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Addressing Skilled Labour Shortages in Malaysia's Printing Industry: Insights from Industry Experts

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ABSTRACT

The printing industry faces significant challenges due to a shortage of skilled workers, which negatively impacts production quality, efficiency, and competitiveness. This article explores the complex challenges associated with the shortage of skilled workers in the printing industry. It identifies specific impacts such as reduced employee retention, delayed production timelines, compromised quality, and decreased customer satisfaction. A qualitative analysis of 8 interviews with key industry stakeholders, including company owners, human resources and operations managers, reveals critical issues such as ineffective employment practices, inadequacies in training programs, and negative industry perceptions. To address these challenges, the article proposes strategies such as improved human resources management, enhanced skills development and training initiatives, technological advancement, and outsourcing. The article also highlights future challenges, including technological disruptions, demographic shifts, and sustainability concerns, emphasizing the need for proactive planning and collaboration to ensure the industry's continued viability and competitiveness. This study also situates the Malaysian printing industry's skilled labour shortage within wider national and global manufacturing trends, highlighting its urgency and the need for coordinated, cross-sectoral solutions.

1. INTRODUCTION

The printing industry relies on skilled professionals for prepress preparation, press operation, and post-press finishing, which require specialized knowledge and experience. The printing industry's need for more skilled workers significantly affects its overall function and competitiveness. The need for more skilled workers may lead to compromised production quality, increased error rates, and decreased efficiency in meeting market demands (Mtshali et al., 2022), resulting in missed opportunities for growth and innovation. Additionally, the printing industry is experiencing a shift towards digital technologies,

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demanding a workforce adept at handling advanced equipment and software (Rahmat et al., 2022; Singla & Anil, 2017). A shortage of skilled workers may impede the ability to adapt to changing market demands, compounded by evolving customer expectations, technological advancements, changes in quality standards, and the need for human resource adjustments (Amri et al., 2022).

Addressing this challenge is paramount for the sustainability and growth of printing businesses, as it directly affects production quality, efficiency, and competitiveness in the market. This article explores the impact of skilled worker shortages in the printing industry and adaptable strategies to overcome this challenge. By delving into the intricate landscape of the printing industry, examining its reliance on skilled professionals, and analysing the implications of workforce shortages amidst technological advancements and evolving market dynamics, this study seeks to provide a comprehensive understanding of the challenges faced by the industry and propose practical strategies for sustainable growth and competitiveness.

2. LITERATURE REVIEW

The printing industry is a sub-sector of the manufacturing industry in Malaysia and ranks among the top five in the country's industrial sector (Department of Statistics Malaysia, 2023). Malaysia has over 2,700 licensed printing companies with legitimate printing premises, excluding micro and small-medium enterprises (SMEs) (Ministry of Home Affairs Malaysia, 2023).

Printing is classified under the item 18110, while related services are under item 18120. Table 2.1 defines the printing activities and related services. Printing company operations range from graphic design to binding and finishing processes. The printing industry provides printing services by producing a wide range of printed products, including stationery, brochures, business forms, invitations, letters, folders, labels, packaging cases, and annual reports. Furthermore, the printing industry supports other key industries by establishing an extensive supply chain (Chung et al., 2006).

Hayes (2022) defines skilled workers as the workforce that possesses the knowledge, training, and experience required to perform tasks that are more complex than routine work. Misni et al. (2020) state that skilled workers are those who are trained to carry out tasks that require higher education and experience, such as degrees, diplomas, or professional certifications in specific fields.

Skilled workers in packaging and labelling printing must have specialized skills in printing techniques and a comprehensive understanding of standard details. Skilled workers in the book printing industry need expertise in various aspects of book printing, including pre-press procedures, printing, quality control, and binding. Security printing requires high proficiency in security features, pre-press procedures, and applicable security codes. Meanwhile, digital printing companies require skilled workers who are efficient in managing digital files, ensuring compatibility with substrates, colour management, and troubleshooting.

Skilled workers who play crucial roles in daily operations are valuable assets in the printing industry as they ensure printing processes are efficient (Ali, 2018; Nurwahidin et al., 2017; Rahmat et al., 2022; Rocha, 2013). Printing businesses require individuals who understand technical language and workflows (Ali, 2018), possess specialized knowledge in printing and the industry (Nurwahidin et al., 2017), thereby ensuring compliance with global standards, enhancing business performance, and delivering high-quality printed products through their expertise in identifying and correcting errors (Rahmat et al., 2022).

A study conducted by the Malaysian Department of Skills Development in 2012 revealed that most printing companies in Malaysia require professional and skilled workers to manage quality standards, explore new markets, develop digital printing, and produce value-added products and innovations. Skilled workers can identify and correct printing errors, ensure accurate colour production, and achieve consistent print quality. They have a deep understanding of printing techniques, materials, and equipment, enabling

them to achieve precise colour production, accurate registration, and consistent print quality. By maintaining strict quality control measures, skilled workers ensure that the final printed products meet the standards required by customers. Their diligence and commitment to maintaining high-quality standards guarantee customer satisfaction, loyalty, and a positive reputation for the company.

The integration of new and advanced technologies is a strategy that can enhance the performance of the printing industry (Ali, 2018). Printing companies need to leverage developments in digital printing to remain competitive and grow their businesses (Gallagher, 2014; Khoon, 2013; Susanto et al., 2013). To facilitate this transition, skilled workers are essential to operate and maintain the latest printing equipment, software, and digital platforms. Their knowledge and expertise can effectively harness these technologies, improving efficiency, productivity, and print quality (Khoon, 2013; Singla & Anil, 2017).

Moreover, skilled labour is crucial in adapting to changing customer trends. Customers expect customized, advanced, and high-quality printing solutions. Skilled workers can understand customer specifications, implement innovative designs, and incorporate individual elements into the printing process. By staying updated with market developments, they can offer solutions that meet customer expectations and provide a competitive advantage for printing companies (Khoon, 2013).

According to the Department of Statistics Malaysia's Monthly Manufacturing Statistics for March 2023, the number of paid workers in the manufacturing sector, specifically in printing and reproduction of recorded media, was 67,428 workers in 2021, increasing by 3.99% to 70,120 in 2022. In the Employment Statistics for the First Quarter of 2023, DOSM categorized printing under the manufacturing and wood products, furniture, paper products and printing subsectors. The number of printing workers in Malaysia's manufacturing sector and its subsectors, including wood products, furniture, paper products, and printing, was 308,200 in 2022, increasing to 309,600 in the first quarter of 2023. Of this total, 36,400 were skilled jobs in 2022, comprising 11.8%. In the first quarter of 2023, the number of skilled jobs increased to 36,700, representing 11.9% of the total employment. The filled employment data showed that 294,700 positions were filled in 2022, rising to 296,000 in the first quarter of 2023. Of these filled positions, 34,600 were skilled jobs in 2022, comprising 11.7%. The skilled employment fill rate was 94.9% in 2022 and remained high at 94.8% in the first quarter of 2023 (Department of Statistics, 2023).

3. METHOD

In the initial phase of this research, eight industry representatives with over ten years of experience in the printing industry were interviewed. These respondents were selected based on their expertise, including company owners and professionals in human resources and operations management. A qualitative approach using thematic analysis was chosen to explore the challenges within industry. Thematic analysis involved examining the interview data to identify recurring themes and patterns that could provide insights into the industry's skilled worker shortages. An inductive approach was adopted, allowing for the exploration of data without preconceived theories or hypotheses. This method was particularly suited for the study as it enabled a deeper understanding of the challenges from the perspectives of industry experts and provided rich, context-specific data. To further strengthen the study, future research could expand the sample size and include quantitative data, enabling more robust generalization of findings across the sector. The focus was on extracting actionable insights to develop strategies that address the ongoing challenges related to skilled labour shortages in the printing sector.

The qualitative approach was selected because it allows for an in-depth exploration of the complexities of skilled worker shortages in the printing industry. The subjective insights from the industry representatives are invaluable in capturing the nuances of the issue. However, the sample size of eight industry representatives may be seen as limiting. Future research could incorporate quantitative methods, such as surveys or case studies, to complement the qualitative findings and provide a more comprehensive understanding of the industry's challenges.

4. FINDING & DISCUSSION

4.1 Causes of Skilled Worker Shortages in The Printing Industry

Official government statistics and numerous studies have shown that over the past ten years, the Malaysian printing industry has experienced skilled workers shortages (Ali, 2018; Ananto et al., 2019; Department of Skills Development, 2012; Department of Statistics, 2023) which was also experienced by the eight industry representatives who participated in this study. Each of the eight industry representatives interviewed in this study mentioned encountering difficulties in sourcing staff, particularly in production. For example, one HR manager shared, “Many graduates apply, but they lack the practical experience required by our company” (R1). Another respondent added, “We lack the budget and time to train new workers intensively, so we prefer to hire those who are already skilled” (R3).

Respondents identified three leading causes behind the current (and likely continuing) problems with finding skilled workers. The first, and for many, definitive cause behind the current difficulties in filling positions for qualified tradespeople is their employment practices. The industry demands experienced workers, and although educational institutions have produced numerous graduates, these individuals often need more experience to meet the primary criteria required by the industry. This practice erects barriers for graduates and restricts their workforce opportunities. Consequently, the industry needs more skilled workers because it neglects the potential contribution of new talent. Experience is gained through training, yet many companies must prioritise providing direct training to their employees, resulting in employees needing more training to perform their duties effectively. Workers need to be afforded adequate opportunities and further development, such as overseas training, to refresh and enhance their skills through training and professional development, causing them to struggle to adapt to the industry's current demands. Financial and time constraints within companies lead to insufficient emphasis on skills development among employees, potentially resulting in a lack of workers possessing specialised skills. Additionally, the issue of low pay further exacerbates the problem, as it fails to attract and retain skilled workers within the industry.

These challenges are not isolated to the printing industry. Similar skilled labour shortages are affecting Malaysia's broader manufacturing sector, which faces a deficit of over a million workers and intense competition for skilled roles, particularly in high-growth areas like semiconductors and automation (Goh & Tang, 2024; Lee, 2025; Randstad, 2025). Globally, the manufacturing sector is experiencing a persistent skills gap, with experts predicting a shortfall of nearly 8 million workers by 2030 due to aging workforces, rapid technological change, and education mismatches (Faethm, 2024; LeanDNA, 2025). Other Malaysian sectors, such as construction, also report critical shortages of skilled labour, further emphasizing that this is a widespread issue with far-reaching implications for productivity, innovation, and economic growth. Without comprehensive solutions, these shortages threaten not only individual companies but also the competitiveness of Malaysia's industries in the global marketplace (Author & Pizzemento, 2024; Invisu, n.d.; Raj, 2025).

According to respondents, the second major contributing cause is the state of printing training institutes and education. Unfortunately, these institutes often fall short of addressing the critical skill areas demanded by the industry, leading to a significant disparity between the skills taught and those required by employers. Moreover, training programs frequently need to provide students with adequate exposure to the technologies utilised within the industry. Due to rapid technological advancements in the printing industry, the training and education provided may need to be improved to maintain the level of competence required to handle emerging technologies. This results in a significant gap in understanding among graduates regarding the specific job requirements and profiles within the printing sector.

Furthermore, there appears to be a need for stronger collaboration between training institutes and industry players. This deficiency hampers the seamless integration of graduates into the workforce.

Establishing robust partnerships and innovative collaborations between training institutes and industry stakeholders could be a viable solution. Such collaborations would facilitate the direct placement of graduates into relevant industry roles, ensuring a smoother transition from education to employment and more effectively addressing the prevailing skills gap.

The final factor to consider pertains to industry perceptions and workforce dynamics. A prevalent negative perception surrounding the printing industry could discourage students from pursuing careers in this field. This perception often stems from the belief that the industry lacks innovation or attractiveness. Consequently, students may gravitate towards employment opportunities in industries perceived as more appealing or offering higher incomes, resulting in diminished interest in the printing sector. Consequently, foreign workers in the Malaysian printing industry are the primarily dominate skilled workers.

4.2 Challenges of Skilled Workers Shortages in the Printing Industry

All respondents in this study reported experiencing challenges due to the shortage of skilled workers. As one company owner noted, “Our work quality declined when skilled workers left, and customers started complaining about delays and inconsistent results” (R5). Another operations manager said, “Sometimes we have to reject large orders due to insufficient skilled staff” (R7). One of the primary themes that emerged pertains to the substantial impact on output quality. With a dearth of skilled workers, printing companies often need help to maintain the desired level of quality in their products and services. One company owner explained, “Because we cannot find enough skilled staff, we have had to turn down several large contracts this year, which directly reduced our profits. Our team is also less able to experiment with new printing techniques, so we risk falling behind competitors who can innovate faster.” (R4). This deficiency manifests in various ways, including instances of poor workmanship and the production of low-quality output. Ensuring consistent quality becomes increasingly challenging without the necessary expertise and experience among the available workforces. Consequently, these quality issues pose significant risks to the reputation and credibility of printing companies, potentially leading to decreased customer satisfaction and loyalty.

Customer satisfaction, another crucial aspect of the printing industry, is profoundly affected by the shortage of skilled workers. The inability to meet customer demand effectively stands out as a significant concern, with printing companies often understaffed and overwhelmed by the volume of work. As a result, customers may experience delays in receiving their orders or encounter difficulties obtaining the desired products and services. According to an operations manager, “We’ve had to extend our delivery timelines and sometimes even reject urgent orders. This has not only disappointed our regular customers but also led to a noticeable drop in repeat business” (R2). Furthermore, the need for more skilled workers can lead to increased customer complaints, as clients may notice a decline in the quality or timeliness of the work produced. It is important to address these customer needs and concerns promptly and satisfactorily to benefit the overall reputation and competitiveness of printing companies in the market.

Production efficiency is another critical area affected by the shortage of skilled workers. The industry faces numerous challenges, from decreased work speed and productivity to production bottlenecks and job delays. A respondent shared, “With fewer skilled workers on the floor, our machines are sometimes idle for hours, waiting for someone qualified to troubleshoot or set them up. This downtime has a real cost—we estimate our output has dropped by about 15% compared to last year.” (R6). With fewer skilled workers available to handle the workload, printing companies often struggle, needing help to keep up with demand and maintain optimal production levels. This shortfall in skilled labour leads to inefficiencies within the production process and limits the range of job options available to clients. Additionally, the shortage of skilled workers can have ripple effects across other departments within printing companies, disrupting workflow and exacerbating existing challenges.

Communication breakdowns compound the challenges associated with the shortage of skilled workers. Misinterpreting specifications and instructions due to insufficient expertise and experience can result in errors and inaccuracies in production. These communication gaps not only hinder the smooth execution of tasks but also contribute to increased resource and time wastage.

Moreover, the absence of skilled workers significantly impacts the confidence and enthusiasm of other less skilled workers in carrying out printing work. As one supervisor put it, “Our experienced staff are stretched thin, and newer workers often feel overwhelmed. We’ve seen an increase in mistakes and, unfortunately, higher staff turnover because people feel unsupported.” (R7). More skilled workers may experience insecurity and uncertainty about their roles and responsibilities in the presence of skilled colleagues. The lack of confidence can manifest in many ways, including fear of operating machinery or taking on additional responsibilities. As a result, the work environment may become tense and inefficient, with less skilled workers hesitant to take on tasks beyond their comfort zone. This reluctance can lead to a bottleneck in the production process, as tasks may remain uncompleted or require additional oversight from supervisors. Furthermore, the lack of confidence among less skilled workers may hinder their ability to collaborate effectively with their colleagues, resulting in communication breakdowns and decreased productivity.

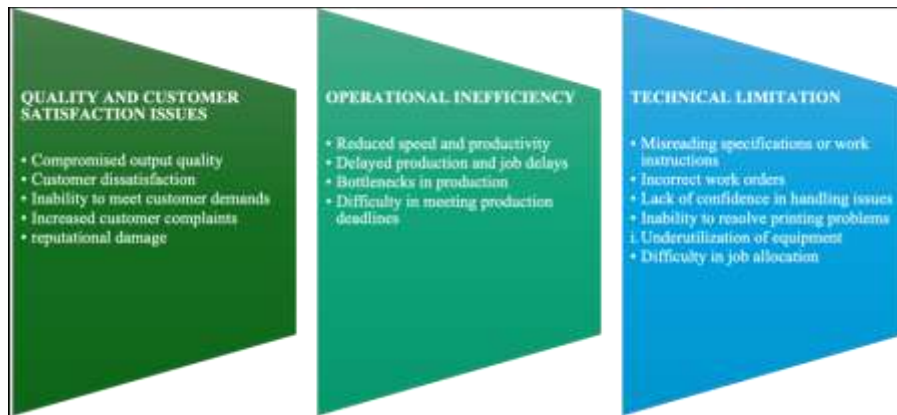


Fig. 1. The challenges of skilled worker shortages

4.3 Strategies to Overcome Skilled Worker Shortages

During the interviews, respondents highlighted several key strategies employed within their organisations to address the challenges of skilled worker shortages in the printing industry. These strategies primarily revolved around effective human resource management, skills development and training initiatives, and the strategic outsourcing of specific job functions.

4.3.1 Strategy 1: Effective Human Resources Management

In order to effectively address the shortage of skilled workers within their printing company, respondents have outlined a comprehensive approach centred around effective human resource management. Attracting the best talent begins with strategic talent acquisition efforts, including initiatives such as providing internship programs where candidates who meet the desired criteria are offered employment immediately upon completion of the training. As stated by an HR manager, “We actively collaborate with

vocational colleges and polytechnics to offer industrial training, and those who perform well are absorbed as permanent employees” (R2).

Additionally, active job postings on platforms like Jobstreet and participation in job fairs broaden the candidate pool. The company maintains close partnerships with educational institutions and training centres to guarantee a steady supply of qualified and skilled labour. At the same time, by establishing close relationships with educational institutions such as vocational colleges, polytechnics, and universities, printing companies have the opportunity to play an active role in shaping educational curricula and training programs that are more suited to the needs of the industry. This allows graduates to be equipped with relevant knowledge and skills before entering the job market, reducing the gap between formal education and real industry needs.

Furthermore, offering competitive compensation packages is paramount. Respondents prioritise providing higher salaries, particularly in regions like Klang Valley, with higher living costs, to retain existing staff and entice new talent. They also include attractive job offers with favourable terms and opportunities for career progression. Creating a positive workplace culture is equally essential, with leadership demonstrating a commitment to hands-on involvement in operations. Emphasising hospitality and support, the company ensures employees feel valued through comfortable facilities and amenities, fostering a cohesive team environment. Retaining experienced senior operators is crucial to this cohesion, as they play pivotal roles in operational management and mentoring junior staff.

Moreover, the company values nurturing solid relationships among staff and fostering spiritual fulfilment, integrating practices such as congregational prayers and religious gatherings into the workplace. By implementing these multifaceted strategies, respondents aim to address the shortage of skilled workers and cultivate a supportive and conducive work environment for employees to thrive and grow professionally.

In addition, printing companies also see foreign workers as another strategy for this issue. Although foreign workers may not have a background in the printing industry, their quick learning skills are often valued. The ability to quickly absorb new knowledge and skills can be a valuable asset in overcoming the shortage of skilled workers. Through a structured learning program and continuous supervision, foreign workers can gain an in-depth understanding of company operations and printing processes, making valuable contributions to the work team in a relatively short period. So, while it may take extra effort to get them started in the industry, their ability to learn quickly makes them valuable in filling the workforce gaps.

Effective human resource management directly addresses the root cause of the shortage of skilled workers in the printing industry. To address employment practices, initiatives such as internship programs and collaborations with training centres provide aspiring professionals with practical experience, bridging the gap between formal education and industry needs. Cooperation with training institutes ensures graduates are equipped with the necessary skills, while competitive compensation packages and a positive workplace culture attract and retain skilled workers, countering negative industry perceptions. Furthermore, the influx of foreign workers with quick learning skills helps fill immediate gaps, diversify the workforce, and challenge stereotypes. By implementing this multifaceted strategy, printing companies can foster a skilled workforce and overcome shortages, fostering a more inclusive and dynamic industry.

4.3.2 Strategy 2: Skills Development and Training Initiatives

Respondents also highlighted the significance of skills development and training in tackling the shortage of skilled workers in the industry. According to one respondent, “Every year we require all operators to attend internal training and external courses related to new technology” (R6). Within this realm, mentorship or peer systems emerged as a crucial strategy, facilitating guidance between seasoned

employees and those with less experience. This is done through various methods, including a peer system where more experienced employees advise those new to the field. In addition, implementing on-the-job training and preparing an annual training plan ensure that employees receive regular training to improve their skills. Online training is also organized, including a structured learning plan within the company and a joint training program with CIAST. In addition, to motivate employees, a salary scheme was introduced to encourage them to achieve higher skill levels. At the same time, other incentives were also provided to encourage them to develop their skills. By applying this strategy, printing companies can help their employees acquire the necessary skills and improve their abilities in performing the assigned tasks. The importance of managerial coaching as part of employee development is also supported by recent empirical research, which found that managerial coaching has a significant positive effect on employee task proficiency—including improvements in both tacit knowledge and role clarity (Mohamad, 2025). This suggests that implementing structured coaching practices, where supervisors actively guide and inspire employees, can directly enhance the effectiveness and adaptability of the printing workforce.

The skills development and training initiatives outlined directly tackle the causes of skilled worker shortages in the printing industry, addressing impacts on quality, customer satisfaction, production efficiency, communication breakdowns, and employee confidence. Through mentorship programs and on-the-job training, printing companies ensure employees receive guidance to enhance skills and workmanship, leading to higher-quality output. These initiatives also improve employees' ability to meet customer demands effectively, reducing delays and errors, thus increasing overall customer satisfaction. Furthermore, skills development initiatives minimize production bottlenecks and job delays by focusing on improving work speed, productivity, and operational efficiency. Clear communication training minimizes errors and inaccuracies, while direct training opportunities and continuous development foster employee confidence, reducing fears associated with operating machinery and improving overall job satisfaction. Overall, these initiatives are crucial in addressing skilled worker shortages, enhancing employee skills, and fostering a more efficient and satisfied workforce in the printing industry.

4.3.3 Strategy 3: Technology advancement

One strategic approach printing company adopt to address skill worker shortages is leveraging technology advancement. A production manager explained, “Investment in new digital machines allows us to reduce reliance on skilled workers, as these machines are easier for new staff to operate after brief training” (R4). With rapid technological progressions in the printing industry, automation and digitalisation play pivotal roles in streamlining operations and reducing the dependency on manual labour. Printing companies invest in advanced printing technologies such as digital printing presses, computer-to-plate systems, and automated finishing equipment. These technologies enhance efficiency and productivity and require less specialised skills to operate, thus mitigating the impact of skill shortages. Additionally, adopting innovative software solutions for design, prepress, and workflow management facilitates seamless collaboration and minimizes the need for highly skilled technicians.

With the incorporation of new technologies, these advanced machine suppliers are also committed to providing continuous training and upskilling programs for their workforce. This initiative aims to equip employees with technical competencies to operate advanced technologies effectively. Employee training focuses on familiarizing them with new software interfaces, troubleshooting procedures and optimizing workflow processes. As a result, printing companies can bridge the skills gap and foster an adaptable workforce that can take full advantage of technological advances. This dual strategy, encompassing technology investment and workforce development, addresses immediate skills shortages and positions in printing companies to thrive in an increasingly digital and automated landscape.

4.3.3 Strategy 4: Outsourcing

A common approach adopted by printing companies facing a shortage of skilled workers is outsourcing the work to other printing companies with the necessary skills and expertise. As one respondent shared, “When there are orders requiring special skills, we outsource to partner companies with the necessary expertise” (R8). This strategy involves entrusting specific tasks or projects to external partners with the necessary capabilities and resources. Outsourcing involves contracting specific tasks or functions to an outside vendor or service provider rather than handling them in-house. In the context of the printing industry, when printing companies lack skilled workers with specific expertise or face capacity constraints, they choose to outsource specific jobs to other printing companies.

The outsourcing process usually begins with assessing the company's internal capabilities and identifying areas with a shortage of skilled workers or specialized equipment. Once these areas are identified, companies look for printing companies with the necessary skills, equipment and capacity to handle the outsourcing work. Negotiating contracts and agreements with selected outsourcing partners is an essential step in the process. This agreement specifies the scope of work, quality standards, timelines, prices and other terms and conditions that govern the outsourcing arrangement. Clear communication and a shared understanding of expectations are essential during this phase. The original printing company retains oversight and quality control responsibility throughout the outsourcing process. They monitor the progress of the outsourced work, conduct quality checks, and ensure that the final output meets the required standards before being delivered to the client. After the outsourcing project is completed, the original printing company evaluates the outsourcing partner's performance. This evaluation helps them determine the effectiveness of the outsourcing arrangement and whether to continue or modify the partnership in the future.

Outsourcing jobs to other printing companies can help address skill shortages and capacity constraints while ensuring timely delivery and maintaining quality standards. It allows printing companies to leverage external expertise and resources to meet customer demands effectively.

Table 1: Strategy in addressing shortages by industry expert

SKILLED WORKERS SHORTAGES IN PRINTING INDUSTRY	
CAUSES Employment Practices Demand for experienced workers Lack of direct training Insufficient opportunities for development Low pay Printing Training Institutes and Education Failure to address critical skill areas Lack of exposure to industry technologies Inadequate collaboration between institutes and industry players Industry Perceptions Negative perception of the industry Diminished interest among students Dominance of foreign workers	CHALLENGES Impact on Quality Poor workmanship Low-quality output Customer Satisfaction Inability to meet customer demand Increase in customer complaints Production Efficiency Decreased work speed and productivity Production bottlenecks and job delays Communication Breakdowns Misinterpretation of specifications Errors and inaccuracies in production Employee Confidence Feelings of insecurity and uncertainty Fear of operating machinery

PRINTING INDUSTRY STRATEGIES			
Strategy 1: Human Resource Management • Talent Acquisition • Employee Retention • Employee Well-being • Incentive Programs	Strategy 2: Skills Development and Training • Skills Development • Collaboration with Training Providers	Strategy 3: Technology advancement • Continuous training and upskilling programs provided by technological vendor	Strategy 4: Outsourcing • Outsource the work to other printing companies that have the necessary skills and expertise.
THE RESULTS			
• Pipeline of qualified candidates • Reduced gap between education and industry needs • Attract and retain skilled workers • Positive work environment • Sense of belonging and fulfillment among employees • Quick learning skills fill workforce gaps • Diversified workforce, challenging stereotypes • Bridged gap between education and industry needs • Countered negative industry perceptions • Fostered skilled and inclusive workforce	• Improved guidance and skill development • Skill enhancement • Accessible learning via digital platforms • Collaborative learning with industry partners • Workforce incentivized for skill development • Better workmanship for higher-quality output • Improved ability to meet customer demands, enhancing satisfaction • Increased work speed, productivity, and operational efficiency • Reduced errors and inaccuracies with clear communication training • Enhanced confidence and job satisfaction, less fear of operating machinery	• Streamlined operations and reduced dependency on manual labor • Increased efficiency and productivity • Mitigated impact of skill shortages • Equipped workforce with technical competencies • Familiarized employees with new software interfaces • Optimized workflow processes • Bridged the skills gap and fostered adaptability	• Address skill shortages and capacity constraints • Ensure timely delivery of projects • Maintain standards quality • Leverage external expertise and resources • Monitor progress and conduct quality checks throughout the outsourcing process • Evaluate performance of outsourcing partner for future collaboration

4.3.4 Future Challenges for Printing Workforce

As the printing industry navigates a landscape of rapid technological advancement, changing consumer preferences, and global competition, several challenges will impact the printing workforce. One significant challenge arises from the technological disruption, with advancements in digital printing, automation, and artificial intelligence reshaping industry practices. While these innovations offer efficiency and quality improvement opportunities, they also necessitate upskilling or reskilling among traditional printing workers to remain relevant in an increasingly digital-centric environment. Moreover, demographic shifts, including an ageing workforce and waning interest among younger generations in manufacturing careers, may exacerbate skilled worker shortages. Addressing this demographic challenge will require targeted recruitment and retention strategies alongside efforts to promote the industry as an attractive career option.

Additionally, sustainability concerns are gaining prominence, prompting the need for environmentally sustainable practices and green technologies within the printing sector. Meeting these demands may require additional training for printing workers to ensure compliance with sustainability standards. Furthermore, globalization intensifies competition, necessitating technical skills, cultural competency, and adaptability among printing workers to thrive in a global marketplace. It is important to note that the situation is dynamic, and what works now may not work later. Therefore, proactive planning, investment, and collaboration between industry stakeholders, training providers, and policymakers are essential to address these challenges and ensure the continued viability and competitiveness of the printing workforce.

5. SUGGESTION FOR FUTURE RESEARCH

The study highlights key areas for further investigation to address the skilled worker shortage in the Malaysian printing industry. One critical area is the impact of technological advancements, such as AI, automation, and digital printing, on skill requirements. Understanding these future needs is essential for workforce and educational program preparation. Another focus is evaluating education-industry partnerships, which could help align curricula with industry needs and improve skilled worker development pathways. Comparative analysis with other countries' printing industries could reveal adaptable strategies for Malaysia.

Psychological factors influencing career choices in printing also need exploration to improve recruitment strategies and attract talent. Additionally, quantitative research on the economic impact of skilled worker shortages could justify increased investment in workforce development. Longitudinal qualitative studies tracking workers' career trajectories would offer insights into retention, skill development, and career progression. Action research with printing companies could assess the effectiveness of intervention strategies. Finally, comparative case studies of companies that have successfully addressed skilled worker shortages would provide best practices and transferable solutions. Future research in these areas can provide valuable insights to help the industry adapt to technological and societal changes, ensuring its long-term sustainability and competitiveness.

6. CONCLUSION

The shortage of skilled workers in the printing industry poses multifaceted challenges that require strategic interventions to mitigate. Through qualitative analysis of interviews with industry stakeholders, it became evident that issues such as inadequate training, low compensation, and limited skill development opportunities contribute to the need for more skilled workers. However, adaptable strategies such as talent acquisition, employee retention, and collaboration with training providers offer viable solutions. Furthermore, addressing future challenges, including technological disruption and demographic shifts, is essential through proactive planning and collaboration. By implementing these strategies and adapting to evolving market dynamics, the printing industry can overcome skilled worker shortages and position itself for sustained growth and competitiveness in the future. As one interviewee summarized, "If we can't solve this shortage, not only will our profits suffer, but the whole industry's reputation and ability to innovate will be at risk." (R3)

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CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

AUTHORS' CONTRIBUTIONS

Norizzati Abd Latif carried out the research, wrote and revised the article. Noor Azly Mohammed Ali conceptualised the central research idea, provided the theoretical framework, designed the research and supervised the research progress. Noor Azly Mohammed Ali also anchored the review, revisions, and approved the article submission.

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