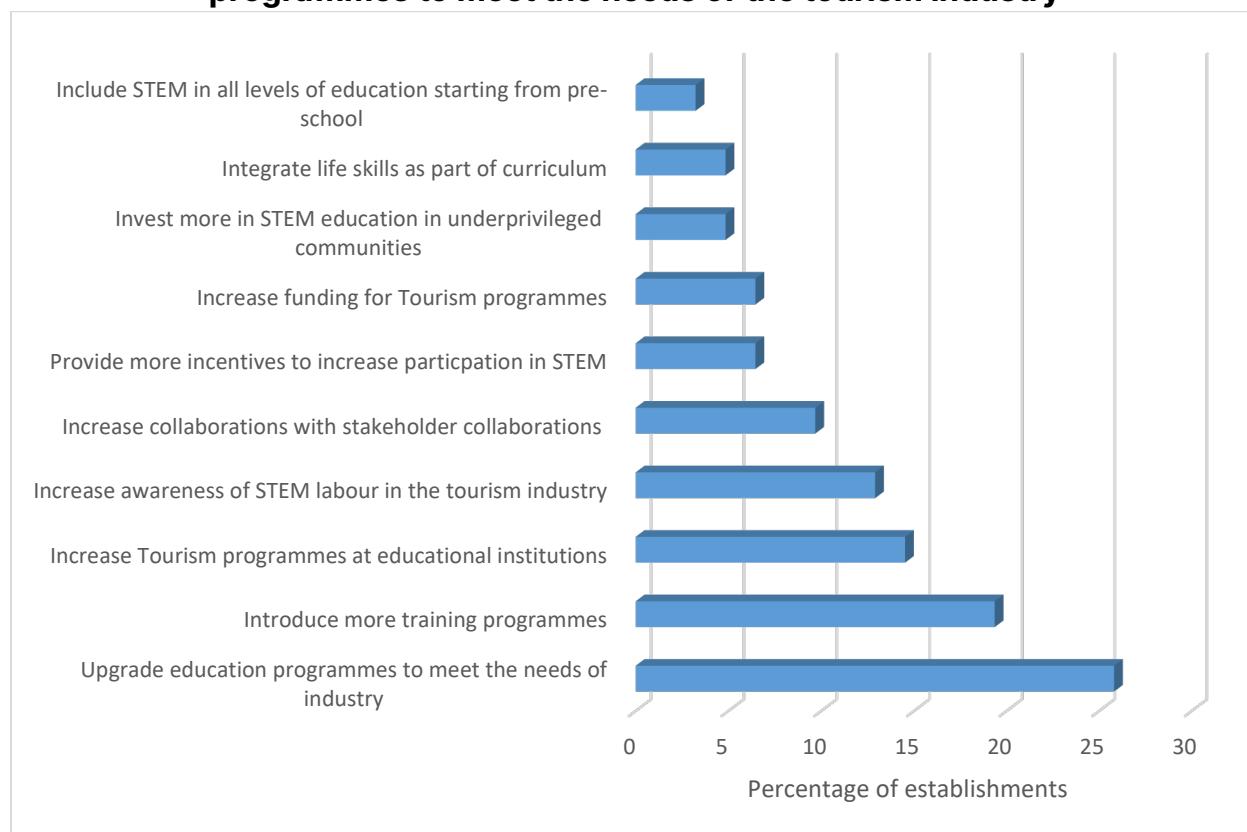
Skills	Difficult	Somewhat difficult	Not difficult	Not stated	Total
1. Critical thinking	5	20	15	60	100
2. Problem Solving	0	15	20	65	100
3. Systems thinking	5	15	15	65	100
4. Creative/inventive thinking	5	14	14	67	100
5. Transdisciplinary thinking	10	5	14	71	100
6. Decision-making	0	20	15	65	100
7. Ethical thinking	5	10	20	65	100
8. Computational thinking	0	20	15	65	100
9. Communication	0	20	15	65	100
10. Collaboration	0	15	20	65	100
11. Empathy	5	10	20	65	100
12. Lifelong/Lifewide Learning	0	10	25	65	100
13. Agency	0	10	15	75	100
14. Resilience	5	10	20	65	100
15. Leadership	10	10	15	65	100
16. Service Orientation	10	5	19	67	100
17. Project Management	10	10	14	67	100
18. Glocal Mindset	10	5	14	71	100
19. Numeracy	5	5	19	71	100
20. Digital Literacy	5	10	19	67	100
21. Civic Literacy	5	5	19	71	100
22. Cultural Literacy	5	5	24	67	100
23. Occupational Health Literacy	5	5	19	71	100
24. Organisational Literacy	5	5	24	67	100
25. Entrepreneurial Literacy	5	5	24	67	100

8. Employers' Recommendations

Employers from the tourism sector provided recommendations on actions needed from the government, private sector and tertiary education institutions to strengthen STEM education and the STEM labour force for the sector.

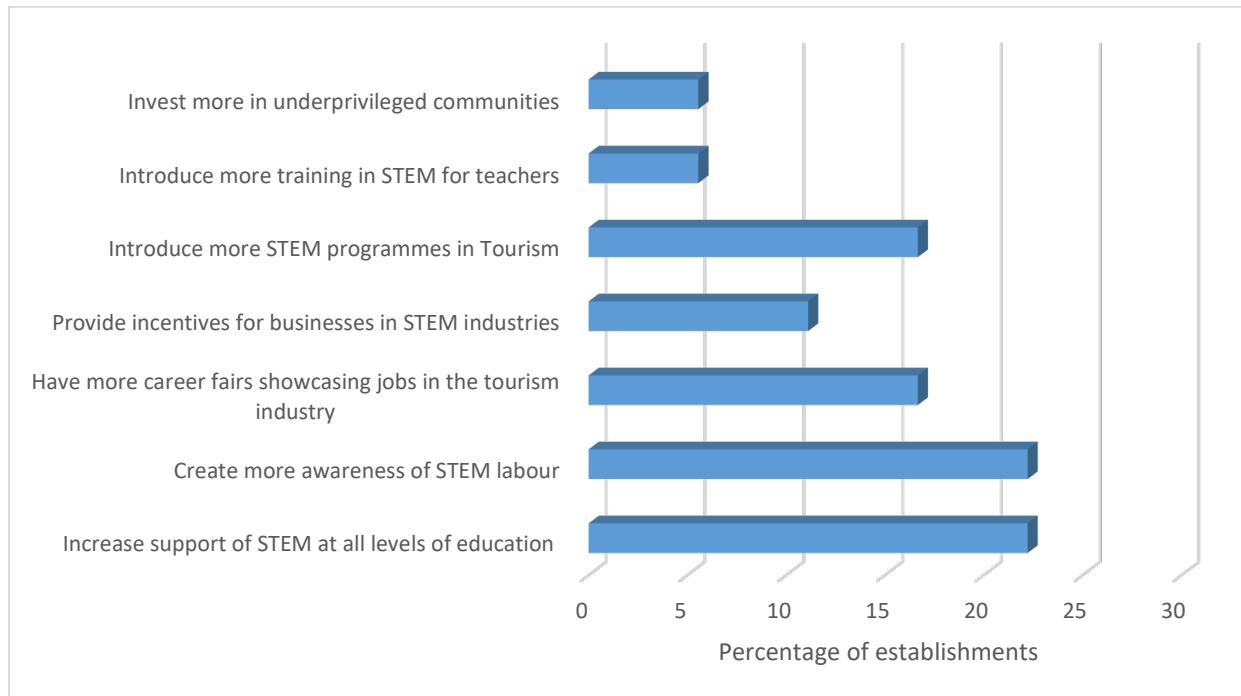
Employers were asked to provide recommendations on how tertiary education programmes can be improved to meet the needs of their industry. The main recommendations cited by employers were to: upgrade education programmes to meet the needs of the industry (26%); introduce more training programmes (19%); increase the number of programmes at educational institutions (15%); and increase awareness of STEM labour in the industry (13%) (Figure 39).

Figure 39: Employers' recommendations to improve tertiary education programmes to meet the needs of the tourism industry



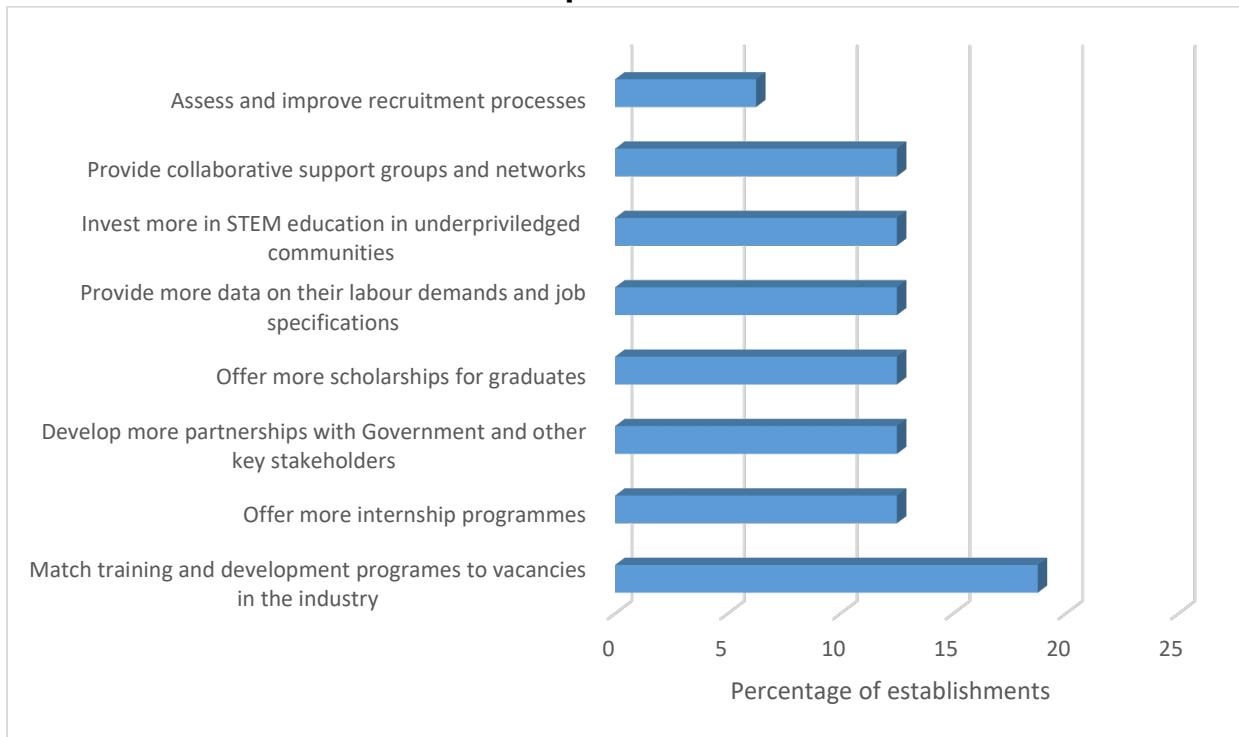
Employers also provided several recommendations on how government could help develop the STEM labour force (Figure 40). The most common suggestions were to increase support of STEM at all levels of education (22%) and create more awareness of STEM labour (22%). Seventeen percent (17%) of the respondents in each case recommended more career fairs showcasing jobs in the tourism industry and introduction of more STEM programmes in tourism.

Figure 40: Employers' recommendations on how government can help develop stem labour



Employers were also asked to provide recommendations on how private sector could help develop the STEM labour force. Figure 41 shows that approximately one-fifth (19%) of the employers recommended matching training and development programmes to vacancies in the industry. This should help to alleviate some labour and skills gaps in the industry. Other recommendations included: offer more internship programmes (13%); develop more partnership with government and other key stakeholders (13%); offer more scholarships for graduates (13%); provide more data on their labour demands and job specifications (13%); invest more in STEM education in underprivileged communities (13%); provide collaborative support groups and networks (13%); and assess and improve recruitment processes (6%).

Figure 41: Employers' recommendations on how private sector can help develop STEM labour



With regard to TVET education, employers recommended more training opportunities be included in TVET programmes (Table 4). In addition, employers stated that government should assist with online training for the workforce as well as subsidised TVET programmes. Several recommendations were put forth on how the business sector could help develop the TVET labour force. These included: increase wages of TVET employees in the sector; conduct more studies on the needs of the sector; create more training opportunities; and offer TVET courses based on the needs of industries.

Table 4: Employers' recommendations to improve TVET education and labour

To improve TVET education programmes to meet the current needs of the industry: <ul style="list-style-type: none">• Introduce TVET programmes to children at an early age• Incorporate different teaching methods to capture the interest of youths• Introduce more online training
For government to help develop the TVET labour force: <ul style="list-style-type: none">• Assist with online training for the workforce• Include TVET from early as primary education• Create more hands-on exciting opportunities that would interest young persons
For the business sector to help develop the TVET labour force: <ul style="list-style-type: none">• Invest in partnerships with educational institutes to offer mentorship/training opportunities• Build a database of trade specialists and match to TVET qualifications• Offer training with incentives• Offer TVET courses for workers in specific industries

9. Technological Advancements in the Tourism Industry

9.1 Overview

Technology is driving significant changes in the tourism industry. Innovations such as Artificial Intelligence (AI), the Internet of Things (IoT), Augmented Reality (AR), Virtual Reality (VR), mobile applications, and big data are enhancing efficiency and competitiveness while transforming the customer experience. Additionally, sustainable technologies, such as eco-friendly fuels and renewable energy, play a crucial role in advancing the industry's progress toward zero emissions. To remain competitive and ensure long-term sustainability, tourism companies must re-evaluate their current strategies and actively leverage these technologies for sustainable development. As new technologies emerge, customer expectations will continue to evolve, reflecting the enhanced experiences and benefits they offer. Companies that fail to keep pace with technological advancements risk losing customers, revenue, and reputation.

This section highlights the key technologies reshaping the tourism sector, improving efficiency, safety, accessibility, customer satisfaction, and sustainability. Drawing on examples from global leaders in tourism innovation, it illustrates how similar advancements can be adopted to improve local tourism operations. The report also outlines the STEM careers associated with these technologies and explores Japan's success in transforming its tourism industry into one of the most attractive destinations in the world, with a focus on the central role technology has played in that transformation.

9.2 The use of advanced technologies in the Tourism Industry

Some of these key innovations include:

- **Artificial intelligence (AI)** is a technology that allows computers and machines to simulate human capabilities such as learning, understanding, problem-solving, decision-making, creativity, and autonomy (IBM 2024). AI-powered chatbots and virtual assistants provide 24/7 customer service, automating tasks like booking, recommendations, and queries. They are important in meeting the expectations of customer service. These chatbots and virtual assistants are especially good at responding to common questions which have standard answers. Additionally, robots equipped with

AI capabilities are used at airports and hotels for services such as cleaning, baggage handling and customer assistance.

- **VR and AR** refer to '*technology blending the digital and physical worlds by superimposing digital information over human perception of physical reality*'.¹⁰ VR uses computer technology to create simulated environments that completely immerse the user, cutting them off from reality while AR enhances real world experiences by adding digital elements to it. The benefits of AR and VR in tourism is significant. VR allows tourists to explore destinations virtually before booking, offering immersive experiences of hotels, attractions, and more which can influence customers' decisions. Museums and cultural sites use AR for interactive experience and learning for visitors.
- **Internet of Things (IoT)** refer to '*a system involving connected devices that gather data, connect with the Internet or local networks, generate analytics, and in some cases adapt behaviour/responses based on the data/analytics in the network*'.¹¹ Tourism is a highly information-driven industry, and as such, it has greatly benefited from the IoT. One of the most significant impacts of technology has been on the distribution of tourism information and products online, transforming how tourism businesses operate. Nowadays tourists can use the internet to explore the many options available to them in terms of destinations, transportation, accommodation, food and entertainment.
- **Blockchain** is a distributed ledger of all transactions across a peer-to-peer network. Blockchain technology is considered by some as the most significant invention after the Internet (Efanov and Roschin 2018). Blockchain is being implemented for secure and transparent transactions in booking systems, loyalty programmes, and identity verification. The use of blockchain can build trust and loyalty among customers. Blockchain technology supports cryptocurrencies and provide additional payment options for customers.

¹⁰ European Foundation for the Improvement of Living and Working Conditions (Eurofound), Eurofound Glossary (2022), <https://www.eurofound.europa.eu/en/eurofound-glossary/#V>

¹¹ World Bank Group, Internet of Things: The New Government to Business Platform: A Review of Opportunities, Practices, and Challenges (World Bank Group, 2017).

- The use of **Big Data and Analytics** is increasingly prevalent in the tourism industry. Tourism companies use big data to analyse customer behaviour and preferences, personalising experiences, improving marketing strategies, and optimising pricing. Companies use data to analyse their performance and make decisions.
- **Mobile Apps:** Travel apps streamline travel, from booking accommodations to accessing local services like maps, guides, or language translation. These apps suggest events and locations that align with users tastes.
- **Renewable Energy:** Renewable energies are those that are derived from natural sources and are constantly replenished, such as: solar, wind, and hydropower. Renewable energy is essential for sustainable tourism. Renewable energy is a vital sustainable alternative to fossil fuels. It would help reduce greenhouse gas emissions and the overall carbon footprint of tourism. Additionally, the transition to renewable energy would attract eco-friendly tourists and thereby create another source of revenue. There is an increasing number of tourism destinations that are gradually harnessing natural and renewable energy resources.

9.3 Growing STEM jobs in the Tourism Industry

The growing adoption of technologies such as AI, IoT, Data Analytics and Blockchain in the tourism sector is driving demand for STEM professionals in areas like data science and analytics; cybersecurity; software development; machine learning and AI; and Blockchain development. Additionally, as the industry embraces digital transformation and green technologies, there is an increased focus on climate-friendly solutions for sustainable tourism. The table below highlights some of the key STEM careers associated with some of the main technologies discussed earlier in this section.

Table 5: Key STEM careers associated with technological advancements in the tourism sector

Technological Advancements	Examples of STEM Careers
<ul style="list-style-type: none"> • Artificial intelligence (AI) • VR and AR • Internet of Things (IoT) • Blockchain • Big Data and Analytics • Mobile Apps • Renewable Energy 	<ul style="list-style-type: none"> • Data Analysts/Scientists: Analyse traveller behaviour and market trends to improve services. • Software Developers: Build applications for travel bookings, virtual tours, and tourism management systems. • AI/ Machine Learning Engineers: Develop AI-driven chatbots, recommendation engines, and smart customer service systems. • Cybersecurity Experts: Ensure secure transactions and protect personal data in online travel platforms. • User Experience (UX)/User Interface (UI) Designers: Design user-friendly tourism apps, websites, and virtual interfaces. • AR/VR Developers: Create immersive experiences for virtual tours and destination previews. • Blockchain Developers: Innovate secure travel transactions and identity management. • Renewable Energy Engineers: Design and implement sustainable energy solutions, reducing carbon footprint, and supporting eco-friendly tourism.

9.4 Examples of leading countries in tourism and technological advancements

Country	Technological Advancements
United States	The U.S. remains the world's leading Travel & Tourism market, contributing a record-setting \$2.36 trillion to the nation's economy in 2023 (World Travel & Tourism Council [WTTC], 2024). AI, VR/AR, and big data are heavily used in tourism apps and services. Silicon Valley is a hub for technological tourism start-ups, and states like Florida and California are using AI-powered marketing to attract tourists. The WEF's Travel and Tourism Development Index 2024 identified the US as one of the top five countries leading the world in growing sustainable and resilient tourism.
Japan	Known for its innovative use of robotics and AI in hotels and airports, Japan uses these technologies for operational efficiency and to deliver exceptional customer experiences. The use of technology reinforces the country's commitment to innovation. The WEF's Travel and Tourism Development Index 2024 identified Japan as one of the top five countries leading the world in growing sustainable and resilient tourism.
United Arab Emirates	Dubai is a leader in smart tourism, using AI, blockchain, and IoT to develop fully integrated smart city tourism services. The country is a major hub for technological innovation and futuristic infrastructure. One of the latest advancements is making air taxis a reality. In November 2024, Joby Aviation, Inc., a company working on electric air taxis for commercial passenger use, revealed that construction had commenced on the first vertiport in its planned air taxi network in Dubai.
China	In 2023, China was the world's second-largest travel and tourism market, contributing US\$1.3 trillion to its GDP (WTTC, 2024). The WTTC forecasts that China will overtake the US as the largest travel and tourism market over the next decade. Driven by new technologies, smart tourism has become an important feature in China's tourism industry. The integration of technologies, culture and tourism is shaping new trends in travellers' experiences. The Chinese tourism industry uses big data analytics, facial recognition, and mobile technology extensively to cater to its large domestic travel market. China's massive investment in digital platforms also fuels its international tourism efforts.

9.5 Benefits of adopting emerging technologies in the Tourism Industry

- Enhanced Customer Experience: Personalisation via AI, seamless bookings through mobile apps, and real-time service adjustments improve overall satisfaction.
- Cost Efficiency: Automated systems reduce staffing costs, streamline operations, and reduce errors.
- Increased Accessibility: VR/AR makes destinations more accessible to individuals who may have mobility or travel limitations.
- Safety and Security: Blockchain and cybersecurity measures ensure safer transactions and protect tourists' data.
- Sustainability: IoT technology can improve resource management in hotels (energy, water), while big data enables better planning to reduce over-tourism. Additionally, renewable energy can reduce carbon footprint and support

9.6 Ease of adoption by local businesses

Challenges:

- Cost of Implementation: Small and medium-sized enterprises (SMEs) may find it costly to adopt high-end technologies like AI, VR, blockchain or renewable energy.
- Skills Gap: Limited local expertise in emerging tech fields may hinder immediate adoption without sufficient training and education programs.
- Infrastructure: Many local businesses may require upgrades in digital infrastructure, such as high-speed internet and IoT systems.

Opportunities:

- Government Support: Adequate support from government initiatives, like grants, information or tax incentives can help businesses transition smoothly.
- Partnerships: Collaborations with tech companies or international tourism bodies can help local businesses implement these technologies affordably.
- Training Programmes: Fostering local STEM talent through education and training programmes will create a workforce capable of driving technological adoption.

By prioritising these aspects, Trinidad and Tobago can modernise its tourism sector to remain competitive in the global market.

9.7 Case Study: Japan's Tourism Industry and Technological Advancements

Introduction to Japan's Tourism Industry Development

Japan has experienced a significant transformation in its tourism industry over the past few decades. From being a relatively niche destination, it has grown into one of the most sought-after countries for international tourists. According to the Japan National Tourism Organization (JNTO) and the Japan Tourism Agency (JTA), the country's Tourism sector recorded a record breaking 36.87 million foreign tourists in 2024, which surpassed the previous record of 31.9 million in 2019 by approximately 16%. The success of Japan's tourism industry can mainly be attributed to a combination of several factors including strategic government policies and technological innovations among others.

Table 6: Examples of key government policies

Visit Japan Campaign (VJC) (April 2003)	The government introduced the VJC to promote international tourism. The aim was to double the number of overseas visitors to Japan to 10 million by 2010.
Abenomics	Former Prime Minister Shinzo Abe's economic policy known as Abenomics aimed to revitalise Japan's economy after two decades of stagnation. The tourism sector was identified as a crucial driver for economic growth under this strategy. The plan focused on three key areas: monetary policy, fiscal stimulus and structural reforms. These efforts led to a significant increase in foreign visitors, from 8 million in 2012 to over 31 million in 2019.
Visa Waivers and Air Access	Japan introduced relaxed visa policies for key markets like China, South Korea, and Southeast Asia. In 2024, Japan's top three inbound tourism markets were neighbouring Asian countries, including South Korea, China, and Taiwan.
Tourism Infrastructure Investment	The Japanese government heavily invested in tourism infrastructure, including the development of transportation networks (bullet trains, airports, and ports), accommodations, and public facilities.
The New Tourism Nation	This plan was approved with the aim of developing Japan into a leading tourism nation. The plan is based on the Tourism Nation Promotion Basic Law of 2006 and focuses on three main goals:

Promotion Basic Plan (March 2023)	sustainable tourism, increase in tourism consumption and promoting regional attractions. The plan highlights the importance of collaboration between the government and private sector.
Favourable Exchange Rate	The Japanese yen declined during the period 2012 to 2015. This depreciation was largely attributed to the implementation of Abenomics which involved the Bank of Japan using aggressive monetary policies to boost the economy. The weakening of the yen made Japan a more affordable and attractive destination for international travellers.
Resumption of flight routes post-COVID-19	This was one of the primary factors that contributed to the surge in tourism after the pandemic.

Technological Innovations in Tourism

Japan has made significant technological advancements to cater to the increasing demand for tourism while improving both the operational efficiency of the sector and the visitor experience. The tourism industry has seen the integration of AI, robotics, mobile apps, and other innovative solutions.

Table 7: Examples of key technological developments

Smart Tourism Platforms and Apps	<ul style="list-style-type: none"> Japan Travel App: JNTO developed the Japan Travel app to provide tourists with real-time information about tourist spots, transportation options, and local events. This digital platform plays a crucial role in streamlining the tourist experience and improving overall satisfaction. Navigation and Language Translation Apps: Given Japan's linguistic barrier, technology has bridged communication gaps. Apps like Google Translate and Waygo have become crucial for tourists, while NaviTime helps visitors navigate Japan's complex public transportation systems in multiple languages.
AI and Robotics	<ul style="list-style-type: none"> Robot Concierges: Japan is a global leader in robotics, and this extends to the tourism industry. At hotels, airports, and even tourist attractions, robot concierges (e.g., at the Henn-na Hotel) assist with check-ins, provide information, and help guests with a variety of needs. AI-based Travel Assistants: Some Japanese travel agencies, such as H.I.S., have deployed AI-powered travel assistants. These systems help tourists book and customize tours, accommodations, and experiences based on preferences and real-time data.
Cashless Payment Systems	<ul style="list-style-type: none"> The introduction of cashless payment systems (e.g., QR code payments, Suica, and mobile wallets) has made it easier for international tourists to spend without relying on cash. This shift to digital payments has been supported by Japan's advanced fintech infrastructure, helping streamline tourist transactions.
VR and AR	<ul style="list-style-type: none"> Japan's tourism sector has begun experimenting with VR and AR augmented reality to create immersive experiences. Museums, such as the TeamLab Borderless in Tokyo, integrate AR and VR to offer tourists interactive art experiences. Additionally, VR is used to preview destinations and attractions, making it easier for tourists to decide on their travel plans.
Big Data	<ul style="list-style-type: none"> Japan's tourism agencies have leveraged big data to offer personalized travel recommendations. By analysing tourist behaviour and preferences through data collected from booking sites, mobile apps, and even social media, tourism providers can tailor marketing efforts and experiences to individual needs, increasing satisfaction and spending.

Smart Transportation Systems	<ul style="list-style-type: none"> Smart Trains: Japan's famous Shinkansen (bullet trains) have become even more efficient with the integration of advanced technologies, including real-time tracking, mobile ticketing, and predictive maintenance, reducing delays and improving customer experience. Autonomous Vehicles and Smart Buses: Japan has also started trials for autonomous vehicles and self-driving buses in tourist-heavy areas, further enhancing mobility options for visitors.
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Economic Impact of Technological Developments

The integration of technology has had a profound economic impact on Japan's tourism industry. By improving efficiency, reducing costs, and enhancing the tourist experience, these innovations have made the country more attractive to visitors and more competitive in the global tourism market.

- Increased Tourist Spend: Cashless systems and personalised services have encouraged higher spending by tourists. As visitors find it easier to make purchases, their overall expenditure on accommodations, dining, transportation, and entertainment has grown.
- Labour Productivity: Automation and the use of AI and robotics in the tourism sector have helped alleviate labour shortages, particularly in high-demand areas like hospitality. This has led to improved labour productivity while keeping service quality high.
- Destination Marketing: Data analytics and digital marketing strategies have enabled more precise targeting of potential visitors, increasing the effectiveness of Japan's tourism campaigns abroad. The ability to provide tailored recommendations has also increased customer satisfaction, encouraging repeat visits.

Challenges and Future Outlook

Despite the successes, Japan's tourism industry faces several challenges, such as:

- Overtourism in Certain Areas: Popular destinations like Kyoto and Tokyo face overcrowding, leading to congestion and strain on local infrastructure.
- Aging Population: Japan's aging population poses a long-term challenge in maintaining a competitive workforce in the tourism sector.

The development of Japan's tourism industry has been fuelled by a combination of government policy, economic incentives, and, significantly, technological innovation. The country's embrace of digital tools - ranging from smart apps and AI to cashless systems and VR - has greatly enhanced both the efficiency of the industry and the experience of visitors. Moving forward, Japan's commitment to leveraging technology, combined with its focus on sustainable tourism and infrastructure development, positions it to overcome challenges such as overtourism and continue to thrive as a top global tourist destination.

10. General Recommendations

The recommendations below are guided by the research undertaken during this study, stakeholder consultations and the results of the industry survey. The recommendations are intended to guide policymakers, educators, employers, and development partners in strengthening STEM talent pipelines and reducing skills mismatches.

STEM Education and Training:

1. Increase the practical/training component in tertiary education programmes. This is widely recognised as essential for preparing graduates better for the workplace. By integrating more hands-on experiences, students can put theory into practice in real-world situations, helping them gain the necessary skills and experience to transition smoothly into the workplace.
2. Greater alignment of tertiary programmes to the needs of industry. Achieving greater alignment of tertiary education programmes with industry needs is crucial for ensuring that graduates are equipped with the skills and knowledge demanded by industry. This alignment can lead to increase employment, productivity and growth.
3. Increase incentives and promotion for students to pursue studies and careers in STEM fields demanded by industry. Increasing incentives and promoting STEM studies and careers that are demanded by industry is essential for addressing labour gaps. This can also result in higher employment rates for graduates and greater success for businesses.
4. Increase research on STEM careers emerging from technologically advanced tourism sectors and promote these careers locally. This is crucial for preparing the workforce for the technological transformation needed to ensure business continuity. Furthermore, these findings should be available to educators, employers, students and all key stakeholders.
5. Introduce new and updated STEM education programmes at all levels based on labour market intelligence and anticipated technological trends. This proactive approach ensures that education systems remain future-focused and responsive. Additionally, this would boost productivity and profitability in businesses and employability of graduates.

6. Make STEM fun so that children can enjoy and as a result pique their interest in STEM. Increasing students' interest in STEM is essential to increasing their participation in STEM education and their pursuit of STEM careers.
7. Fully integrate STEM skills into the curriculum at an early age. Students will have a greater understanding, appreciation and interest in STEM from a young age. Furthermore, integrating STEM skills into the curriculum at an early age would help develop STEM skills that are essential in an increasingly technology-driven world.
8. Create/introduce more resources that help parents and teachers make STEM more relatable and fun for children. This would help students develop an appreciation and enthusiasm for STEM, which can lead greater interest and participation in the field.
9. Fostering partnerships between government, businesses, universities and all stakeholders to continue promoting and enabling skills development. These collaborative efforts help bridge the gap between education and industry needs and increase the STEM capacity of the workforce.

STEM Labour Force Development:

1. Provide more training and apprenticeship programmes based on the needs of the industry. This will ensure that graduates are able to transition smoothly into the workplace and reduce the mismatch of skills.
2. Provide more career guidance for young people through mentorship, structured programmes or career paths. This would help increase the participation of young people in STEM careers and satisfy anticipated future demand for STEM jobs.
3. Retrain employees to meet the current and future demand of the workplace. This is essential for addressing labour shortages and remaining competitive, in a rapidly evolving industry. Furthermore, retraining supports employee retention and boosts productivity.
4. Provide more support and incentives to promote STEM. Providing incentives to pursue STEM careers is crucial for driving innovation and competitiveness in businesses.

5. Encourage more labour force studies on STEM skills and STEM jobs. Undertaking more labour force studies on STEM skills and STEM jobs is crucial for understanding labour market trends and gaps. This data will enable policymakers to develop policies and programmes to address these gaps and facilitate greater alignment of education and training with industry needs.
6. Provide data on technological advancements within the sector and the benefits of investing in these technologies for employers. Many employers operate small businesses and therefore it is important to raise awareness of emerging technologies that are transforming the industry and the benefits of adopting these technologies. This could stimulate demand for STEM jobs that are needed to keep up with emerging technologies and ensure the industry's long-term sustainability.
7. Increase investment in Research, Development, and Innovation to drive the tourism industry into the technological age. Technological advancements are key to transforming the sector into an automated, low-carbon, and energy-efficient industry. This investment would also stimulate the demand for STEM talent associated with emerging technologies.
8. Promote STEM jobs tourism employers identified as key for future growth. This will increase employability of students and increase the STEM talent in the workforce.
9. Given the lack of response for the TVET section, undertake studies that focus solely on TVET.

11. Conclusion

In conclusion, this study offers a comprehensive assessment of the current and future STEM labour needs within the tourism sector of Trinidad and Tobago. As automation and digital transformation accelerate, several studies have projected significant shifts in the job market, with notable declines in certain job categories. The most competitive businesses will be those that proactively invest in building core skills among their workforce to stay ahead of these changes. The WEF reported that analytical thinking, creativity and flexibility were among the top skills needed in 2025. The findings of this survey offer valuable insights into the existing skillsets of the local workforce and the growing demand for 21st-century competencies. Technological advancements such as AI, AR/VR, and Renewable Energy are expected to significantly reshape how work is done across the tourism sector. Ultimately, this study highlights that the tourism businesses best positioned for long-term success will be those that actively develop the adaptive, innovative, and technical skills required to thrive in an evolving, technology-driven environment.

While the findings reveal that the current STEM workforce within the tourism industry in Trinidad and Tobago is relatively small and demand was low, the outlook for integrating STEM talent into the sector is promising particularly as the country continues to embrace digitalisation and innovation. This technological shift presents a strong case for expanding STEM roles in tourism. IT positions were identified as some of the most difficult STEM roles to fill which highlights a critical skills gap that must be addressed to support technological advancement in the industry. Moreover, the number of STEM professionals is expected to grow in the coming years, with employers anticipating increased demand for occupations such as Environmental Scientists, Food Scientists, Software Developers, and Web and Digital Interface Designers over the next five years. This indicates a clear need for targeted workforce development and training strategies in these STEM fields to meet the evolving needs of the industry.

Furthermore, the study highlights a skills gap between what employers require and the skills possessed by the current workforce. While most employers believed that it was important for employees to possess all 19 core skills to achieve business objectives many rated the core competencies of existing employees as medium or low. There were noticeable gaps in critical areas, especially in self-reflection and learning to learn, emotional intelligence, communication, collaboration and teamwork and strategic thinking. The ability to address these gaps will be crucial for employers seeking to maintain their competitiveness and their ability to adapt

to future challenges. While employers indicated that the mismatch of skills has not yet severely affected operations, there is a potential risk that these gaps could impact their future growth and sustainability if left unaddressed. Leveraging STEM talent effectively within the tourism sector could play a pivotal role in transitioning toward a knowledge-based, innovation-driven economy. Failure to capitalise on STEM capabilities could result in missed opportunities for growth, reduced competitiveness, and an inability to address industry challenges effectively.

21st Century Skills within the tourism sector is critical not only for the sector's development but also for ensuring the broader economic growth and sustainability of the nation. The implications of these findings are significant. First, there is an urgent need for a strategic approach to workforce planning and development that aligns education and training programmes with the demands of the tourism industry. This includes improving the STEM curriculum at various levels to ensure a STEM talent pipeline that can effectively meet the industry's evolving needs. Collaboration between industry stakeholders; education and training institutions; and government will be key to developing relevant training and apprenticeships programmes. Through collaboration, there will be greater alignment between education and training programmes and industry requirements, thereby, ensuring that the future workforce is equipped with the skills demanded by the industry and helping to reduce the skills gap.

Moreover, addressing the skill shortages in key STEM areas will require a multi-faceted approach, which would involve increased promotion of STEM education and careers to increase the talent pool in the tourism industry. To remain competitive in a rapidly evolving tourism sector, employers must prioritise upskilling and reskilling their existing workforce to adapt to technological advancements and emerging work processes. Countries such as Japan have demonstrated the importance of integrating workforce development with innovation. Through initiatives that blend hospitality with robotics and AI such as automated check-ins, robotic concierge services, and multilingual translation tools Japan has managed to maintain high service standards while addressing labour shortages. Countries that are adopting emerging technologies in the tourism industry are leveraging data analytics, digital concierge apps, and immersive virtual reality to enhance tourist experiences. These advancements require a workforce capable of managing and innovating within tech-enhanced environments. Reskilling initiatives thus not only equip employees to thrive in increasingly digital workplaces but also mitigate job displacement by aligning human capabilities with the demands of automation and smart tourism systems.

The study's findings also have broader implications for the national development goals. By fostering a STEM workforce equipped with 21st Century Skills and competencies, Trinidad and Tobago can strengthen its position in the global tourism industry, contributing to economic growth, innovation, and sustainability. Additionally, the adoption of green technologies and the shift toward more climate-friendly tourism operations will require a workforce skilled in environmental engineering and related disciplines, further reinforcing the importance of STEM education and training.

Ultimately, the findings from this study will inform policy decisions and guide the development of programmes aimed at addressing the skills disparities in the tourism sector. Data-driven policies and strategies will ensure that both the current and future workforce are well equipped to meet the challenges posed by technological advancements and global sustainability goals. By addressing these labour needs proactively, Trinidad and Tobago can increase the productivity, innovativeness and competitiveness of its tourism industry, driving growth and development in this critical sector.

Appendix I: Occupational Groups

- 1. Managers** - Includes occupations whose main tasks consist of planning, directing, coordinating and evaluating the overall activities of government, enterprises and other organisations, or of organisational units within them, and formulating and reviewing their policies, laws, rules and regulations. Formal preparation for these occupations may be supplemented or replaced partly or wholly by on-the-job training and/or experience. Examples: Managing Directors, Senior Officials, Hotel Managers and ICT Managers.
- 2. Professionals** - Includes occupations whose main tasks require a high level of professional knowledge and experience. The main tasks consist of increasing the existing stock of knowledge, applying scientific and artistic concepts and theories, teaching about the foregoing in a systematic manner or engaging in any combination of these activities. Competent performance in most occupations in this occupational group requires skills which have been acquired from tertiary-level education leading to a university or post-graduate university degree. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples: Farming, forestry and fisheries professionals, Mechanical Engineers, Software Developers and Visual Artists.
- 3. Technicians and Associate Professionals** - Includes occupations involving the performance of mostly technical and related tasks connected with research and the application of scientific or artistic concepts, operational methods, and government or business regulations. Most occupations in this occupational group require skills which have been acquired from post-secondary education leading to an award not equivalent to a first university degree. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples: Civil engineering technicians, Agricultural technicians, Ships' deck officers and pilots and Web technicians.
- 4. Clerical Support Workers** - Includes occupations which involve the recording, organising, storing, computing and retrieving of information and performing a number of clerical duties in connection with money-handling operations, travel arrangements, requests for information and appointments. Most occupations in this occupational group require skills which have been acquired from secondary-level education lasting about five years. On-the-job training and/or

experience may supplement formal preparation or replace it partly or wholly. Examples: Secretaries, Office Clerks, Hotel receptionists and Transport clerks.

5. **Service and Sales Workers** - Includes occupations involving personal and protective services related to travel, housekeeping, catering, personal care, or protection against fire and unlawful acts, or demonstrating and selling goods in wholesale or retail shops and similar establishments, as well as at stalls and in markets. Most occupations in this occupational group require skills which have been acquired from secondary-level education lasting about five years. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples: Travel Attendants, Conductors, Guides, Cooks, Waiters and Bartenders.
6. **Skilled Agricultural, Forestry and Fishery Workers** - Workers in this group grow and harvest field or tree and shrub crops, gather wild fruits and plants, breed, tend or hunt animals, produce a variety of animal husbandry products, cultivate, conserve and exploit forests, breed or catch fish and cultivate or gather other forms of aquatic life in order to provide food, shelter and income for themselves and their households. Most occupations in this occupational group require skills which have been acquired from secondary-level education lasting about five years. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples: Market gardeners, Crop growers, Poultry producers and Deep-sea fishery workers.
7. **Craft and Related Trades Workers** - Workers in this group apply specific knowledge and skills to construct and maintain buildings, form metal, erect metal structures or set machine tools. They make, fit, maintain and repair machinery, equipment or tools, carry out printing work, and produce or process foodstuffs, textiles, or wooden, metal and other articles, including handicraft goods. Most occupations in this occupational group require skills which have been acquired from secondary-level education lasting about five years. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples: Riggers, Cable splicers, Aircraft engine mechanics and repairers and Musical instrument makers and tuners.
8. **Plant and Machine Operators and Assemblers** - Workers in this group operate and monitor industrial and agricultural machinery and equipment on the spot or by remote control, drive and operate trains, motor vehicles and mobile machinery and equipment, or assemble products from component parts according to strict specifications and procedures. Most occupations in

this occupational group require skills which have been acquired from secondary-level education lasting about five years. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples: Cocoa, coffee and chocolate processing machine operators, Assemblers, Mobile farm and forestry plant operators and bus drivers.

9. Elementary Occupations - Covers occupations which involve the performance of simple and routine tasks which may require the use of hand-held tools and considerable physical effort. Most occupations in this occupational group require skills which have been acquired from primary education. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples: Cleaners and helpers in offices, hotels and other establishments, Crop farm labourers, Kitchen helpers, Messengers, package deliverers and luggage porters.

Source: International Labour Organization. 2012. *International Standard Classification of Occupations*

Appendix II: STEM Occupations

STEM occupations include computer and mathematical, architecture and engineering, and life and physical science occupations, as well as managerial and postsecondary teaching occupations related to these functional areas and sales occupations requiring scientific or technical knowledge at the postsecondary level.

Science	Computer Science/ IT	Engineering	Mathematics
<ul style="list-style-type: none">• Natural Sciences Managers• Animal Scientists• Food Scientists and Technologists• Soil and Plant Scientists• Biochemists and Biophysicists• Microbiologists• Zoologists and Wildlife Biologists• Biological Scientists, All Other• Conservation Scientists• Foresters• Epidemiologists• Medical Scientists, Except Epidemiologists• Life Scientists, All Other• Astronomers• Physicists• Atmospheric and Space Scientists• Chemists• Materials Scientists• Environmental Scientists and Specialists, Including Health• Geoscientists, Except Hydrologists and Geographers• Hydrologists	<ul style="list-style-type: none">• Computer and Information Systems Managers• Computer Systems Analysts• Information Security Analysts• Computer and Information Research Scientists• Computer Network Support Specialists• Computer User Support Specialists• Computer Network Architects• Database Administrators• Database Architects• Network and Computer Systems Administrators• Computer Programmers• Software Developers	<ul style="list-style-type: none">• Architectural and Engineering Managers• Architects, Except Landscape and Naval• Landscape Architects• Cartographers and Photogrammetrists• Surveyors• Aerospace Engineers• Agricultural Engineers• Bioengineers and Biomedical Engineers• Chemical Engineers• Civil Engineers• Computer Hardware Engineers• Electrical Engineers• Electronics Engineers, Except Computer• Environmental Engineers• Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	<ul style="list-style-type: none">• Actuaries• Mathematicians• Operations Research Analysts• Statisticians• Data Scientists• Mathematical Science Occupations, All Other

Science	Computer Science/ IT	Engineering	Mathematics
<ul style="list-style-type: none"> • Physical Scientists, All Other • Agricultural Technicians • Food Science Technicians • Biological Technicians • Chemical Technicians • Environmental Science and Protection Technicians, Including Health • Geological Technicians, Except Hydrologic Technicians • Hydrologic Technicians • Nuclear Technicians • Forest and Conservation Technicians • Forensic Science Technicians • Life, Physical, and Social Science Technicians, All Other • Computer Science Teachers, Postsecondary • Mathematical Science Teachers, Postsecondary • Architecture Teachers, Postsecondary • Engineering Teachers, Postsecondary • Agricultural Sciences Teachers, Postsecondary • Biological Science Teachers, Postsecondary 	<ul style="list-style-type: none"> • Software Quality Assurance Analysts and Testers • Web Developers • Web and Digital Interface Designers • Computer Occupations, All Other 	<ul style="list-style-type: none"> • Industrial Engineers • Marine Engineers and Naval Architects • Materials Engineers • Mechanical Engineers • Mining and Geological Engineers, Including Mining Safety Engineers • Nuclear Engineers • Petroleum Engineers • Engineers, All Other • Architectural and Civil Drafters • Electrical and Electronics Drafters • Mechanical Drafters • Drafters, All Other • Aerospace Engineering and Operations Technologists and Technicians • Civil Engineering Technologists and Technicians • Electrical and Electronic Engineering Technologists and Technicians • Electro-Mechanical and Mechatronics Technologists and Technicians 	

Science	Computer Science/ IT	Engineering	Mathematics
<ul style="list-style-type: none"> • Forestry and Conservation Science Teachers, Postsecondary • Atmospheric, Earth, Marine, and Space Sciences Teachers, Postsecondary • Chemistry Teachers, Postsecondary • Environmental Science Teachers, Postsecondary • Physics Teachers, Postsecondary • Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products • Sales Engineers 		<ul style="list-style-type: none"> • Environmental Engineering Technologists and Technicians • Industrial Engineering Technologists and Technicians • Mechanical Engineering Technologists and Technicians • Calibration Technologists and Technicians • Engineering Technologists and Technicians, Except Drafters, All Other • Surveying and Mapping Technicians 	

Source: Bureau of Labour Statistics, Department of Labour, US. 2021. *'Occupational Employment and Wage Statistics Survey'*

Appendix III: 19 Core Skills

- 1. Analytical and critical thinking** - The ability to assess issues appropriately and adequately, and analyse relevant information to form an opinion or take an individual or a collective decision. The ability to think clearly, logically and rationally; to evaluate and interpret information; and to objectively analyse and evaluate an issue to make a judgement.
- 2. Career management** - The ability to establish, plan and work towards the achievement of short- and long-term goals having both tangible and intangible success criteria. The ability to exchange information and ideas with individuals and groups that share a common interest, developing relationships for mutual benefit. The ability to use labour market information and intelligence to help identify work opportunities, understand work contexts and work conditions and apply job-search skills.
- 3. Collaboration and teamwork** - The ability to work in diverse teams effectively and respectfully, assuming shared responsibility for outputs and demonstrating willingness and flexibility. The ability to identify and acknowledge the feelings, experiences and viewpoints of others, showing care, affection and kindness.
- 4. Collect, organise and analyse information** - The ability to search, select, evaluate and organise information in order to effectively and efficiently mobilise relevant information. The ability to re-structure and model sourced information to produce personal interpretations of data.
- 5. Communication** - The ability to listen effectively in order to decipher meaning; articulate thoughts and ideas effectively; exchange information; and express opinions, desires, needs and fears using oral, written and non-verbal skills in diverse environments for a range of purposes.
- 6. Conflict resolution and negotiation** - The ability to reach a consensus between divergent interests by utilising logical argument and influencing others to cooperate, thereby resolving disagreement or dispute.
- 7. Creative and innovative thinking** - The ability to utilise a wide range of idea creation techniques, so as to generate, articulate and apply inventive and original ideas and perspectives, thereby solving complex tasks and life issues through original ideas.

8. Emotional intelligence - The ability to identify, understand and manage one's own emotions, as well as helping others to do the same. It can comprise of four domains: self-awareness, self-management, social awareness, and relationship management, which together have 12 competencies, including empathy, adaptability, achievement orientation and positive outlook.

9. Energy and water efficiency - The ability to use energy and water efficiently in ways that sustain the natural and physical environment.

10. Environmental awareness - The ability to understand and demonstrate an awareness of the physical environment and the need for it to be protected.

11. Foundational literacies - Literacy, numeracy, health, financial, scientific, cultural, and civic

- Literacy: the ability to understand, identify, interpret, create and communicate effectively utilising inscribed, printed, or electronic signs or symbols for representing language.
- Numeracy: the ability to understand and have the confidence and skill to work with numbers and mathematical approaches in all aspects of life.
- Health literacy: the ability to gain access to, understand and utilise information in ways which promote and maintain good health.
- Financial literacy: the ability to understand and apply financial management skills appropriately and to be able to make a financial plan, manage debt, calculate interest, understand the time value of money in order to make informed and effective decisions about personal financial resources.
- Scientific literacy: the ability to understand those scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity.
- Cultural literacy: the ability to understand the perspectives of people from diverse backgrounds instead of considering one's cultural beliefs and practices as the correct ones.
- Civic literacy: the ability to participate effectively in civic life through knowing the rights and obligations of residents at local, state and national levels.

12. Operate safely in an online environment - The ability to safely use basic online functions, applications, digital learning and communication platforms and media to explore, analyse and share information safely and ethically.

13. Planning and organising - The ability to plan and organise tasks in order to fulfil the job responsibilities satisfactorily within a given time and appropriately for a complex environment and situation.

14. Problem-solving and decision-making - The ability to identify and assess issues and problems, utilise available resources to generate and “brainstorm” potential solutions, evaluate the pros and cons of solutions and decide on a solution

15. Self-reflection and learning to learn - Self-reflection is the ability to apply reason to thought and behaviour, reflecting upon personal characteristics, assessing progress and identifying areas of for self-improvement. Learning to learn is the ability to apply the cognitive process of personal learning (what and how we learn) and to make use of guidance to continuously pursue learning new knowledge and skills and strive for improvement.

16. Strategic thinking - The ability to think conceptually, imaginatively, systematically and opportunistically, leading to a clearly defined set of goals, plans, and the new ideas required to survive and thrive in competitive and changing environments.

17. Use basic hardware - The ability to operate a personal computer, tablet, mobile phone or other digital device using the hardware functionalities, such as a keyboard, mouse, navigation buttons and touchscreen technology, where appropriate.

18. Use basic software - The ability to use and troubleshoot basic programs and applications, and able to word process, manage files, and access and adjust privacy settings.

19. Waste reduction and waste management - The ability to use, manage and dispose of resources in ways that sustain the natural and physical environment.

Source: International Labour Organization. 2021. *Global framework on core skills for life and work in the 21st century*

Appendix IV: STEM Competencies that Support TVET

1. **Creative/Inventive** - Thinking combine or connect ideas and information in unique and novel ways to generate new ideas, applications, products, processes, or services
2. **Critical Thinking** - Apply logic and reasoning to make sense of data or information by posing questions, putting forward arguments, exploring counterexamples, searching evidence, identifying relationships, recognising patterns and trends, evaluating pros and cons, and synthesising information
3. **Systems Thinking** - Understand the bigger context of a system, its emergent properties, and behaviour over time by knowing the connections, interrelationships, and dynamics of its constituent parts
4. **Problem Solving** - Identify feasible and efficient solutions to solve problems and to create new opportunities
5. **Transdisciplinary Thinking** - Put together relevant concepts and processes from multiple disciplines to generate solutions and new applications
6. **Decision-making** - Make a logical choice of action by looking at evidence, exploring alternatives, considering likely impact, evaluating options and providing justifications
7. **Computational Thinking** - Develop or apply computational models, tools and techniques to interpret and understand data, solve problems, and guide decision-making
8. **Ethical Thinking** - Use value system as guide for making choices that adhere to acceptable standards and protocols.
9. **Numeracy** - Apply mathematical ideas in personal, occupational, societal, and scientific contexts by reasoning, creating representations, or using measuring instruments or calculating tools
10. **Digital Literacy** - Search, evaluate, create, and share digital information using ICT device, equipment, tools, platforms, and applications for communication, collaboration, or problem solving

11. **Civic Literacy** - Contribute to the broader goals of the community by participating proactively in community affairs and observing social responsibility
12. **Cultural Literacy** - Be sensitive and respectful of the culture where an individual is immersed in
13. **Occupational Health Literacy** - Understand and apply occupational safety standards and protocols as well as take care of one's health and well-being to maintain productivity
14. **Entrepreneurial Literacy** - Detect an opportunity and make it grow in a sustainable way applying relevant knowledge, skills, and attitudes
15. **Organisational Literacy** - Negotiate way within an organisation by understanding its structure, dynamics of its members, communication channels, and appropriate procedures
16. **Communication** - Convey and exchange thoughts, ideas and information effectively through various mediums and approaches
17. **Collaboration** - Work effectively in a team to achieve shared goals either through face-to-face or virtual interaction
18. **Empathy** - Sense, share and respond positively to the feelings of another
19. **Agency** - Manage own behaviour and emotions to act professionally and independently, make choices freely, and pursue goals persistently
20. **Lifelong/Lifewide Learning** - Find opportunities to enhance one's knowledge and skills for continual learning; Maintain curiosity, passion, and growth mindset; Connect learning to a purpose and real-world context
21. **Resilience** - Thrive or prosper despite difficult circumstances; Be adaptable and flexible
22. **Leadership** - Lead others to attain shared goals by managing relationships, respecting diversity, recognising talent, and empowering people

23. **Service Orientation** - Support a culture of service excellence within the organisation by producing products or providing services that exceed the expectations of the customers
24. **Project Management** - Use resources (human, material, and time) wisely to deliver work-related tasks or projects
25. **Glocal** - Mindset Be adaptive to global standards but remain responsive to local needs

Source: International Labour Organization. 2021. *STEM in TVET Curriculum Guide*

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