




Organisational innovation and gender diversity: Insights from the civil engineering industry



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Orientation: The civil engineering industry is vital in ensuring that infrastructure development has a beneficial social, economic, and environmental impact.

Research purpose: This study explored the role of gender diversity and organisational innovation with a view to address social ills in the civil engineering industry in South Africa.

Motivation for the study: The study is premised on the paucity in extant research and responds to calls for more research on the role of gender diversity and organisational innovation with a view to address social ills in the civil engineering industry.

Research design, approach and method: Employing the interpretivist paradigm, 15 civil engineering professionals were purposively selected based on their extensive experience and comprehensive deep knowledge of the industry and interviewed using the semi-structured approach of interviews using the Microsoft Teams (MS Teams) platform. Thematic analysis was used to analyse the interview transcripts.

Main findings: From thematic analysis, the following themes emerged from the primary data: skewed gender representation, females' retention challenges, creation of an inclusive environment, building a strategic female structure, inclusive innovation, and role models and mentors' deficit.

Practical and/or managerial implications: The civil engineering industry needs to empower women occupying positions of power and not just fill the numbers through the removal of the male gatekeeping effect as the current status shows male dominance. It is also critical to create an inclusive environment, grow the pool of females to build the numbers critical for gender diversity, particularly at the top, and promote mentorship opportunities.

Contributions and/or value add: This article advances knowledge on the role of gender diversity and organisational innovation with a view to address social ills in the civil engineering industry and exposes the shared patriarchal values that many organisations appear to promote. It further highlights that society still struggles with infrastructure that does not address its needs and points the civil engineering industry towards the current skill sets and experiences of its female workforce, and how to leverage those capabilities to benefit the industry and the entire society.

Keywords: Organisational innovation; gender diversity; civil engineering; inclusive innovation; social role theory.

Introduction and background

The civil engineering industry is responsible for the planning, design and development of infrastructure. Consequently, it plays a crucial role in ensuring positive social, economic and environmental impacts during infrastructure development. Globally, reports have highlighted numerous challenges facing this industry, including 'inadequate water quality, increasing traffic congestion, poor and degrading infrastructure' (Becerik-Gerber et al. 2014:2), as well as a lack of diversity and a poor record of innovation (Guy 2023). Unfortunately, lack of diversity characterises leadership roles dominated by men in business and society as a whole (Pafford & Schaefer 2017). The civil engineering industry, like many male-dominated sectors, exhibits a marked deficiency in the representation of women in leadership positions. The Commission for Employment Equity (CEE 2023) notes that disparities in this industry are glaringly evident in the primary sector of civil engineering construction. This situation reflects the prevailing gender imbalances within the industry. In male-dominated sectors such as mining, men tend to occupy top-ranking positions (Mashaba & Botha 2023), while women are often overlooked for promotions in what are referred to as 'core mining positions' (Moalusi & Jones 2019).

Some women within the civil engineering industry have expressed concern about a pattern which preserves certain jobs, especially in leadership roles, for one gender at the expense of another (Benschop & Van den Brink 2019). In fact, the Engineering Council of South Africa (ECSA) submits that professionally registered women engineers voiced concerns about a perception within the industry that certain tasks and roles are still perceived as traditionally male-dominated (ECSA 2021a). According to Benschop and Van den Brink (2019), the perceived lack of gender diversity (GD) in the civil engineering industry worldwide stems from the industry's failure to recognise the invaluable skills and experiences of females. Amoah, Kajimo-Shakantu and Van Shalkwyk (2022) have observed that the male-dominant civil engineering industry carries many challenges, chief of which is the lack of innovation, resulting in infrastructure products that are often not fit for purpose, with adverse consequences to society.

There have been calls for the industry to improve its innovativeness and become more inclusive of gender diversity to address industry challenges (Catherine & Alice 2018:53; Creamer Media 2017). In this regard, Marín, Nicolás and Rubio (2019) argue that gender diversity within the industry will enhance organisational innovation because of women's perceived greater empathy and social orientation compared to men. This notion of associating women with social orientation and specific skills such as nurturing and empathy is supported by the social role theory (Eagly & Steffen 1986), which underpinned this study. The social role theory is discussed at greater length later in the article. When a woman assumes leadership within an organisation, it often leads to increased attraction of more women, as they can envision opportunities for advancement (Palmer & Bosch 2017). Ultimately, this dynamic can foster gender diversity within the civil engineering industry, enhancing much-needed innovative engineering solutions to address social issues, including the well-being of employees in the workplace to ultimately provide novel products and or services (He & Jiang 2019; Nadeem, Bahadar, Ammar & Ume 2020) that meet the exact needs of society, including customers or clients, while also being environmentally- or green-friendly (Javed et al. 2023).

While prior studies have sought to advance our understanding of gender diversity and organisational innovation, many aspects however remain unexplored. For instance, extant research on organisational innovation has primarily focussed on technological, product and process innovations (Na & Shin 2019; Strohmeyer, Tonoyan & Jennings 2017), all of which are prevalent in male-dominated and technology-intensive industries. However, the role of gender diversity and organisational innovation with a view to address social ills in the civil engineering industry remains largely unexplored. In this regard, Mthombeni-Moller (2023) and Catherine and Alice (2018) call for more research on gender diversity within this sector because it is crucial for women to exert influence over infrastructure planning and design, particularly

emphasising social inclusivity. Through empirical data from civil engineering professionals, this study explored the role of gender diversity and organisational innovation with a view to address social ills in the civil engineering industry in South Africa. To this end, the study is organised as follows: the first section reviews the relevant literature on the topic, followed by the section outlining the research design and methodology adopted for the study. Thereafter comes the presentation and discussion of the study's empirical findings. Lastly, the study concludes with the contribution, recommendations, limitations and directions for further research.

Literature review

Overview of the South African civil engineering industry

As a subsector of the construction sector, the South African civil engineering industry holds responsibility for the design, construction and maintenance of infrastructure upon which society at large depends (Akampurira & Windapo 2018; American Society of Civil Engineers [ASCE] 2022). This industry is characterised by its multidisciplinary nature, encompassing both consulting and contracting civil engineering services (Consulting Engineers South Africa [CESA] 2021). Consulting engineering services encompass various aspects, including infrastructure design, investigations, environmental assessments, architectural work and numerous other disciplines, while contracting engineering involves the execution of the work planned by consulting engineers based on submitted documentation (ECSA 2021b).

In South Africa, civil engineering is the most significant contributor to the construction sector in terms of revenue, gross domestic product (GDP) and employment. For instance, revenue-wise, Statistics South Africa (Stats SA 2022) reported that civil engineering works were the highest contributor (24%) towards the overall R406 billion income received in the construction sector from services rendered in 2020. Furthermore, the civil engineering industry generated an annual income of R10.8 billion in 2020 in consulting fees (CESA 2021:28) and R32.8 billion in contractors' fees (South African Forum of Civil Engineering Contractors [SAFCEC] 2021:32). The GDP measures the amounts of goods and services produced in the economy (South African Reserve Bank [SARB] 2022a). The civil engineering industry and the broader construction sector made a value-added contribution to the country's GDP of R97.44 billion in 2020 (SARB 2022b). While commendable, however, the general performance of the civil engineering industry has deteriorated over the past 5 years because of the general economic decline and the coronavirus disease 2019 (COVID-19) pandemic, which exacerbated the situation (Gamil & Alhagar 2020).

Regarding the employment outlook, in 2020, it was reported that the South African construction sector lost approximately 33 000 jobs by the end of the fourth quarter of 2021 (Stats SA 2022:8). Similarly, the disinvestment challenge has had a

detrimental effect on employment in the South African construction sector in recent years (SAFCEC 2021:7). Employment in the civil engineering industry declined by 3.2% in the second quarter of 2021, with the industry experiencing a cumulative loss of approximately 60% of its workload between 2015 and 2021 (SAFCEC 2021:7). This trend also highlights the influence of COVID-19, especially on sectors not classified as essential services during a pandemic, such as the civil engineering industry. Furthermore, reduced investment in infrastructure development by key stakeholders adversely affected civil engineering employment rates (Windapo 2021). In addition, there is a significant lack of gender diversity in South Africa as only 11% of engineers affiliated with the Engineering Council of South Africa (ECSA 2021b) are female. The notion of gender diversity is being discussed here.

Gender diversity

Gender diversity is a phenomenon that has been widely researched globally and reported to be valuable or add value in the workplace (Ansari et al. 2016; Chigudu 2018). Gender is 'a multidimensional concept that broadly refers to the roles, behaviours, activities and attributes that a given society considers appropriate for men and women' (Prospectors and Developers Association of Canada [PDAC] 2019:6). These expectations are commonly known as gender norms or roles, which tend to be rigidly categorised as either masculine or feminine. However, it is important to recognise that gender is fluid and exists on a spectrum. Women are stereotypically associated with the traditionally feminine sphere, characterised by communal traits and a preference for altruism and equity (Hechavarria et al. 2012). Conversely, men are often viewed as more agentic and instrumental (Eagly 2009). Hence, when individuals are categorised based on their sex, it activates gender stereotypes that influence judgements and behaviours, as individuals are limited by the characteristics ascribed to each group (Del Mar Fuentes-Fuentes et al. 2023).

Diversity refers to the 'existence of differences among employees at workplace based upon their colour, ethnicity, gender, age, social class, physical attributes, nationality, education, personality, skills and knowledge' (Kaur & Arora 2020:3). From another perspective, Jordan (2011) describes diversity as all the ways in which people differ. In contrast, gender diversity pertains specifically to the single attribute that distinguishes individuals from one another – their gender. It is an umbrella term that refers to a wide range of gender-related identities and ways of expression which involves acknowledging that everyone deserves to be treated with respect regardless of gender identity and expression, ensuring the establishment of a secure and inclusive culture, that organisational systems and processes ensure representation from all genders in the decision-making process for formulating company policies or making decisions that affect the workforce (PDAC 2019:6).

Some researchers have challenged the notion that an equal or balanced number of males and females signifies gender diversity, suggesting that it should be kept at a low to moderate, or moderate to a high level (Fine, Sojo & Lawford-Smith 2020). Chigudu (2018) asserts that true diversity displays an inclusive culture that accepts and respects all diverse actors within the workforce. Unfortunately, however, this is not the case in the corporate world, which has marginalised women from occupying powerful positions and, instead, are considered for non-decision-making in the workplace through rigid systems (Ansari et al. 2016; Chigudu 2018).

Schwab et al. (2016) submit that gender diversity at a moderate level is more effective than a diverse team with too much representation. They contend that a skewed, diverse team does not foster the discovery of dissimilar knowledge among team members as patriarchal behaviour is noticeable in the workplace, especially in male-dominated organisations where it is a man's world, and women are made to feel that they do not belong (Moalusi & Jones 2019) in such organisations. While other research places value on the quantity of gender in the mix (Cicchello et al. 2021), the number does not hold significance if those who make the most significant number are not empowered to participate in value creation or decision-making. Hence, while the use of quotas is an inclusion mechanism, it has offered little to no benefits as it often leads to tokenism (Ghafoor, Duffour & Khan 2022), where females are appointed in the industry as a public relations act and not given the platform to raise their voices. Consequently, there is high female turnover, and women will continually be under-represented in the industry.

Broadly speaking, workforce gender diversity can play a significant role in improved productivity when promoted and managed well within firms (Saxena 2014). Gender diversity at the top management and governance levels continues to be a challenge globally. According to the World Economic Forum (WEF) report, women globally occupied 32.2% of senior leadership positions comprising directors and c-suite in 2023 (WEF 2023:7). In South Africa, the CEE reported that in 2022 men occupied about 73.5% and women 26.5% of top management positions, while the majority of senior management positions (62.8%) were in the hands of men and 37.2% of the positions were in the hands of women (CEE 2023:38, 43). Interestingly, despite the presence of mixed outcomes, some studies suggest a significant positive association between gender diversity and organisational performance (Fine et al. 2020; Moreno-Gómez, Lafuente & Vaillant 2018), organisational innovation (Colovic & Williams 2020) and idea diversity (Johnson, Cuthbert & Tynan 2021).

Organisational innovation

Organisation innovation (OI), sometimes classified as a separate type of innovation from technology or non-technological innovations (Camisón & Villar-López 2014),

has various definitions in literature. For example, while Jiménez-Jiménez and Sanz-Valle (2011) define innovation in an organisation as a process and outcome, Camisón and Villar-López (2014) describe innovation in an organisation as the process of implementing new methods internally and externally. As such, Swart-Opperman and April (2015:36) view innovation as the process of creating a new product or service. However, the key element that stands out is that irrespective of the type of innovation, innovation introduces something new. In this study, OI is defined as the employment and execution of new ideas or methods and processes in the organisation, to provide new or enhanced products and services to the internal and external environment.

Diverse innovations such as technical, marketing, process, administrative and product innovations will emerge as new ideas come in a variety of various purposes and forms (Hellriegel et al. 2012:354). Social innovation is another type that promotes innovations as important to society, such as green or environmental innovations, but can also take any form of innovation, provided it is for society's well-being. Phillips, Deiglmeier and Miller (2008) define social innovation as:

[A] novel solution to a social problem that is effective, efficient and sustainable or just than the existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals. (p. 39)

In terms of classification of the different types of innovations, Camisón and Villar-López (2014) classify innovations as technological (product and process innovations) and non-technological (marketing and organisational innovations).

Notably, Azar and Ciabuschi (2017) separate organisational innovation as an isolated innovation. As already mentioned, the context of organisational innovation for this study is that all types of innovations in organisations fall under the umbrella of organisational innovation. Furthermore, this study posits that it is this broad spectrum of organisational innovation (diverse innovation) that necessitates gender diversity, which introduces different perspectives and, therefore, various ideas from women and men in top management who are the decision-making body in an organisation. The International Labour Organisation (ILO 2019) reports that 'a more gender diverse workforce and management structure enhances creativity and innovation, making businesses more successful'. Na and Shin (2019) contend that women are innovative in marketing innovation, attributing the idea that women are risk averse compared to men who have a high profile of taking risks. In contrast, Prabowo and Setiawan (2021) found that 'the firms led by female CEOs exhibit a greater probability to innovate'. On the other hand, some studies have found that women are not as innovative as men when it comes to technological innovations (Alsos, Hytti & Ljunggren 2016; Hozer-koćmiel, Misiak-kwit & Lisowska 2017).

Ordinarily, industries such as civil engineering are technically oriented and thus focus on technological innovation to implement their day-to-day tasks. Such technology-intensive industries would often overlook the non-technological innovations, such as social innovation, which exist to address societal problems and benefit society (Phillips et al. 2008). Overlooking these innovations is likely to result in women being disregarded in industries such as civil engineering. As reflected in some studies, men have more prowess in technological innovations than women (Alsos et al. 2016; Hozer-koćmiel et al. 2017). On the other hand, studies attest that women possess higher social orientation than men (Marín et al. 2019). Social orientation is one's awareness of people and the ability to form relations and adjust to those people (Geisler & Allwood 2018). Therefore, having a high level of social orientation creates the opportunity for social innovation in an industry such as civil engineering that provides crucial services to society. This means that the infrastructure will be developed by the participants having all people in mind, being aware of their needs and adjusting the project designs to meet them. Therefore, the study posits that gender diversity shapes organisational innovation.

Theoretical grounding

Social role theory

The study adopted the social role theory. According to this theory, organisational gender stereotypes divide and ascribe various roles between men and women, associating them with their innate abilities and skills (Ridgeway 2001). Therefore, the social role theory can be perceived to trivialise females' contribution to male-dominated industries. The theory explains the inference of associating women with social orientation, while men are associated with authoritative skills (Eagly & Steffen 1986). The social theory postulates that based on the biological and psychological makeup of both women and men, society assigns communal roles such as caring for others and empowering other people to progress to women, and agentic roles that need physical strength or involve risks and those that dictate leadership to men (Eagly & Steffen 1986; Gustafsson Sendén et al. 2019).

However, if adequately applied, the skills and abilities of each gender can be capitalised to offer organisational innovation and, thus the firm's performance. While men are said to be self-assertive, women are viewed as socially oriented. Hence, associating men and women with specific skills makes gender diversity a topical phenomenon. Therefore, the social role theory further provokes investigation into the types of innovation possible if men and women share equal opportunities in the working environment. Innovation is essential as the civil engineering industry and its construction sector interact with the engendered environment daily, potentially impacting organisational innovation negatively. Hence, this study argues that organisational innovation that is pro-social and environmentally conscious is critical for the construction sector and the civil engineering industry as a whole to consider.

For instance, globally, the industry faces infrastructure challenges (Becerik-Gerber et al. 2014), which are attributed to inadequate diversity and innovation (Guy 2023). Therefore, this study argues that using a well-managed social theory, as mentioned in this section, will benefit the industry. The salient underrepresentation of females at the top management in the civil engineering industry adversely affects organisational innovation such as infrastructure planning, design and provision aspects. Importantly, this study also recognises that men and women are intrinsically not the same, neither are they equal – just as not all men are the same nor equal because each individual's circumstance is different. What is important is for all to be given equal opportunity to contribute towards a common goal, using their diverse skills and abilities.

Research methodology

The study employed the qualitative research approach, with an interpretivist paradigm in addressing its objective. A qualitative approach is largely reliant on the perspectives and the interpretations or meanings of the phenomena under investigation (Gillani 2021; Barquero, Bosch & Gascón 2019). In this study, the perspectives of civil engineering professionals in South Africa were considered of great importance for the achievement of the objectives of the study. Fifteen participants were selected based on their experience and deep knowledge of the industry (Campbell et al. 2020; Setia 2016). Access to participants was through an established professional network in the specified industry.

Data were collected by means of 15 qualitative semi-structured interviews with civil engineering managers. Each interview was recorded with a digital voice recorder, following permission to record these proceedings from the participants. Two different audio recorders were used – a smartphone and an MS Teams meeting tool so as to try and minimise glitches that technology and served as a backup for data (Assarroudi et al. 2018; DiCicco-Bloom & Crabtree 2006). After the 15 interviews, it was clear that a point of data saturation had been reached. During the data transcription process, the identity of participants was anonymised by assigning pseudonyms for ethical reasons (Hennessy et al. 2022). Transcription was followed by the process of coding, which involved extracting the key expressive words from the data and ascribing descriptive labels to those words (Erlingsson & Brysiewicz 2017). The study employed inductive data analysis using the hybrid categorisation matrix to develop the study-specific emergent themes. Assarroudi et al. (2018) assert that the categorisation matrix incorporates predetermined categories or themes from theory while allowing for new categories. Critical to this study were participant-specific realities on organisational innovation and gender diversity, the subject matter under investigation. Subsequently, listening to the recorded audio against the interview transcripts in a process known as thematic analysis, the

interview transcripts were read several times for an in-depth understanding of the participants' views to deduce the main themes (Kiger & Varpio 2020). Six themes emerged from the participants' expressive words as grouped according to their similarities.

The study employed four measures of trustworthiness – credibility, dependability, transferability and confirmability. Credibility allows harmony between what the participants have said and what the researchers have presented (Nowell et al. 2017); dependability ensures 'data stability over time and conditions' from a view that two separate researchers will draw the same inferences while using the same data (Kemparaj & Chavan 2013); transferability is the application of data findings to other similar context or groups (Houghton et al. 2013; Kemparaj & Chavan 2013); and confirmability provides a process where inferences are made about the study, project corroboration of interpretations and analysis of the data, with the evidence provided during the credibility step (Haven & Van Grootel 2019). Ethical considerations were meticulously adhered to – before data collection, ethical clearance and the participants' informed consent were sought while assurance and reassurance of confidentiality were also provided. Furthermore, the researchers ensured that the participants' privacy and rights were not compromised during and post the study by associating their views with anonymous identities in the public space.

Research findings

Table 1 displays the composition of the 15 study participants who are professional civil engineers with titles such as owners of consulting firms, associate, general and senior project managers, regional managers, technical executives and one junior project manager. The managerial experience of participants varied and ranged between 2 and 36 years, making their contributions invaluable. The participants were asked to specify their gender classification to assist in defining gender diversity for the purpose of this study. They all ascribed to the binary gender classification with four females and 11 males.

Themes

The following themes emerged from the thematic analysis of the primary data: skewed gender representation, females'

TABLE 1: Designations of participants ($N = 15$).

Participant designation	Participants (n)
Consulting firm owner	2
Associate	1
Section or divisional manager	2
General manager	1
Technical executive	2
Regional manager	2
Senior project manager	4
Junior project manager	1

quotas, leading to people resigning, leaving and affecting projects:

'So the way I see diversification is where we we're having a mix, a diversification but it does work. It's pointless for me that we diversify that doesn't work. People resign, people leave, the project takes the whole turn and everybody, but we have diversified. So if I take the detail of a positive outcome ... to the diversification, I think we still have a long way to do.' (Index B, male, divisional manager)

A participant female with experience in the private section, expressed that by the time she had decided to leave for the public sector because of a lack of transformation:

'By the time I decided that I was leaving, it was very clear to me that I will never be considered for anything beyond the job I'm doing. One, because I'm female. Two, because I'm black. Three, because it's a boys' club over there, so they keep promoting people who, you know that person that everybody knows does nothing.' (Index M, female, private section worker)

This study highlights that failure to embrace gender diversity in the industry promotes high female turnover. Index C, for instance, appealed to the industry to appreciate gender diversity, or else it will continue to battle in retaining and keeping women in the industry. Many participants clearly stated that gender diversity has very little to do with numbers. Instead, it has much to do with the participatory process, as Maton (2008) mentioned, where empowerment is the value through which women are recognised. Again, Index B, a male divisional manager, outlined that diversity is only worthwhile if it works, especially in an environment where people resign and leave.

Likewise, Index H, a male senior project manager, shared his views on what leads to female turnover. He shared the narrative of a competent female who was ideal for a management position. She was frustrated and left when decision-makers overlooked her for a role that she was suitable for. As Index H puts it, 'So we are losing competence, because of difficulty to transform'. Losing competence means recruiting, and this process is an additional cost to the company. It is, therefore, worrying that the best few available females leave the industry – the very people who are supposed to be mirrored to the young girl child and other females who aspire to a career in engineering. As a result, this will also have a detrimental effect on leadership development and mentorship of female professionals who are already in the industry (Krzakiewicz & Cyfert 2019).

Theme 3: Creation of an inclusive environment

Creating an inclusive environment emerged as the third theme, which was developed from the participants' suggestions, using expressions such as empowerment, engagement, involvement and participation of women, giving women opportunities to speak and influence or share opinions. The divisional manager, suggested that the industry should create roles aligned to the capabilities of women, thus ensuring that women participate in the environment:

'So that that's to me where we need to manage it is to create roles on the engineering side dedicated or that they explore that, I think is the right word, that exploit the female capability, the excellence that the female brings.' (Index B, male, divisional manager)

A participant stated the following:

'Breach the exclusion line and get more involved into innovative ideas for engineering also and construction, by employing maybe robotics, AI fourth industrial revolution, you know all those things, safe analytics and minimise the physical element requirement in the industry.' (Index O, male, technical executive)

Index C reported as follows:

'It's all about all participation around the table. And it's inevitable that if you're absent in discussions so your views and thoughts will not be considered. And for me, that's where it starts. And then it's followed by the kind of empowerment which is required. Whereby when women come into the industry, there should be an effort that they should be equally empowered #1 so that they can feel that they are part of the team and their views are taken serious. So that's quite key and quite important #2 is that they must therefore equally be given a space to contribute and their views should be equally recognized and appreciated like views which might come from other gender.' (Index C, female, general manager)

Participants expressed their views that creating an inclusive environment is a crucial part of the industry change, and the industry leaders hold the powerful decision to make this change. Their expressions indicated that it is fair to promote numbers, but if they do not supplement empowerment, the numbers will offer no value, consistent with Shore, Cleveland and Sanchez (2018).

Theme 4: Building a strategic female structure

The fourth theme emerging from the study was the industry's urgent need to grow the pool of female engineers, which starts at a foundation level. Participants emphasised how building the strategic female structure for gender diversity is not only the responsibility of the industry. Most participants communicated that the point of departure in the value chain starts at school, where young girls should get exposure to the civil engineering industry. For instance, a participant suggested that specific attention should be paid to rural areas, where engineering should be introduced to females to create a female base for the industry:

'You start with gender diversity. One, start from the bottom and encourage the students from schools. From schools try and encourage the ladies because, as it in urban areas, mostly you'll find that, I don't think there's anything much we can do most women know they can go into engineering. But in rural areas mainly or maybe some outflung schools where they are semi-rural to sell it to them as well the ladies. We might find out of 20, 1 lady is interested ... So we need to break that barrier and by starting at schools because if they choose their ... and you have a lot more filtering into the industry.' (Index D, male, regional manager)

In addition, other participants highlighted the need for young girls to be exposed to science, technology, engineering

and mathematics (STEM) subjects, which are the foundation for a career in engineering. Index F's viewpoint is:

'Yeah, I think it would be nice if we can expose young girls like at school level, expose them more towards technology. What does it mean to you doing a design. What does it mean to apply these science methods. To just give them more opportunity to actually see what is in the engineering field and what you know. So yeah, I don't know maybe go to school and show them what can be done so that they are interested in and then in the end they will end up being part of the team where we are now'. 'Let's expose more young girls at the young age to the engineering industry so that we can diversify our teams, in the long run'. (Index F, male, senior project manager)

Index G reported:

'So you need to establish some kind of role models and that people can mirror to saying that this can be done. Because that's the one other dynamic that that you need to bring into this thin, which then goes back to where it probably all starts in terms of maths and science at primary school. And then make sure that you get the girl child to accept that maths is not a difficult thing. You know, the science is not a man thing, you know. So there's a lot of things that you could do to build up the girl child early on for them to take engineering as a as a serious career.' (Index G, male, engineer & firm owner)

Theme 5: Inclusive innovation

The fifth theme which emerged was inclusive innovation whose construction was influenced by two factors. Firstly, all the participants anonymously defined innovation in the industry as a new way of doing things or doing things differently than before. Secondly, the participants suggested that the critical inputs of both men and women, using their varying strengths and experiences, would lead to inclusive innovation in the industry. Interestingly, the participants underscored the organisational and multi-tasking skills necessary for the industry, specifically developed by women, as they commonly play communal household roles at a societal level.

The participants also underscored the gendered traits that they found to influence how the civil engineering industry conducts business. Some of these traits included men having more self-assertion than women, a trait men used to deliver on projects and, if needed, deal with contractual disagreements. In contrast, women possessed more of what participants referred to as the 'softer side', such as emotional intelligence, empathy and social orientation than men – traits seen as necessary when one dealt with the social element, whether with employees or the community. The following responses highlight the self-assertion and the emotional intelligence that men and women possess more than each other, respectively.

The study revealed that because men were the only ones involved in developing the products or services of the civil engineering industry, involving women would bring extra value. Prior literature suggested that using the complete skill sets of both men and women rather than of men only would

enable sustainable socio-economic and environmental development of the country (Bayeh 2016). Furthermore, participants underscored the need to include women in the industry because of how men and women see things. These different perceptions were shaped by: (1) inborn skills or traits and (2) the experiences of both men and women in society. Regarding inborn skills, consistent with the literature, participants ascribed differing agentic and communal traits to men and women, respectively (Eagly & Wood 2016; Gustafsson Sendén et al. 2019).

Theme 6: Role models and mentors' deficit

The other theme that appeared as relevant to the study is the lack of female engineers that would have had the potential of attracting girl children into the industry for gender diversity. The technical executive with approximately 12 years of experience in this position indicated that they also did not know anything about black males because they were racially excluded from the engineering field. As such, it resonates with him when he thinks of a girl child who is an aspiring engineer and needs someone she can look up to. Below is his view:

'I feel that by not having yes by not having women or a lot of women we, people from the outside don't see it as, like it chases people away. It doesn't welcome because you don't see a representation. You don't see a whole lot of women doing this. You feel like argh, maybe it's not for me, maybe it's not something I would enjoy, you know.' (Index J, male, technical executive)

The perception regarding the lack of females in the industry not only affects role modelling but also deters the development of young engineers who need support. According to Index H, who is a technical executive as well as a senior project manager, young people are resigning because of a lack of mentorship. This lack of mentorship is a result of the deficit of female engineers whom the industry could not retain:

'So you now have a problem of young guys coming in and if you look at the turnover, people who are resigning, it's young guys who are resigning because there's no mentorship. You can only achieve your goal, ye [of] mentorship if you have built your building blocks are in place. You understand. So now we have a situation where our industry has a deficit of female engineers.' (Index H, male, technical executive)

The depiction of turnover was so evident that the lack of retention will have a negative effect on role models and mentorship in the industry. Everyone needs some kind of a role model to look up to, in order to navigate and progress in life. Index G, a black male, warmly and implicitly expressed that at a point in time he also experienced unfair biases. He was recounting the time when he was racially excluded in engineering because he is a black man. Acker (2012) explicitly speaks about the intersectionality that speaks to the overlapping of social identities such as race and gender. The participant was thinking of a young girl who is an aspiring engineer with no role model who can inspire her. The industry will not be able to attract more females in the industry if it cannot transform and show a different picture

about the industry. It needs to exhibit that the engineering field is for both females and males, which will not require only words but actions. Themes 1 to 5 detailed much on the problems which deter women from staying in the industry. Further perceptions as expressed by Index J is that the current picture of the civil engineering industry chases people from outside away, as they do not see representation.

Similarly, Index C was of the view that the lack of diversity at the top precludes the required inspiration that females need to feel a sense of belonging in the masculine-cultured engineering field (Cheryan et al. 2017). On the other end, the issue of mentorship also appears to affect the retention of young engineers who are already in the industry. This shows that the industry lacks a strategic learning orientation which Krzakiewicz and Cyfert (2019) highlight as essential in promoting leadership development, and mentoring female professionals to foster gender diversity at senior levels. Index H speaks of the resignation of young people because of the lack of mentorship and the industry female deficit. With the civil engineering industry having a female deficit as a result of the aforementioned antecedents, gender diversity is nearly impossible.

Conclusion

The study explored the role of gender diversity and organisational innovation with a view to address social ills in the civil engineering industry. While literature revealed innovations associated with gender diversity, insights from civil engineering were unknown. This article aims to fill the current knowledge gap and gain a better understanding of which organisational innovations are appealing and relevant to the industry. This is particularly important because the industry has frequent interactions with the environment. Furthermore, the industry develops the required infrastructure to meet societal needs. The insights of managers from their lived experiences availed much for this study.

The study's findings indicate that gender diversity is pivotal in inclusive innovation, where all genders are represented and thus participative. These findings suggest that gender diversity, in which all genders create industry value, will enable an environment that leads to innovative civil engineering solutions that will benefit society. Firstly, the infrastructure will be designed and developed considering all societal needs, irrespective of gender. Secondly, it means that the value that gender diversity creates within the industry for the industry workforce will benefit both men and women. This refers to the working conditions and working types of equipment pertaining to the industry's daily activities. These findings show that if only males are represented, the organisational innovations only advance the needs of male civil engineers while overlooking those of females. These findings attribute this inclusive organisational innovation to the traits that women possess alongside men and their experience in conducting social roles. These attributes include empathy and emotional

intelligence, which make up human skills. Women's experience of playing social and household roles was found to have a positive impact in ensuring that value creation will consider the infrastructure needs of society and the needs of the female workforce. This study contributes to empirical and theoretical literature by exposing the shared patriarchal values that many organisations appear to promote. At the same time, society still struggles with infrastructure that does not address its needs. It thus challenges male-dominated industries such as civil engineering to take stock of the skill set and experiences of its female workforce and leverage those capabilities to benefit the industry and the entire society.

There are several implications from the study. Firstly, the civil engineering industry needs to empower women occupying positions of power to make decisions and not just fill the numbers. Empowering women will therefore mean women, as the commonly marginalised group, should consistently (Maton 2008:5) 'gain greater control over their lives and environment, acquire valued resources and basic rights, and achieve important life goals and reduced societal marginalization'. Women empowerment can possibly be achieved through the removal of the male gatekeeping effect as the current status shows male dominance, which, without any interventions, could perpetuate patriarchy in decision-making positions. Therefore, male counterparts should invite women to the decision-making table to advance gender diversity and organisational innovation in the civil engineering industry.

Secondly, the industry needs to transform the traditional way of managing personnel matters to deal with the current high turnover of female civil engineers. The participants generally agreed that sector leaders can focus on creating a welcoming and appreciated environment for women. Providing bursaries is not sufficient for gender diversity, the same way as numbers are not to define gender diversity. Women need to be empowered, and they need support. The same support that male civil engineers receive should also be afforded to women to help them settle and progress in the industry. The industry, therefore, needs to filter women at the senior management level and competitively retain them. Furthermore, as female civil engineers are filtered in the industry, it is imperative to accommodate and develop them to be the best in this multidisciplinary by taking note of their skills and leveraging them in infrastructural development and innovation. In instances where there are skills gaps, upskilling will be required.

Thirdly, there is a critical need for an inclusive environment within the civil engineering industry. Essential elements, such as the provision of opportunities to participate, which the participants cited, should also be visible. There are specific processes and practices that inclusive organisations should exhibit that currently need to be improved in the industry; for instance, psychological safety allows female employees to express their opinions safely. To get the critical

mass for working gender diversity or true gender – one that will have a voice – the civil engineering industry needs to put a female-friendly structure in place as their involvement and influence towards decision-making and, ultimately, organisational innovation. Fourthly, the study revealed the necessity to grow the pool of females to build the numbers critical for gender diversity, particularly at the top, which all start at a foundation level. However, it should be emphasised that building the number of female civil engineers takes concerted effort and is not only the industry's responsibility. The industry needs to create awareness of what the civil engineering industry entails while promoting the subjects needed for this field and what it means to be a female in this industry.

In summary, these findings signify the positive effects of social role theory, which promotes the ascription of gender roles according to society's standards. The relevance of the theory to these findings is that affording men and women to share equal opportunities in the working space, and to participate in infrastructure development optimising their different skills, will result in inclusive innovation.

Limitations and direction for future research

Notwithstanding the contribution of this study towards knowledge on organisational innovation and gender diversity, it has some limitations. Firstly, the study's findings cannot be generalised to other engineering industrial sectors because of the purposive sampling method employed herein. To this end, future investigations could employ stratified sampling in other industries such as chemical engineering, manufacturing, agriculture and services. They could also compare their outcomes to this study for similarities or otherwise. Secondly, the study utilised data from a single moment in time through the cross-sectional survey, which limits the observation and reporting of long-run effects over time. Future studies could observe changes in the variables under observation by employing longitudinal surveys.

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Competing interests

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Authors' contributions

M.L. conceptualised the study, collected data and wrote the first draft of the manuscript. D.P. supervised the study, and reviewed and edited the manuscript. S.M. co-supervised the project and edited the manuscript.

Ethical considerations

An application for full ethical approval was made to the University of Johannesburg, Department of Business

Management Ethics Committee and ethics consent was received on 29 August 2022. The ethics approval number is 22SOM38.

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Data availability

The data that support the findings of this study are available on request from the corresponding author, D.P.

Disclaimer

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