



## ENGINEERS' PERCEPTIONS OF THEIR ROLE IN SOCIETY: THE SOUTH AFRICAN CASE

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### ABSTRACT

Being sparked by interactions with students in the context of a course called 'Engineer in Society', this work-in-progress study explores how engineers conceived of their role during the period of apartheid in South Africa. The literature suggests that engineers consider their contribution to society in solely technical terms rather than in social or political terms. Using interviews with engineering academics, this paper examines how respondents' navigated engineering practice and academic work. The findings indicate significant complexity in terms of how engineers conceived of their role in relation to society, a relationship that was mediated by politicised academic institutions and differentiated cultural norms. This also has an impact on the notion of the culpability of engineers and the question of whether they resisted or complied with the pervasive and brutal regime of apartheid. Although the study revealed a variety of positions and dispositions taken on by engineers, an interesting stance was that of 'technical activism' which involved engineers resisting apartheid by exploiting the liberal spaces that were made available in the context of their engineering work.

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## 1 INTRODUCTION

Given the nature of the engineering curriculum, it is not surprising that engineering students tend to view their contribution to society in solely technical terms [1] while being inattentive to the political dimensions of society. A new undergraduate course offered at the University of Cape Town in 2020 called 'Engineer in Society' aimed to bring the social aspects of engineering to the attention of students. Given that the first democratic elections in 1994 was such a singular moment in the history of South Africa, the course deals directly with apartheid – the infamous political regime that gripped South Africa for 48 years before democracy – and its impact on engineering activity.

Interactions with students in this course prompted the launch of a research project to investigate two things: (i) the transformational learning that was a specific intention of the course and; (ii) the role of engineers – both academics and practitioners – in South African society, focusing on how they negotiated apartheid. Some work has been done on the first part [2] and this paper is a work-in-progress for the second part of the project. While the intention is that these findings feed back into the course to provide the students with a more nuanced understanding of how engineers negotiated society under apartheid, this phase has not yet been initiated.

### 1.1 Background

To provide some background, it is worthwhile describing how the broader research project emerged from the Engineer in Society course. At the beginning of 2020, when the course was being offered for the first time, two lectures were set aside to introduce students to the role of engineering in South Africa. The first lecture was billed 'part 1' and it focused on the role of engineering during apartheid; the focus of part 2 was the role of engineering in society after the first democratic elections.

Part 1 sketched the history of engineering in South Africa, starting with the discovery of gold which caused a sudden influx of engineers in the late 1800s and marked the start of engineering education in that country. It also delved into the details of a few large engineering projects, pointing out the political dimensions of these projects and how they supported apartheid in one way or another. The intention was to then open the floor (this was about a month before the Covid-19 pandemic hit South Africa) for discussion. The question put to the students was whether engineers have 'blood on their hands' [3] for their role under apartheid. But before opening the floor, it dawned on the lecturer – who is one of the authors of this paper – that the political dimension of engineering is very seldom discussed.

As might be expected, the student discussion was lively. Most students were of the view that engineers who worked in South Africa during apartheid are guilty for not standing up to such an unjust system. Some empathised with the inaction of engineers, pointing out that engineers were probably weighing up the personal cost, and the cost to their families, if they spoke out against what was a very brutal regime. One student suggested that engineers were not liable because they were just doing their jobs but this was not a popular perspective.

It is important to point out that all of the students in the class were born after 1994 and therefore had not experienced first-hand what apartheid was like but were

reflecting on the issue from what they had learned in school and heard from others. Given that the class was made up of a diverse cohort of students, ranging from those whose parents and families had been severely oppressed by apartheid laws, others with families who benefited from apartheid, and a few international students, a variety of perspectives was to be expected.

As mentioned above, this experience sparked the launch of a research project and this paper is a work-in-progress on the second part of the project which focuses on how engineers negotiated South African society, particularly under apartheid. It addresses the following research question:

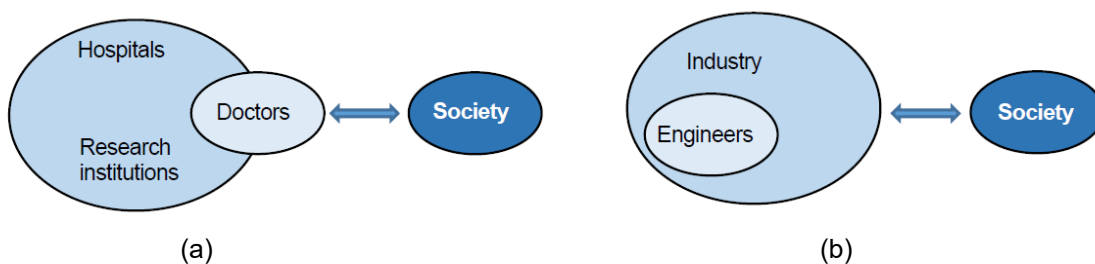
*How did engineers conceive of their role in relation to society during the period of apartheid in South Africa?*

What follows is a discussion of the role of engineering and engineers in society, as framed by [4] and [5], followed by the research approach. The initial findings are then discussed and conclusions are drawn that consider the particular dimensions of the South African case.

## 2 CONCEPTUAL FRAMING

Engineers play an important role in society. Definitions of engineering emphasise the technical aspect, but they also frequently include the social aspect of engineering. The national body for accreditation of engineering programmes and professional registration, the Engineering Council of South Africa (ECSA), defines engineering as ‘the practice of science, engineering science and technology concerned with the solution of problems of economic importance and those essential to the progress of society’ [6]. Other definitions point to the role of engineers in advancing or improving society for the benefit of humanity.

Exactly how engineering does this is complex. Unlike doctors who have a more direct relationship with society, Aslaksen [4] suggests that engineers are almost completely embedded within industry which mediates the relationship with society.



Illustrating the indirect interaction between engineers and society, in (b), as opposed to the direct interaction between doctors and society (their patients), in (a) [4].

The term ‘industry’ is used here in a broad sense to refer to the engineering enterprise as well as government entities and even educational institutions [4]. However, in the context of this work it is important to distinguish between engineers who work in industry and engineering academics who work at universities.

This framing has implications in terms of the potential benefits that engineering holds for society. The technical expertise of engineers is vital for the growth of industry and, through this means, has the capacity for improving humankind. As the world becomes increasingly globalised, engineering is adapting and remains important for the growth of industry in general. However, Cech [5] critiques the norms and values embedded in engineering, noting the narratives of heroism that the profession uses to present itself in relation to society. This is evident in the *Grand Challenges* [7] document produced by the US National Academy of Engineering that Cech [5] targets but can also be clearly seen in the centenary publication of the South African Institute for Mechanical Engineering (SAIMechE) [8] that was published in 1993, one year before the fall of apartheid. Such documents tend to valorise the technological aspects, narrowly conceiving of social change as technological change with scant regard for the 'religious, political, environmental, and cultural factors that are interwoven in societal change' [5].

This research paper contributes to Cech's [5] call for increased reflexivity – that is, a 'critical examination of engineers' role in the past, present and future of societies'. It does this by drawing on the context of South Africa, a country with a history of a political system which discriminated on the basis of 'race'<sup>2</sup>, resulting in a legacy of social and economic injustice. In exploring how engineers understood their role under apartheid, in terms of valorising technological aspects, it provides a critical evaluation of the role of engineers in society more generally. Following this, it explores the extent to which engineers saw themselves, within the context of a pervasive and brutal regime, as contributing to, or resisting, apartheid.

### 3 METHODOLOGY

#### 3.1 Research design

A qualitative research design [9] was developed for this study. Semi-structured interviews were the primary source of data with the intention to access the perceptions and experiences of the participants. This paper is a work-in-progress piece, reporting on the findings of the first five interviews with engineering educators.

#### 3.2 Data collection and analysis

The interview schedule was developed by all the researchers at the start of the project, revisited before data collection took place and adjusted as themes emerged from the interviews. The interviews were conducted face-to-face or online via Zoom or MS Teams. Respondents were selected through purposive sampling with the aim of ensuring some representation of the sub-disciplines of engineering (mechanical, electrical and chemical). All of the respondents selected for this initial stage were white males who had worked in academia for between 22 and 43 years, thus having experienced the workplace during apartheid. The respondents had a mix of university and industry experience. One respondent had spent significant time in industry – 20 years – before joining the university but most combined industry work with university research in some way. One respondent – who saw himself more of an

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<sup>2</sup> It is acknowledged here that 'race' was used as a construct to institutionalise oppression in South Africa. Such references are not intended to entrench racial classifications. However, given the history of South Africa and the nature of this study, it is impossible to avoid the use of these designators.

activist than anything else – left engineering during his undergraduate studies although he remained active in engineering education.

Ethics approval for the research was obtained through the Faculty Ethics Committee to ensure that issues such as protection of information and informed consent were addressed. Pseudonyms were used when storing the data and reporting the findings. Further permission was required from the UCT's Human Resources division since some of the respondents were employees of the university.

The table below provides a brief description of the trajectories and positions of the research participants. The interviews that were conducted in person were audio recorded; those conducted online were video recorded. In both cases the recordings were transcribed which formed the basis of the findings. A methodology of narrative inquiry in the mode of Polkinghorne [10] was employed for the data analysis. Narrative inquiry is particularly suited for the topic of this paper since a 'storied narrative... preserves the complexity of human action with its interrelationship of temporal sequence, human motivation, chance happenings, and changing personal and environmental contexts'. Polkinghorne [10] identifies two forms of analysis in his work but this paper draws on 'paradigmatic analysis' which analyses a set of narratives, the aim being to 'identify particulars as instances of general notions or concepts'.

Table 1: Research participants

Pseudonym	Background
Nikolai	Engineering academic involved in theoretical research around the deformation of materials at an English-language university during apartheid.
Gary	Grew up in Rhodesia (now Zimbabwe) to English-speaking parents, Worked in engineering consulting for 20 years before working part time at the university and consulting.
Zachery	Studied engineering but switched to a degree in applied mathematics. Took a university post as a way of being an activist in the higher education space.
Ryden	Born into an Afrikaans-speaking family and served two years in the military during apartheid. Worked for an engineering company that consulted for an arms procurement company under apartheid. Currently an academic at an English-language university.
Barry	Grew up in South West Africa (now Namibia) and studied in South Africa. Now an engineering academic at an English-language university.

#### 4 FINDINGS AND DISCUSSION

Although this paper draws on only five interviews, the results demonstrate a complex interaction between institutions, engineering activity and the political complex that had an overbearing effect on social activity. This in turn affected how engineers understood their role in South African society during this time. Although the interviewees were all engineering *academics*, there was significant overlap in terms of their work for (private) industry and university work which involved academic research and associated activities such as publishing papers and attending conferences. Of course, successful technical research in the university context often

leads to collaborations and contracts with industry. However, the findings suggest even more of an overlap through a close, symbiotic relationships between industry work and university research, as well as dual roles via part-time appointment arrangements.

This has implications for understanding the impact of engineering activity on society since a mutually beneficial relationship between the university and industry suggests even more embeddedness. For example, if an engineer working on a particular technology dedicates time to writing research papers for publication because of the prestige and reward this provides in the university space, this takes time away from the development of technology and its application which arguably has a greater chance of impacting society.

For this initial analysis, it is useful to focus on the armaments industry and the electricity industry although other industries, such as the synthetic fuels industry, were also mentioned. Nikolai was involved in theoretical research around the deformation of materials. This work was relevant to the arms industry but the English-language<sup>3</sup> university at which he was employed prohibited academics from associating with industry in any way, whether private arms companies or the arms procurement agency of the South African Department of Defence, Armscor. Nikolai relates how he found himself in a 'lose-lose situation' because, while he was prohibited from associating with any organisations that supported apartheid, he was treated as if he belonged to an apartheid state when travelling overseas for conferences.

In contrast, Ryden was born into an Afrikaans-speaking family, went to an Afrikaans high school and then served two years in the military which, at the time, was compulsory for all school-leaving white males. He then went to an Afrikaans university and studied engineering. Immediately after graduating, he started working for an engineering company which consulted for Armscor. During this time, he retained ties to the university in terms of lecturing and he also studied his Master's:

... I actually did my Master's on the aerodynamics of a mortar bomb. And I remember at that time, I thought, 'I don't know... this is not ideal' and so on but, you know, it's a cutting edge project, that's what do you think, you know, I do this cutting edge project and CFD modelling and wind tunnel work and all that. But... but the application, I guess I told myself, 'Well, we're protecting the country'. I mean, I was in the army for two years... I mean, you are dulled a little bit to this... you know, you don't think too deeply about all the other stuff.

What is interesting about these stories is the very circumscribed way in which engineering work impacted society. Nikolai was very much embedded in the English-language university at which he was employed. Its policies limited his interactions with industry so that he researched in a rather isolated way. Interestingly, the stand that the university took against apartheid (although whether it went far enough is contested) also meant that he identified with its struggle against apartheid. As well as setting limits on association with industry, the university partnered with progressive corporations that funded programmes for the admission and academic support of black students a decade before these students were officially allowed onto

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<sup>3</sup> As a result of its colonial past, South Africa was divided into English- and Afrikaans-speaking universities under apartheid.. Afrikaans is a derivative of Dutch which was spoken by the first European settlers.





the campuses of 'white' institutions. In the case of Ryden, he was also very much embedded in industry, even working for a company that Nikolai was prohibited from interacting with. The difference was that his upbringing and army experience 'dulled' his conscience about the possible consequences or implications of his engineering work on society.

Another of the respondents, Gary, spoke at length about the embeddedness of engineering in industry. He worked for about 20 years in electrification before he joined an English-language university in 2000. This meant that much of his work occurred during the apartheid years which resulted in him building up tremendous experience in low-cost electrification. He put this to use in the strong drive for electrification after apartheid fell and became involved in work with the national utility, municipalities in South Africa, electricity entities across sub-Saharan Africa as well as becoming involved in electrification policy at various levels. He shared how he has even given comments twice to the Federal Energy Regulatory Commission in the USA. About embeddedness, he had this to say:

The technical has no impact except through social, economic, and legal provisions. We kid ourselves that we're important as engineers. But it's not our engineering that's important, it's our *outputs* and our *outcomes*... through assimilation in society, [this] gives the *impact*, which is quality of life or economic activity or things like that. We are at the bottom end of this chain. And most engineers don't operate... don't even get into the assimilation areas, don't... don't even look at it.

The extent to which this embeddedness relates to the culpability of engineers in relation to apartheid is interesting. One might expect that, since engineers are so embedded in industry (broadly speaking), they see themselves as being less culpable or responsible for the injustices of apartheid. Interestingly, both Ryden and Nikolai acknowledged some guilt in terms of not standing up against apartheid, even though they were in very different social circumstances. Speaking about himself, Nikolai said:

...my wife and I had a view that you are either against apartheid and you were an activist, or you basically just sat through the middle of it and allowed these things to happen around you. And you were – if you did that – you were just as guilty...

Ryden spoke about the difficulty of recognising that apartheid was wrong when you were raised in a system that supported – and was supported by – apartheid: '...it is very difficult. I mean, I would definitely say I have contributed to something that in the big picture is not right...'

Gary and another respondent, Zachery, both argued that one had to exercise as much agency as possible, in whatever position one found oneself, to challenge the system. Everyone was aware of the very serious consequences of becoming known to the Bureau of State Security (BOSS) who tapped phones, sorted to tactics of intimidation, and incarcerated – or worse – dissidents for transgressing apartheid laws. To avoid this meant trying to find ways to oppose the systematic injustice that pervaded society while 'keeping your nose' clean (in the words of Nikolai).

Since the areas that Gary's consulting firm were assigned to were designated 'black' by the government, he saw his electrification work as significantly improving the quality of life of the recipients of his efforts. Although he was not a supporter of the regime, and he recognised the social and political factors at play in engineering, he



took this stance: 'I made it clear that my contribution was technical.' He related many instances of how he worked hard to ensure good access to electricity at a reasonable cost, even if his client was not supportive of this effort.

Zachery is an interesting case because he saw himself, firstly, as an activist and then as an educator. The English-language university at which he worked was simply the context he chose to push against the pervasive injustices of apartheid that he recognised, both before *and after 1994*. About the role of engineers under apartheid he made this comment:

...whether you are an engineer, or whether... it didn't matter what you were, and, and, you know, because it was so tightly controlled... as long as they were pushing the boundaries, you know, as long as they were willing to push the boundaries. In other words, they can't just accept that in fact, the plan is that these people aren't going to have electricity... the issue was to push; push in the liberal spaces that were created. And to always have to keep your eyes open to look below the surface as to what's happening.

## 5 CONCLUSION

The emerging findings from this study suggests indicates, as expected, that the embeddedness of engineering activity mediates the engagement of engineers with society. However, the multiple dimensions of the relationship between engineers and society show that this process of mediation is extremely complex. The ways in which the participants navigated apartheid society was influenced by the academic institutions at which they were employed, and the ways in which academia interacted with the engineering industry. Furthermore, the differences between the cultural norms within society (in this case, between Afrikaans- and English-speaking segments of society) added another layer of complexity. These differences extended to the overlapping constituencies of academic institutions, engineering industry and the state.

This complexity plays out in terms of how engineering academics conceived of their culpability in relation to apartheid. The framing of the lecture given in the Engineer in Society course assumed inaction and complicity on the part of engineers, but this research indicates a range of reflexivity. Some respondents did conceive of their relative inaction as contributing to the systematic oppression of apartheid (Nikolai and Ryden) although this was couched in explanations about the difficulty of standing up the regime. Others saw themselves as alleviating the suffering of black people through their engineering work and associated technical prowess (Gary). While this does not equate to a narrative of engineering heroism in the sense of Cech [5], it can perhaps be understood as 'technical activism' on the part of South African engineers who saw themselves as resisting apartheid by exploiting 'liberal spaces'. Others, such as Zachery, considered themselves as activists under apartheid, and emphasised the importance of 'look[ing] below the surface as to what's happening' rather than allowing their conscience to be 'dulled' by the prevailing political system. Across the spectrum, these perspectives provide valuable insights and much-needed material for students to understand the South African case, the complexity of society and the role of engineers within it.





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