

EVALUATING THE SUCCESS RATES OF THE ASSESSMENT OF PROFESSIONAL COMPETENCE (APC): INSIGHTS AND IMPLICATIONS FOR PROFESSIONAL DEVELOPMENT

MOLUSIWA STEPHAN RAMABODU

Construction Management and Quantity Surveying, Faculty of Engineering and the Built, Environment, Durban University of Technology. Email: molusiwar@dut.ac.za

Abstract

This study examines success rates in the Assessment of Professional Competence (APC) for quantity surveyors in South Africa, focusing on demographic influences on candidates' outcomes. Employing a post-positivist philosophical stance, the research uses a quantitative methodology to conduct a systematic analysis of institutional records from the South African Council for the Quantity Surveying Profession (SACQSP). Data from 2019 and 2020 APC assessments were analyzed based on race, gender, and geographic location, providing a comprehensive view of success rates across demographic groups. Additionally, this study assesses the impact of the Professional Skills Modules (PSM), designed for candidates without an accredited Honours degree, on APC outcomes. Statistical tests, including binary regression and Chi-square, were utilized to identify potential patterns and disparities in success rates. Findings suggest that demographic factors may influence APC outcomes, highlighting the need for measures that ensure fairness and accessibility in professional competency assessments. This research contributes to the ongoing conversation about inclusivity and professional development within the quantity surveying field, advocating for reforms that uphold excellence as the primary standard for achieving professional recognition. Through these insights, the study aims to enhance support structures for current and future professionals, fostering equitable opportunities in the evolving landscape of quantity surveying.

Keywords: Assessment of Professional Competence (APC), APC Success Rates, Professional Competence Evaluation, Professional Development, Competency Assessment, APC Training Outcomes.

INTRODUCTION

The Assessment of Professional Competence (APC) is a pivotal component in many professions, serving as the gateway to full professional recognition (Dada and Jagboro, 2012)(Witt et al., 2013). Established by professional bodies such as the Royal Institution of Chartered Surveyors (RICS) and other regulatory authorities in sectors like engineering, architecture, construction, and real estate, the APC aims to validate an individual's ability to apply theoretical knowledge in real-world settings, demonstrating professional competence and ethical integrity(Ameh and Odusami, 2014) (Mooya, 2015).

As industries become increasingly complex and interconnected, the APC has evolved to incorporate both traditional assessment criteria and emerging competencies in areas like digital technologies, sustainability, and risk management (Fadhel and Jasim, 2019). Success in this assessment, therefore, not only confirms professional status but also signals a readiness to contribute effectively to the evolving demands of the profession.

In many ways, the APC represents the culmination of years of education, practical experience, and continuous professional development (Fadhel and Jasim, 2019); (Pietrafesa et al., 2021).





It is a process that tests candidates' technical knowledge, professional judgment, interpersonal skills, and their ability to apply these in practical contexts (Saputra et al., 2022).

This rigorous evaluation ensures that those who attain professional status meet the high standards expected by their industries and are equipped to deliver quality services that uphold the integrity and reputation of their professions (Matjie, 2018)(Zanni et al., 2013). However, despite its critical role in professional certification, the success rates of APC candidates vary widely across industries, regions, and even among professional bodies. These disparities raise important questions about the factors influencing APC outcomes and how they can be addressed to enhance the professional development landscape (Musonda and Okoro, 2021).

In the context of the built environment, for example, the APC is recognized as a major stepping stone toward chartered status, enabling professionals to practice independently and be acknowledged as experts in their fields (Toyin and Mewomo, 2023) (Onososen and Musonda, 2022a). Attaining this status has significant implications not only for the individual's career prospects but also for the wider industry, as it directly influences the quality and professionalism of services delivered to clients and stakeholders (Ijagbemi et al., 2017) (Connelly et al., 2018).

As the built environment faces new challenges—ranging from sustainability and climate change to digital transformation and global competition—the role of competent professionals becomes even more critical. Thus, understanding the factors that contribute to APC success or failure is vital for both aspiring professionals and the institutions that train them (Saputra et al., 2022).

Despite the clear importance of the APC in professional trajectories, research on the success rates of APC candidates and the factors influencing these outcomes remains relatively sparse. The limited body of literature that does exist often focuses narrowly on specific professions or geographic regions, leaving a gap in our understanding of the broader trends and variables that may affect success rates across diverse sectors and countries (Ijagbemi et al., 2017) (Yap et al., 2022). Moreover, the existing research tends to focus on immediate factors such as exam preparation and mentoring, without fully considering the wider socio-economic, institutional, and individual factors that can significantly impact performance (Lee, 2020) (Al-Ruwaishedi et al., 2024).

This gap highlights the need for a more comprehensive evaluation of the APC process and its implications for professional development. The primary objective of this study is to evaluate the success rates of candidates undergoing the APC process and to provide insights into the key factors that contribute to both successful and unsuccessful outcomes (Mooya, 2015) (Onososen and Musonda, 2022b). This research will examine several variables that influence APC performance, will consider the broader implications for professional bodies, training institutions, and policymakers in terms of how APC processes can be optimized to better support candidates, especially in light of emerging challenges such as technological advancements and shifts in industry expectations.





The study is driven by the hypothesis that while technical knowledge and practical experience are critical to APC success, other less tangible factors—such as the support structure provided by employers, access to resources for continuous learning, and the individual's ability to adapt to new challenges—also play a crucial role. Furthermore, we posit that discrepancies in success rates can be partially explained by differences in the preparation and support systems available to candidates from various socio-economic and educational backgrounds (Connelly et al., 2018). For example, candidates who work in well-resourced firms or have access to structured mentorship programs may perform better in the APC than those in smaller firms or those who are self-employed (Glass et al., 2008) (Onososen et al., 2024).

The findings of this study are expected to have significant implications for the way in which professional bodies, educational institutions, and employers approach the APC process. By identifying the factors that contribute to higher success rates, this research can inform the development of more targeted support systems for APC candidates. For instance, professional bodies might consider offering more accessible mentorship programs or revising their APC preparation resources to better reflect the diverse needs of candidates (Hall et al., 2018). Similarly, employers can play a more active role in supporting their employees through the APC process by offering structured professional development opportunities and creating a workplace culture that values continuous learning and skill development.

Moreover, the study's findings will contribute to ongoing debates about the inclusivity and accessibility of the APC process (Fox and Skitmore, 2007). If certain groups—such as candidates from disadvantaged backgrounds or those working in smaller firms—are found to face systemic barriers to success, there may be a need for policy interventions to ensure that the APC process remains fair and equitable. Professional bodies could consider implementing alternative assessment methods that consider the diverse experiences and backgrounds of candidates, while educational institutions might revise their curricula to better prepare students for the practical realities of the APC and professional life.

RESEARCH METHOD

This study employed a post-positivist philosophical stance, focusing on uncovering patterns in professional competency assessment outcomes through systematic analysis of documentary evidence (Akinradewo et al., 2018); (Onososen et al., 2023). Post-positivism allows for a critical, objective approach to observable data while recognizing potential biases (Tjebane et al., 2023); (Maharaj et al., 2023).

This perspective informed the choice of a quantitative research design, facilitating an empirical evaluation of success rates in the Assessment of Professional Competence (APC) for quantity surveyors in South Africa. Quantitative research approach was adopted, grounded in documentary analysis of institutional records (Makhathini et al., 2023). This approach aligns with Creswell's (2014) definition of quantitative methods, emphasizing the collection and analysis of numerical data that can be organized, classified, and evaluated (Schultz, 2010) (Musonda et al., 2023).





Data was obtained from the South African Council for the Quantity Surveying Profession (SACQSP), a statutory body established under the Quantity Surveying Profession Act, 2000 (Act 49 of 2000). As the regulatory authority for the quantity surveying (QS) profession in South Africa, SACQSP was deemed the most appropriate source for reliable data on competency skills in the field. Data collection focused on the success rates of candidates in the APC interview, covering records from 2019 and 2020. Data were categorized by race (African, Asian, Coloured, White), gender (Male, Female), and province within South Africa, allowing for demographic analysis. The data also included information on unsuccessful candidates, providing a basis for comparative analysis across demographic groups (Scoresby et al., 2023) (Arowoiya et al., 2024). The target population for this study comprised quantity surveying professionals from the Gauteng province.

This population was chosen because quantity surveyors in this region are directly involved in the construction process and decision-making in the built environment (Ebekozien et al., 2023) (Ferlito et al., 2022). The sample was selected to reflect the professional groups most likely impacted by and invested in the APC's outcomes and professional competency standards. Data analysis was conducted using Microsoft Excel and the Statistical Package for Social Sciences (SPSS)(SPSS Inc., 2007) (Tjebane et al., 2022). Excel was used for initial data organization and categorization, while SPSS facilitated advanced statistical analysis. This combination of tools enabled efficient data handling, enabling the identification of patterns and trends across demographic variables in the APC success rates (Liphadzi et al., 2022); (Badamasi et al., 2022).

Descriptive and inferential statistics were applied to examine the relationships between candidate demographics and APC outcomes, with results interpreted in the context of professional development implications for the quantity surveying field (Zegeye, 2017). Ethical clearance was obtained from relevant authorities to access and analyze institutional records. Data were anonymized to protect individual identities, ensuring confidentiality and adherence to ethical research standards. This methodological framework supports a robust examination of factors influencing APC success rates and offers valuable insights into competency development within the South African quantity surveying profession.

FINDINGS AND DISCUSSION

Success rates of candidates who were successful in the Assessment of Professional Competence (APC) interview in 2020

Figure 1 provides success rates of candidates who were successful in the Assessment of Professional Competence (APC) interview in 2020. The data is categorized by race (African, Asian, Coloured, White) and gender (Male, Female). Among African candidates, 60% of successful candidates were female and 31% were male. A significant 92% of successful Asian candidates were male, while only 8% were female. This group had a relatively small sample, with 5.1% male and 2.4% female. White candidates: 57.1% of successful White candidates were male, while 32% were female. The significant gender gap in some racial groups, especially among Asian candidates, suggests the need for targeted initiatives to support female candidates in professional development programs.





The varying success rates across racial groups point to possible systemic inequalities or barriers to access for certain groups (like Coloured candidates). This may suggest a need for more inclusive support systems and preparatory programs to level the playing field. The relatively higher success of African candidates, especially females, may indicate the positive impact of diversity and inclusion efforts in some regions. Continuing to focus on policies that promote diverse talent development can help in fostering professional growth.





Unsuccessful Candidates by Gender and Race

In figure 2, are the unsuccessful candidates for the Assessment of Professional Competence (APC) interview in October 2020. A high proportion of unsuccessful African candidates were female (92.9%), compared to 65% male. This suggests a disparity where African females may have faced more challenges in passing the APC interview, despite their strong showing in the previous success chart. Among White candidates, only 7.1% of unsuccessful candidates were female, with a larger portion of unsuccessful candidates being male (25%). This indicates that White males had a higher failure rate relative to females. Both groups had very low percentages of unsuccessful candidates, with 5% each for both male and female. The data shows that while African women made up a large percentage of the successful candidates, they also experienced the highest failure rates.

This could indicate that despite significant strides, African women may still face barriers in preparation, access to resources, or other systemic factors. This points to a need for enhanced support systems, mentorship, or tailored training programs for this group. The higher failure rate for White male candidates suggests that males in this demographic may also require targeted support or that different preparation strategies could be more effective. While White





females had lower representation among unsuccessful candidates, it's important to assess whether support mechanisms in place are effectively aiding their success. The consistently small percentages for Asian and Coloured candidates across both successful and unsuccessful categories may suggest underrepresentation in the APC process as a whole. Professional development efforts should consider strategies for increasing participation and success rates among these groups, ensuring that opportunities for advancement are more inclusive. By addressing these disparities, organizations can work toward creating a more equitable pathway for all candidates in the APC process, ensuring that professional development programs are inclusive and tailored to the needs of diverse populations.



Figure 2: Unsuccessful Candidates based on race

Unsuccessful APC candidates by Province

Figure 3. Presents data on unsuccessful APC candidates in October 2020, broken down by province and gender (Male and Female). This information is crucial for understanding regional differences in APC success rates and the implications for professional development strategies across South Africa. 50% of unsuccessful candidates from Gauteng were female, the highest proportion of female failures across all provinces. Males also accounted for 30% of unsuccessful candidates in Gauteng, highlighting the province as having a significant number of unsuccessful candidates overall. In Eastern Cape, the failure rate for females is 15%, while males account for 50% of the unsuccessful candidates, indicating a significant gap between male and female outcomes while in Western Cape, the percentage of unsuccessful candidates is also skewed, with 25% male and 14.3% female. While females fared better than males here, both genders experienced notable failures. In KZN, the data shows a more balanced gender distribution, with 15% female and 10% male candidates failing while Limpopo and Mpumalanga have very low percentages of unsuccessful candidates, which may be attributed





to lower participation rates in the APC interview process. In Mpumalanga, 7.1% of males failed. Interestingly, Northwest had 14.3% of females fail, while no males from this province were recorded as failing, suggesting either a very small male candidate pool or a strong performance by male candidates. In Free State: Failure rates are quite even, with 10% male and 14.3% female candidates being unsuccessful. The high failure rate of females (50%) compared to males (30%) suggests that Gauteng female candidates may face unique challenges in passing the APC interview. Further investigation into the training resources, mentorship, and preparation strategies available to female candidates in this region would be essential. Similarly, the disparity in male (50%) and female (15%) failure rates suggests that males in the Eastern Cape May require more targeted support in professional development programs. KwaZulu-Natal and Free State show a more balanced distribution of unsuccessful candidates across genders, implying that professional development efforts may be more equitable or effective in these regions. However, attention should still be given to reducing the overall failure rates. Limpopo and Mpumalanga show low percentages of unsuccessful candidates, which may suggest smaller candidate pools or higher success rates. However, the low representation also indicates a need to investigate the level of participation in APC interviews from these provinces and ensure that opportunities for professional development are widespread. In the Western Cape, the failure rate for males is higher than females (25% vs. 14.3%), which contrasts with other regions where females tend to have higher failure rates. This could indicate specific local factors affecting the professional development of male candidates, warranting further exploration.



Figure 3: Unsuccessful Candidates based on province





DOI: 10.5281/zenodo.14234840



Figure 4: Successful Candidates based on programs



Percentage of unsuccessful candidate during the APC interview in May and October.

Figure 5: Unsuccessful Candidates in 2020 based on race







Percentage of unsuccessful candidate during the APC interview in May and October.

Figure 6: Unsuccessful Candidates in 2020 based on sex

Binary Logistic Regression and Chi-squared Test

	Explanation of Binary	y Logisti	c Regression	and Chi-s	quared Test
--	-----------------------	-----------	--------------	-----------	-------------

Factors	N (%)	Odds Ratio (OR)	95% CI for OR	P-value
Race				
African	86 (48)	0.374	(0.19, 0.73)	0.004**
White	75 (41.9)	2.4	(1.20, 4.80)	0.013*
Other	18 (10.1)	1		
Sex				
Male	111 (62)	1.18	(0.61, 2.27)	0.618
Female	68 (38)	1		

Binary Logistic Regression

Binary Logistic Regression is a statistical method used to model the relationship between a binary dependent variable (in this case, pass/fail) and one or more independent variables (factors such as race and sex). This method estimates the probability of the dependent variable occurring (e.g., passing the interview) based on the independent variables. Odds Ratio (OR): The odds ratio is a measure of association between an exposure (or factor) and an outcome. It represents the odds of the outcome occurring for a particular group compared to the odds for a reference group. An OR greater than 1 indicates a higher likelihood of the outcome, while an OR less than 1 indicates a lower likelihood. 95% Confidence Interval (CI) estimates the uncertainty around the OR. If the CI does not include 1, it suggests that the association is statistically significant. The p-value indicates the probability of observing the results given that the null hypothesis is true. A p-value less than 0.05 (often denoted with ** or *) suggests a statistically significant association.





The Chi-squared test is a statistical test used to determine whether there is a significant association between categorical variables. In this context, it helps assess whether race and sex have an impact on the binary outcome (passing or failing the interview). If the test shows a significant association, it suggests that the variables are not independent of each other. The odds ratio of 0.374 indicates that Africans are significantly less likely to pass the interview compared to the reference group (Other), with a p-value of 0.004 suggesting a strong statistical significance. The odds ratio of 2.4 indicates that Whites are 2.4 times more likely to pass the interview compared to the other race group, with a p-value of 0.013, which is also statistically significant. This group serves as the reference category, meaning their odds are set at 1 for comparison. The odds ratio of 1.18 indicates a slightly higher likelihood of males passing the interview, but the p-value of 0.618 suggests that this association is not statistically significant. This group serves as the reference, and the analysis indicates no significant difference in passing rates compared to males.

The results of this analysis reveal important insights into the factors influencing success rates in the interview process, particularly in the context of the Assessment of Professional Competence (APC) (Sapti et al., 2019). The strong statistical association between race and interview outcomes highlights systemic disparities that warrant attention (Ijagbemi et al., 2017). The data indicate that being African significantly decreases the likelihood of passing the interview, while being White notably increases that likelihood (Ameh and Odusami, 2014). This could reflect broader societal inequalities and biases present within the assessment processes, suggesting that race plays a crucial role in opportunities for professional development (Lee, 2020). The analysis indicates that sex does not significantly impact passing rates. This finding suggests that, at least in this context, the interview process may be relatively equitable concerning gender.

The findings prompt a need for further investigation into the reasons behind the disparities based on race (Yap et al., 2022). Organizations may need to examine their recruitment and assessment practices to ensure they are fair and unbiased (Pietrafesa et al., 2021). Implementing training for assessors on implicit bias and creating more inclusive evaluation criteria could help level the playing field. Professional development programs could be designed to specifically support individuals from underrepresented racial backgrounds (Yap et al., 2022). This may include mentorship opportunities, preparatory workshops, or resources aimed at equipping candidates with the skills and confidence needed to succeed in the interview process (Naidoo, 2004).

Organizations should consider revising their policies to ensure that the selection criteria and assessment methods are transparent, equitable, and conducive to promoting diversity and inclusion within the profession (Aigbavboa et al., 2020). The results underscore the importance of continuous monitoring and research into the factors affecting professional competence assessments (Chegu Badrinath et al., 2016). Future studies could expand the scope to include additional variables and a more diverse participant pool to gain a comprehensive understanding of the dynamics at play (Khanh et al., 2021). In conclusion, while the analysis highlights a troubling trend regarding race and passing rates in the interview process, it also provides an





opportunity for organizations to critically reflect on their practices and implement meaningful changes that promote equity and professional growth for all individuals.



Figure 7: Successful Candidates in 2020 based on province and sex



Figure 8: Unsuccessful Candidates in 2020 based on race and sex







Figure 9: Unsuccessful Candidates in 2020 based on sex and province



Figure 10: Successful Candidates in 2020 based on race and sex





CONCLUSION

In conclusion, the report in figure 1 to 10 represents the Assessment of Professional Competence remains a cornerstone of professional certification, with far-reaching implications for both individual careers and the broader industry. However, despite its importance, the factors influencing APC success rates remain underexplored. By evaluating these factors and their broader implications, this study seeks to contribute to a more nuanced understanding of how professional development can be optimized to support both current and future professionals in meeting the evolving demands of their industries. As the landscape of professional work continues to shift, ensuring that the APC remains a robust, fair, and accessible process will be critical to the sustained success of professions globally.

The journey toward professional registration as a Quantity Surveyor is a rigorous process that culminates in the Assessment of Professional Competence (APC) interview, a decisive step that determines a candidate's readiness to join the ranks of registered professionals. This final interview represents not only the culmination of years of education and practical experience but also a critical gateway through which aspiring professionals must pass.

For candidates without an Honours degree from an accredited institution, the South African Council for the Quantity Surveying Profession (SACQSP) has developed the Professional Skills Modules (PSM). These modules serve to bridge the knowledge gap, providing candidates with the essential skills and theoretical knowledge required to meet the standards of the profession. Once these modules are completed and the requisite minimum experience has been gained, candidates become eligible to sit for the APC interview. A successful outcome in this interview grants the coveted title of professional Quantity Surveyor, opening doors to new opportunities and recognition in the industry.

This paper investigates deep into an analysis of the success rates of the APC interviews, with a focus on how demographic factors such as gender, race, and geographic location (province) influence candidates' outcomes. By evaluating data collected from the 2019 and 2020 APC assessments, this study offers critical insights into the disparities and patterns that may exist in the success rates of candidates. The analysis includes a comprehensive review of the following key datasets:

- Successful candidates from the APC interviews in 2019 (both May and October assessments)
- Successful candidates from the APC interviews in 2020 (both May and October assessments)
- Unsuccessful candidates from the APC interviews in 2019 and 2020
- Pass rates for the Professional Skills Modules (PSM) in 2019

To further refine the analysis, binary regression and Chi-square tests have been employed to identify statistically significant trends. The aim is to uncover whether systemic factors such as gender or race may influence success rates and to provide a foundation for understanding how





professional competency can be more equitably achieved. This study not only seeks to shed light on the current state of professional competency assessments in South Africa but also aims to inspire reforms that foster inclusivity and equal opportunity for all aspiring professionals, ensuring that excellence, rather than external circumstances, determines the future leaders of the quantity surveying profession.

References

- 1) Aigbavboa, C.O., Oke, A.E., Aghimien, D.O., Akinradewo, O.I., 2020. Improving resilience of cities through smart city drivers. Constr. Econ. Build. 20, 45–64.
- Akinradewo, O., Oke, A., Aigbavboa, C., Mashangoane, M., 2018. Willingness to Adopt Robotics and Construction Automation in the South African Construction Industry. In: Proceedings of the International Conference on Industrial Engineering and Operations Management.
- 3) Al-Ruwaishedi, M.R., Khraisat, D., Taib, N., Azzam, E., 2024. In-Depth Survey on Using BIM Digital Technologies in Jordanian Architectural Industry. Civ. Eng. Archit. 12, 2744–2754.
- 4) Ameh, O.J., Odusami, K.T., 2014. Nigerian construction professional's education and deficiencies in the area of project management. J. Constr. Dev. Ctries. 19, 1–14.
- 5) Arowoiya, V.A., Onososen, A.O., Moehler, R.C., Fang, Y., 2024. Influence of Thermal Comfort on Energy Consumption for Building Occupants: The Current State of the Art. Buildings 14, 1310.
- 6) Badamasi, A.A., Aryal, K.R., Makarfi, U.U., Dodo, M., 2022. Drivers and barriers of virtual reality adoption in UK AEC industry. Eng. Constr. Archit. Manag. 29, 1307–1318.
- 7) Chegu Badrinath, A., Chang, Y.T., Hsieh, S.H., 2016. A review of tertiary BIM education for advanced engineering communication with visualization. Vis. Eng. 4, 1–17.
- 8) Connelly, B.L., Crook, T.R., Combs, J.G., Ketchen, D., Aguinis, H., 2018. Competence- and Integrity-Based Trust in Interorganizational Relationships : Which Matters More ? J. Manage. 44, 919–945.
- Dada, J.O., Jagboro, G.O., 2012. Core skills requirement and competencies expected of quantity surveyors: Perspectives from quantity surveyors, allied professionals and clients in Nigeria. Australas. J. Constr. Econ. Build. 12, 78–90.
- 10) Ebekozien, A., Aigbavboa, C.O., Adekunle, S.A., Aliu, J., Thwala, W.D., 2023. Training needs of built environment professionals: the role of fourth industrial revolution. Eng. Constr. Archit. Manag.
- 11) Fadhel, A., Jasim, A., 2019. Conceptual skills in leading change: A competence approach to public sector leadership. Br. Univ. Dubai.
- 12) Ferlito, T.-L., Musonda, I., Tjebane, M.M., Onososen, A.O., 2022. Systematic Literature Review on Sustainable Construction Strategies for the Development of Affordable Housing. In: The Twelfth International Conference on Construction in the 21st Century (CITC-12. pp. 195–203.
- Fox, P., Skitmore, M., 2007. Factors facilitating construction industry development. Build. Res. Inf. 35, 178– 188.
- Glass, J., Dainty, A.R.J., Gibb, A.G.F., 2008. New build: Materials, techniques, skills and innovation. Energy Policy 36, 4534 – 4538.
- 15) Hall, M., Engler, J., Hemming, J., Alema-Mensah, E., Baez, A., Lawson, K., Quarshie, A., Stiles, J., Pemu, P., Thompson, W., Paulsen, D., Smith, A., Ofili, E., 2018. Using a virtual community (The health equity learning collaboratory) to support early-stage investigators pursuing grant funding. Int. J. Environ. Res. Public Health 15.





- Ijagbemi, C.O., Kanakana, M.G., Campbell, H.M., 2017. Interventions and pathways for South African women in engineering and the built environment professions. African J. Sci. Technol. Innov. Dev. 9, 669– 678.
- 17) Khanh, H.D., Kim, S.Y., Khoa, N. Van, Tu, N.T., 2021. The relationship between workers' experience and productivity: a case study of brick masonry construction. Int. J. Constr. Manag. 0, 1–10.
- 18) Lee, D.-W., 2020. The expertise of public officials and collaborative disaster management. Int. J. Disaster Risk Reduct. 50.
- 19) Liphadzi, M., Musonda, I., Onososen, A.O., 2022. The use of building information modelling tools for effective waste management: A systematic review. In: World Building Congress, IOP Conf. Ser.: Earth Environ. Sci. 1101 062001. IOP.
- 20) Maharaj, R., Musonda, I., Onososen, A., 2023. Construction Organisation's Planning and Implementation: The Case Between Conceptualization and Implementation Teams. Springer 245.
- Makhathini, N., Musonda, I., Onososen, A., 2023. Utilisation of Remote Monitoring Systems in Construction Project Management. In: Haupt, T.C., Akinlolu, M., Simpeh, F., Amoah, C., Armoed, Z. (Ed.), Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster, Development. Springer.
- 22) Matjie, T., 2018. The Relationship between the Leadership Effectiveness and Emotional Competence of Managers in the Public Sector. Int. J. Public Adm. 41, 1271–1278.
- 23) Mooya, M.M., 2015. The education and professional practice of valuers in South Africa: A critical review. Prop. Manag. 33, 245–274.
- 24) Musonda, I., Okoro, C., 2021. Assessment of current and future critical skills in the South African construction industry. High. Educ. Ski. Work. Learn. ahead-of-p.
- 25) Musonda, I., Onososen, A.O., Moyo, T., Tjebane, M.M., 2023. COVID-19 and shock events in the AEC sector-Perspectives on mitigating measures. In: Manu, P., Cheung, C., Yunusa-Kaltungo, A., Emuze, F., Saurin, T.A., Hadikusumo, B.H.W. (Eds.), Construction Safety, Health and Well-Being in the COVID-19 Era. Routledge, New York.
- 26) Naidoo, G., 2004. Leadership and governance for a sustainable public service: The case for selected South African public service organizations 1–399.
- 27) Onososen, A., Musonda, I., Dzuwa, C., 2024. Enhancing Human-Robot Teaming in Construction through the Integration of Virtual Reality-Based Training in Human-Robot Collaboration. In: 41st International Symposium on Automation and Robotics in Construction, ISARC 2024. International Association for Automation and Robotics in Construction (IAARC), pp. 623–630.
- 28) Onososen, A.O., Musonda, I., 2022a. Perceived Benefits of Automation and Artificial Intelligence in the AEC Sector: An Interpretive Structural Modeling Approach. Front. Built Environ. 8, 1–16.
- 29) Onososen, A.O., Musonda, I., 2022b. Ergonomics in construction robotics and human-robot teams in the AEC domain: a review. In: World Building Congress, IOP Conf. Ser.: Earth Environ. Sci. 1101 052003. IOP.
- Onososen, A.O., Musonda, I., Onatayo, D., Tjebane, M.M., Saka, A.B., Fagbenro, R.K., 2023. Impediments to Construction Site Digitalisation Using Unmanned Aerial Vehicles (UAVs). Drones 7, 1–23.
- 31) Pietrafesa, E., Bentivenga, R., Stabile, S., 2021. Emerging technologies for learning in occupational safety and health: The experience of the videogame 'becoming safe'. Int. Conf. High. Educ. Adv. 1011–1018.
- 32) Sapti, M., Pancapalaga, W., Widari, W., 2019. Managing Risk of Construction Projects to Enhance Project Performance Delivery. J. Sains dan Seni ITS 53, 1689–1699.





- 33) Saputra, N., Patrick, G., Ronald, 2022. Digital Competence as a Mediator for the Leadership in Empowering Workforce Agility. In: Proceedings of 2022 International Conference on Information Management and Technology, ICIMTech 2022. Institute of Electrical and Electronics Engineers Inc., pp. 612 – 617.
- 34) Schultz, J., 2010. The road to recovery. Planning 76, 30–33.
- 35) Scoresby, K., Jurney, C., Fackler, A., Tran, C. V, Nugent, W., Strand, E., 2023. Relationships between diversity demographics, psychological distress, and suicidal thinking in the veterinary profession: a nationwide cross-sectional study during COVID-19. Front. Vet. Sci. 10.
- 36) SPSS Inc., 2007. SPSS base 16.0 user's guide.
- 37) Tjebane, M.M., Musonda, I., Onososen, A., 2022. Building Information Modelling Mandates and Government Efforts: A Systematic Review. In: The Twelfth International Conference on Construction in the 21st Century (CITC-12 Amman, Jordan | May 16-19, 2022. pp. 239–247.
- 38) Tjebane, M.M., Musonda, I., Onososen, A., Ramabodu, M., 2023. Challenges for the Implementation of Sustainable Construction Practices in Developing Countries: A Bibliometric Review. In: Advances in Information Technology in Civil and Building Engineering. ICCCBE 2022. Lecture Notes in Civil Engineering, Vol 358. Springer,. Skatulla, S., Beushausen, Switzerland.
- 39) Toyin, J.O., Mewomo, M.C., 2023. Assessing the innovative skills and competencies required of construction management graduates. Organ. Technol. Manag. Constr. 15, 90–106.
- 40) Witt, E., Lill, I., Malalgoda, C., Siriwardena, M., Thayaparan, M., Amaratunga, D., Kaklauskas, A., 2013. Towards a framework for closer university-industry collaboration in educating built environment professionals. Int. J. Strateg. Prop. Manag. 17, 114–132.
- Yap, J.B.H., Skitmore, M., Lim, Y.W., Loo, S.-C., Gray, J., 2022. Assessing the expected current and future competencies of quantity surveyors in the Malaysian built environment. Eng. Constr. Archit. Manag. 29, 2415–2436.
- 42) Zanni, M.-A., Soetanto, R., Ruikar, K., 2013. Exploring the potential of BIM-integrated sustainability assessment in AEC. In: Sustainable Building Conference.
- 43) Zegeye, Y., 2017. case of Employment Equity in the Western Cape Education and Health.

