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Promoting energy efficiency in a South African university

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Abstract
Electricity supply issues have resulted in widespread blackouts and increased utility costs in South Africa. This is placing financial pressure on universities as they have limited means of increasing their income to cover the additional energy costs and, at the same time, are energy-intensive due to peculiar usage patterns and sprawling campuses with many (and often large) buildings. Thus, they must become energy-efficient. This is a case study of one such attempt. Four main findings emerged. Firstly, energy demand side management (DSM) had to be implemented in distinct phases due to unforeseen implementation hurdles. Secondly, there are both barriers and enablers to becoming an energy-efficient campus; that is, DSM requires managerial buy-in, capacitated operational personnel and money. Thirdly, personnel can either support or hinder DSM implementation. So, while hiring dedicated, skilled personnel to harness organisational commitment to DSM is essential, all personnel need training in energy-efficient behaviour and should be held accountable for DSM initiatives within their sphere of influence. An energy champion – at the highest level of the organisation – to influence policy and drive the behavioural and structural changes required, is strongly recommended. Lastly, DSM technologies may be readily available but are not necessarily bought, installed or used correctly due to behavioural and institutional cultural constraints.

Keywords: *sustainability, campus operations, barriers, champions*

Highlights
- *The challenges facing universities when adopting energy-efficiency are identified.*
- *There are also enablers to achieving energy-efficiency targets.*

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1. Introduction

South African universities, like other organisations, households and businesses are faced with increasing pressure to manage electricity demand and costs down by becoming energy efficient [1]. This is to address financial and generation capacity constraints. As Pretorius et al. note, residential energy consumption increased by 50% from 1994 to 2007 [2]. The price of electricity in South Africa has increased by over 200% between 2008 and 2014, so that universities face escalating energy costs, at a time when their operating budgets face multiple demands and opportunities to increase income are few. In addition, South Africa's main energy supply company, Eskom, is unable to keep up with demand and rolling blackouts (known locally as load shedding) often ensue [3]. Such losses of electricity supply are hugely disruptive and costly. Thus, managing energy costs down has become essential. Furthermore, many South Africans look to universities to provide leadership, and as such pressure is on them to be exemplars of energy efficiency. One key aspect thereof is to retrofit their built environment into an energy-efficient one, as buildings are known to consume significant amounts of energy, mostly during the operations phase. Most South African campuses were not, however, designed for energy efficiency. They cover large areas, have many buildings, and were mostly constructed in an era when energy optimisation was unimportant. As energy efficiency is seldom viewed as a core university function, prioritising it is a new concept. There are a number of implementation barriers that need to be overcome. This study, of a large, multi-campus contact residential university in Gauteng, explored what managerial approach is required to 1successfully achieve energy efficiency, that is manage down electricity consumption. It contributes to the literature, as previous energy efficiency studies at universities, focused mainly on national initiatives. Furthermore, little research has been conducted on energy efficiency within public building typologies.

1.1 An international perspective

A number of authors have long maintained that universities have a moral responsibility to engage in sustainable practices, including the creation of energy-efficient campuses [4–8]. Thus, the notion that universities must lead by example is not new [9, 10]. Despite this, few universities have assumed a leadership role in environmental responsibility and sustainability [11–13]. Arguably, this is due to a number of barriers impeding the emergence of sustainable campuses [14–15]. Empirical studies posit numerous explanations for why this is so. These include: (1) university management not seeing sustainability as part of their core business; (2) rhetoric is more common than action; (3) lack of financial resources (made worse by the usually long payback periods); (4) lack of expertise and information; (5) inhibiting organisational structures and organisational culture; and (6) a lack of incentives [16]. Krizek et al. [17] suggest that universities face specific and unique pressures, such as competing yet equally important priorities; organisational diffusion; financial constraints and internal power struggles, as shown in Figure 1.

Sharp suggests that the various university subcultures (teaching, research, administration, operations) create power groupings and internal struggles ensue [18] so that organisational alignment is required to ensure an overarching vision of campus sustainability. Some scholars also point to the lack of leadership within the sector [15,19,20]). Rosenbloom concurs, recommending that sustainability requires a champion at very senior levels to drive it, as implementation requires authority and resources [21]. Therefore, institutions have to accept that sustainability is not simply an accounting exercise, but requires a change in approach and way of thinking.

Pearce and Miller [23] argue that universities often fail to capitalise on the enviro-economic opportunities because campus operations are invisible to campus decision-makers, making them unaware of the issues at hand. In addition, there is a tendency to save money by deferring maintenance, especially in an environment where capital and labour are often costly and scarce in the first place. For example, a survey of approximately 400 USA colleges and universities found billions of US dollars value in deferred maintenance [22]. Rosenbloom [21] found that decentralised decision-making is a major inhibitor. For example, although a (temporary) shift in funds from student services to retrofitting buildings would ultimately offer students a better service, this seldom happens, as budgets are devolved to different people with different responsibilities. Other studies point to organisational complexity as the primary problem [5,18,23–26].

1.2 Sustainable campuses – the South African perspective

South African universities face not only internal barriers to the establishment of sustainable campuses, but also considerable national ones (see Table 1), the most significant being energy generation, transmission and distribution. In particular, Eskom monopolises electricity generation [2,27] and so plays a pivotal role in either hindering or helping an organisation become energy efficient. For example, Eskom is the custodian of national energy data, it sets electricity prices (along with the National

1 Universities' primary goals are seen as recruiting students, skilled staff and grant funds [22], [6].

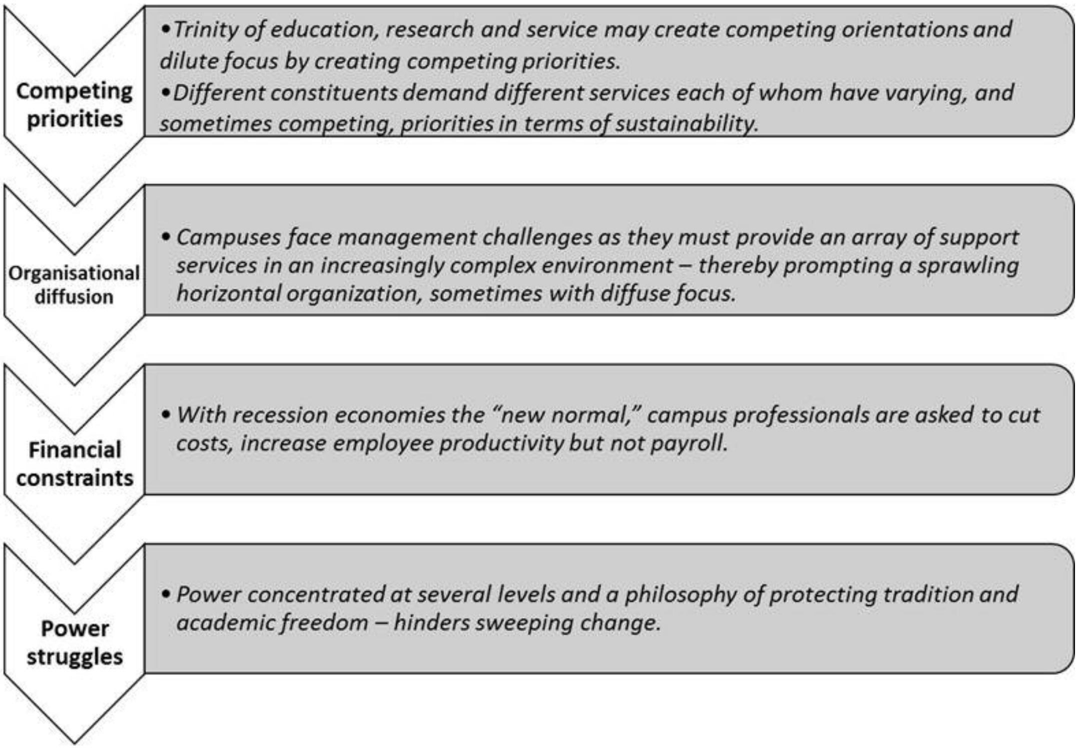

Figure 1: Barriers to achieving sustainable campuses (adapted from Krizek et al. [17]).

Table 1: National barriers to energy efficiency [29, 30].

Barrier	***Description***
Historically low energy pricing	Due to historically low prices of coal and electricity
Lack of knowledge and understanding of energy efficiency	Across all stakeholders
Institutional barriers, and resistance to change	Fears that energy efficiency will disrupt production or work processes
Lack of investment confidence	Scepticism that the returns on the initial investment will materialise

Energy Regulator and the municipalities) and often large users pay less per kilowatt hour than smaller ones. This creates an unfavourable environment for energy efficiency [28]. However, with Eskom facing serious supply problems, rolling blackouts and steep electricity prices increases (at rates far above inflation) are frequent occurrences, so that many consumers are prompted to seek ways to become energy efficient (to contain costs) and reduce their reliance on Eskom (to ensure security of supply).

Another pivotal player is the local municipalities, who buy electricity from Eskom and sell it to consumers, such as universities. Consequently, municipalities are 'middle men' in the electricity supply chain and they sell electricity on at a profit. With their small tax base and limited monetary transfers from national government, most municipalities use electricity sales to sustain themselves and cross-subsidise other municipal services. Accordingly, they have a stake in high tariffs and high electricity consumption. Be this as it may, there are additional, and serious problems at the municipality level in South Africa, with respect to metering and billing. That is, most municipalities do not have the technical and financial skill to bill accurately, and what information they do have is often of such a poor quality that it is unusable [28]. So, electricity or utility bills can be best described as estimates, although some municipalities, such as the City of Johannesburg have been found to be systematically overcharging [31]. As Thovhakale et al. [32] highlight, such accounting problems are a significant barrier to energy efficiency because users are unable to make informed decisions about their energy consumption and there is seldom a direct relationship between reduced consumption and a reduced utility bill. Therefore, building a business case for energy efficiency is difficult, as the return on investment cannot be calculated with certainty. Users are often forced to verify their own consumption by installing additional meters. In fact, Thovhakale et al. [32] advocate the installation of additional meters to verify consumption, together with the nomination of champions within an organisation to drive energy efficiency. Thus, they argue, reducing energy consumption in buildings is a skilled activity. South Africa also has specific technological barriers that need to be overcome, in, for example, lighting, solar water geysers and heat pumps. For South Africans, such technologies represent high investment costs coupled with a lack of trust in unfamiliar technology. People lack training and understanding of how they work. In some cases, there are also operational problems relating to the use of the technologies [33]. Thus, incentives for their adoption are not clear.

South African universities also have internal barriers to overcome. To date there have been few studies on their energy efficiency. Heun & DeVries [34], however, found that a lack of clarity within the organisation meant that those wanting to implement energy efficiency measures do not know who to approach or even how to get the process going. University personnel and students are found to be 'disengaged' with respect to DSM – unaware of how much electricity they consume and how much it costs, and unwilling to change unless there are incentives or enablers to do so. They concluded that dedicated personnel and policies are required if energy efficiency is to be achieved. Other studies found other hurdles such as: a lack of in-house expertise (and hiring such personnel is difficult due to the skills shortage and high salaries they can command) and lack of data (a perennial South African problem) [35, 36, 37]. Additionally, the initial high capital investment requires an understanding of long-term savings benefits, which is a challenge as budgetary pressures are usually short-term [34, 37]. If all the savings generated from DSM interventions are not ring-fenced for additional DSM investments, then momentum is lost, limiting opportunities and long-term benefits. Based on the literature, the barriers to achieving energy efficiency are: (1) lack of in-house experience or of dedicated capacity; (2) lack of data; (3) lack of initial capital investment; (4) lack of incentives; (5) unclear organisational boundaries (6) unwilling personnel; (7) lack of awareness, and poor communication with personnel. There are also proposed solutions in the literature: (1) a dedicated enthusiastic driving team headed by an energy manager located in facilities management; (2) support from management, with a focus beyond mere financial viability; (3) submetering and reliable data management; (4) having a sustainability office; and (5) having a revolving energy efficiency fund [34–37]. Systemic solutions to these barriers involve three key components: behaviour, information (or data), and integration [36]. At the institutional level, Delport [35] recommends the formation of an Energy Co-ordination Committee, an Energy Action Team, and the drafting of an Energy Policy as a precursor for successful energy DSM. This is in line with what Fawkes [38] found in a specific South African industry, along with poor managerial commitment, low levels of commitment by personnel, confusing investment and communication channels, and the lack of an energy policy. Lastly, any public South African organisation, including universities, will find that most energy DSM research has focused on residential, commercial and industry buildings. With little research on public building typology, the learning curve is great and costly.

Unlike some of their international counterparts, however, South African universities also experience other unique pressures, including the need to promote transformation and diversification. Dealing with issues of access, equity and quality relative to the standard functions of a university are significant challenges [39]. Thus, Badat [40] refers to a situation where universities face 'demand overload', compounded by the fact that South African universities are significantly underfunded. South African universities are, then, seldom in a position to implement DSM, even should funds be available, as pressure to channel such funds to other functions is immense. In such a context, it seems that a way forward for them is to focus on the pragmatic benefit of cost reduction, to enable savings on the utility bill to be redirected to the core mission of teaching and research [3]. Although energy-efficient campuses are not common in South Africa, where attempts have been made, the focus has been on technical interventions to reduce consumption (e.g. energy-efficient lighting). But technical interventions have their limits [41–43]. There is a growing body of evidence to suggest that adopting a behavioural approach in conjunction with technical interventions is required if energy efficiency is to be achieved [43–45]. The behavioural approach involves trying to influence people's attitudes using various techniques such as incentives, awareness raising or skills development [46]. Saini [47] argues that 'well-motivated personnel are best able to develop and implement energy efficiency policies'.

2. Research design and methodology

A qualitative research design, with in-depth interviews with key university personnel and a case study approach, was adopted. Case studies are a popular qualitative research methodology [48]. Case studies have been adopted in various studies with a sustainable campus focus [49–54]. The university that formed this case study is one of South Africa's the largest residential universities, with a student population of roughly 50 000 and a personnel complement of approximately 6 000. It was formed through the merger of various smaller higher education institutions and has four campuses comprising 302 buildings or 661 974m^2 of built environment [55]. The utility bill is high. The institution is flagged as a 'high energy user' by the local authority, indicating that in the future it will be forced to implement energy reduction targets or endure financial penalties. Recognising this, the university committed itself in 2012 to achieving a 7% consumption reduction by 2013 [3]. This study explored the process through which the university set about achieving this target and records the lessons it learnt along the way. Interviews with key stakeholders involved in DSM initiatives were conducted between January 2011 and December 2012, using a purposive sampling approach, and each was interviewed twice. Seven individuals (academics, executive managers and a consultant) participated (see Table 2). All ethical considerations were adhered to and consent from university management was obtained. The narrow range and limited number of participants is a shortcoming, and a better distribution between academic and administrative personnel would have been preferred.

Table 2: Description of respondents with references used in text.

Respondent	***Level in organisation***	***Cited as***
Prof A	Research professor	Respondent A
Dr B	Senior lecturer	Respondent B
Dr C	Executive	Respondent C
Mr D	Director	Respondent D
Mr E	Director	Respondent E
Mr F	Director	Respondent F
Mr G	Consultant	Respondent G
Mr H	Campus official	Respondent H

3. Results

The need to manage the 2005 merger between the three 'parent' institutions of university, meant that for a number of years energy efficiency was not a priority. Thus, the first step towards DSM was an electrical safety audit in 2010. Although the audit revealed that the biggest campus had the highest electricity consumption, the serious problem of no extant wiring data for the other campuses meant that all electrical infrastructural investment had to go into extensive (and costly) electrical infrastructural rehabilitation and upgrading (Respondent D).

Then attention turned to electrical metering and the auditing of the municipal electrical accounts. This audit found that accounting personnel had left some utility accounts unpaid for years as, with no access to meter readings, they could not authorise payments as they could not verify their accuracy (Respondent H). Forensic auditing of all the utility accounts revealed that the municipal bills were inaccurate, sometimes resulting in under-billing, but evidence of systematic overcharging by the municipality emerged and it could not be determined if the electricity meters were read on a regular basis (Respondent C). Improving the electricity metering system to verify accounts was, therefore, urgent. But this was seriously hampered when, in 2011, there was a data system crash, and all real-time electricity readings for the main campus were lost. Consequently, the creation of an electricity consumption baseline dataset was delayed (Respondent C). In addition, establishing and validating electrical metering took on a lengthy trial and error approach until it was realised that metering must at the level of individual buildings (Respondents D and H).

During this time, some DSM interventions were carried out, such as installing energy-efficient lights, banning the purchase of new air-conditioners, removing hot water boilers and buying stand-by generators to cope with the blackouts. It was found that the main campus-wide air-conditioning system was extremely energy-intensive, partly because the plant was old and inefficient. The student residences were also found to be major energy users (Respondent G). It was also a period when a Steering Committee on Energy Efficiency, Water and Resource Efficiency was formed and made a sub-committee of the University Council. But still 'a lot had to be done' (Respondent C), especially as 'over weekends [power consumption] should drop yet [it hasn't]' but where, how and why this was occurring remained unknown and unaddressed (Respondent D).

Another realisation was that dedicated personnel – energy efficiency champions to drive energy efficiency – are needed (Respondents F and D). The use of 'consultants and temps' meant DSM initiatives were undertaken on an ad hoc basis. There was no overall plan, policy or strategy. Thus, a 'utilities director' with high levels of DSM technical expertise (knowledge and experience) and competence is needed to institutionalise DSM (Respondent D). Such a utilities director would ensure that institutional energy efficiency targets are met, and that a more structured or coordinated approach to energy efficiency is taken. Considering the size of the problem and the lack of internal capacity, this Utilities Director also needs strong leadership and managerial skills, and the ability to think on their feet and be a consummate problem solver (Respondent D).

Be that as it may, both the creation of the utilities director post and filling it was fraught with delays, partly due to financial constraints and human resources policies. Although the position required a highly skilled, senior, qualified and experienced engineer, the university remuneration bands could not accommodate the salary such a person commanded. Although one was eventually hired, once the university overrode its remuneration bands, he soon left due to uncompetitive performance incentives and retention polices (Respondents D and E). Despite this, significant advances were made under his leadership. The university was able to recoup monies overpaid to the municipality (about R23 million) and energy efficiency targets were included in the performance contracts of specific personnel members for the first time (Respondent D).

Lack of training and development of personnel in relation to DSM was another finding. It was realised that all personnel, 'even the finance guys', need to know about energy efficiency (Respondent F). This includes management, which must grasp the business case for DSM, that is, that 'the capital costs will be recovered through lower operating costs' (Respondent F). There also needs to be collaboration with academics, which was not occurring and so the skills and knowledge of academics went unutilised: 'we should be tapping into that intellectual space … we may have done stuff which, if we consulted with them, we could have done differently or solved the problem' (Respondent D). Lastly, it was realised that a formal energy policy was required to get buy-in from all stakeholders and ensure enforcement of energy efficiency decisions, systems and initiatives. Policy proved to be pivotal as it 'binds every person' and 'without an energy efficient policy, you do not have a fall-back position' (Respondent B). With no clear-cut policy on energy efficiency there was 'no enforcement, no rules, and no regulation' (Respondent G). That is, the policy can be used to defend DSM initiatives if they are challenged.

The promulgation of an energy policy was a turning point in DSM initiatives, as it institutionalised energy efficiency, preventing new employees derailing it with a new focus (Respondent B). Thus, policy has a lasting effect. Unfortunately it took years to get the policy drafted and ratified as it was delayed by conflicting priorities and bureaucratic procedures (Respondents D and F). University structures and governance processes are so cumbersome and complex, with numerous administrative steps and approval levels required, so 'you need to be very patient' (Respondent B). It took time to get everyone to sign off the documents, but the tender processes are also very long, as is the evaluation period and appointing the contractor. There could be up to 12 months of delays, or even more (Respondents D and F).

Rising electricity costs proved to be a major driver of DSM (Respondent C). Above-inflation increases and threatened financial penalties compelled university management to include energy-saving targets in the institutional scorecard (Respondent D). Once this occurred, the business case to use a return on investment argument to justify DSM enabled the approval of energy-efficiency projects. But as there was 'only so much money', DSM arguments needed to be financially very strong to compete against other priorities, as all were funded from one limited reserve fund (Respondent C). One respondent said that 'five years ago [management] wouldn't be very positive [but as] these initiatives [have] such a huge effect on the bottom line…it makes business sense [now]' (Respondent C). Despite this, money was limited and the projects were run on tight budget (Respondent D). Once management set targets, operational personnel had to meet them, with targets embedded in the performance contracts of personnel at Director level. As these targets were not filtered down to more junior personnel, however, their effectiveness was limited (Respondent F). For example, procurement personnel did not have DSM targets. Procurement itself was highly inefficient (Respondent G described procurement as the 'backwards and forwards throwing of documentation'). Procurement challenges demoralised operational personnel. Thus, there is a need to 'streamline procurement and [fix) glaring problems' (Respondents G and F).

The organisational structure of the Operations Division resulted in 'nobody [being] responsible for DSM' at individual campus level, as DSM projects were driven centrally despite implementation being required at campus level (Respondents B, D and G). Consequently there was a lack of focus and coherency (Respondents D & F). It also caused tensions between campus and central decision-making (Respondent D). For instance, campus personnel, who controlled capital budgets, were told to reduce spending, which they did – by purchasing cheaper, energy-inefficient incandescent lights (Respondent F).

Whilst there was recognition that 'projects should be planned [and] executed', the university seldom followed planned processes as regular crises/emergencies derailed a strategic approach (Respondent D). Power struggles between personnel and between divisions were another problem. For example, academics and operations personnel competed for money: 'You [want] money for greening [but] a professor needs something urgently for his research laboratory' (Respondents C, F and H). What is more, although there were a number of academics involved in the field of energy efficiency, only a few actively participated in the operational interventions of the university.

The institutional culture did not value energy efficiency or change. Long-serving personnel were the most resistant to change, perhaps due to extensive merger-related change resulted in 'change fatigue' (Respondent F). Personnel were apathetic and/or negative towards energy efficiency: 'The tap isn't closed … air-conditioners left on'. Some refused to co-operate. For example, each division or department had its own kitchen but personnel each had 'their own kettle, own heater, even their own microwave in their office' (Respondents C and G). This was also true for students in residences, all of whom had a plethora of personal appliances in their rooms (Respondent B). Negligence was another issue, such as failing to switch off computers or lights: 'If it doesn't affect a person in his personal capacity, there is a tendency of 'don't care that much' (Respondent C). It was felt that personnel and students did not treat university funds and property with care (Respondents A and C).

Some of this could be attributed to users being unaware of the need to conserve energy or how much electricity cost the university (Respondents B, D and F). Technology could, therefore, assist in reducing wastage: 'Technology will solve 60% of the … issues where people fail to put off their computers, lights' (Respondents A and H). Respondents felt that if users were provided with feedback and information, using the university website, personnel circulars, and posters in lifts and real time displays (e.g. dashboards) things would improve (Respondent C). One respondent suggested that management should inform personnel better, communicate the energy target and reiterate that it must be met (Respondent F).

4. Discussion

The four main findings emerging from the data will now be discussed. For this university, implementation of DSM occurred in two distinct phases: an 'uncoordinated phase' and a 'coordinated phase'. The former was characterised by the dominance of merger-related issues, with DSM not being prioritised. Thus, the merger was a disruptive, time- and resource-intensive process. There was no energy policy, which also inhibited the achievement of energy efficiency targets. The coordinated phase commenced with the appointment of a professional engineer as utilities director. This phase had an energy policy that empowered operations personnel and linked energy efficiency interventions to institutional goals and governance systems. Thus, an energy policy promotes buy-in to DSM, embeds energy efficiency into institutional practice, makes DSM targets enforceable, and ensures procurement of energy-efficient products (embedding DSM targets into purchasing decisions so that the lowest bid is not automatically accepted if it means DSM targets cannot be met). Furthermore, such a policy ensures that new managers cannot arbitrarily change targets, systems and procedures.

Analysis of the utility accounts proved to be invaluable. Firstly, scrutinising the bills made personnel aware of the true cost of energy inefficiency and awakened personnel to possibilities for saving money, as other researchers have found [57, 58]. Secondly, the university realised that independent meters must be used to verify account readings. In this regard, the sub-metering of individual buildings is essential. Unfortunately the overall university budget hindered the adoption of DSM systems and technologies, as capital was seldom available for retrofitting. In particular, limited operational budgets caused all energy-efficiency projects to be driven by short-term financing concerns. This is problematic as most DSM return on investment takes place over the medium to long term. The human resources budget was also a barrier to the hiring (and retention) of the energy champion in the form of the utilities director. Thus, finances can act as a driver and a barrier at the same time, as others have found [21,59,60].

Personnel are key role-players in DSM and, as such, operational and technical personnel must be empowered with the right levels of expertise, decision-making ability and accountability. Energy-efficiency targets must be embedded in the performance contracts of all operations personnel. They also require specific DSM training and development. In addition, as finance personnel pay the utility bills and manage procurement, they also need DSM training and targets. Initially, the lack of an energy-efficiency champion with specific DSM expertise hindered the implementation of DSM. For example, although the energy policy took a long while to be adopted, partly due to competing priorities that are natural in a large, complex institution, it was mainly because there was no one to drive or chaperone it through the system. In South Africa professional engineers with DSM experience are, however, much in demand and in short supply, so hiring such a person challenged the university human resources policy due to performance bonuses and retention-incentive constraints. This situation was aggravated by the need to adhere to national (and regional) employment equity targets. Without dedicated personnel, however, DSM progress is slow, ad hoc and subject to whimsical changes.

The study also revealed that the academics were an untapped source of expertise, so that opportunities for academics and operational personnel to collaborate on DSM initiatives went unrealised. For example, academics could supervise postgraduate students using the campus as their study site, or assist with the analysis of campus energy consumption data. Academics could also embed energy efficiency and sustainability issues into the university curriculum, at the very least promoting user awareness of the need to save energy. That said, operational personnel must still be able to achieve energy efficiency targets independently. In this regard, an energy efficiency task team has a crucial role to play in integrating DSM measures across all university activities. In particular, a senior university manager, preferably the utilities director, must chair the team. The task team must meet regularly and everyone involved in DSM initiatives should report to it.

For this university, organisational culture hindered the uptake of DSM projects, as the organisational culture inhibited quick decision-making, slowing reaction times in an environment that is unpredictable and fluid. Delays in the adoption of an energy policy, for example, were partly due to the cumbersome, procedural and bureaucratic nature of the organisation. For example, numerous stakeholders had to be engaged and re-engaged. This artificially prolonged the processes and caused frustrating delays. This is in line with the findings of Tudor et al. [56], who identify an 'ingrained' organisational culture often negating individual actions. In addition, organisational culture did not promote cooperation across divisions. Thus, although personnel from different divisions were responsible for different aspects of the energy efficient campus initiative, they did not work as a team. Decision-making devolved to the level of the division, but the overall lack of collective ownership meant that operational logjams resulted. Line managers found themselves having to make both reactive decisions and manage crises simultaneously. The structural separation of divisions contributed to inter-departmental power struggles, tensions and conflicts. For example, there were often tensions between institutional-level decision-making, where energy efficiency projects had to be approved, and the campuses which were responsible for day-to-day implementation. Finance personnel had a significant role to play (with respect to analysing utility accounts, procuring DSM technologies and managing capital expenditure), but this was seldom recognised by the various parties. Improved communication, information-sharing, training and development are required to effect a cultural change. Another inhibitor was the mismatch between the skills and attitudes of people in the job and those required for the job. In line with many studies, all respondents were unanimous that the management of the behaviour of users (personnel and students) was a key factor to reduce energy consumption [43, 61, 62]. Users drive up energy consumption for reasons related to perceived comfort levels, convenience and neglect. Thus, managing behaviour is the next step for this university to achieve energy efficiency. It is recommended that marketing campaigns are used to communicate energy efficiency messages to users.

5. Conclusions

Overly bureaucratic systems and internal power struggles were barriers to DSM in this study, showing that organisational structure and culture impact on DSM initiatives. In addition, other priorities, such as dealing with the merging of three different institutions, can delay the implementation of DSM. Untrained and unaccountable personnel hinder DSM initiatives; DSM is enabled when employees are skilled and tasked with achieving energy efficiency. The existence of a high-level champion contributes significantly to the success of DSM activities. Finally, academics should be viewed as a key resource that can be harnessed to enhance DSM achievements. In conclusion, successful DSM requires top-level managerial buy-in, capacitated operations personnel capacity, and dedicated funds.

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