Proceedings of the International Conference on Industrial Engineering and Operations Management
Pretoria / Johannesburg, South Arica, October 29 – November 1, 2018

Business process reengineering during technology implementation in power plants

T. Buthelezi, A. Marnewick

Postgraduate School of Engineering Management
Faculty of Engineering and the Built Environment
University of Johannesburg
Auckland Park, Johannesburg, South Africa
thamsanqab@gmail.com, amarnewick@uj.ac.za

Abstract

Business process reengineering (BPR) aims to challenge and assist organisations to break away from old ways of conducting business processes and embrace new ways to execute business processes. The implementation of new technology allows organisations to improve and simplify methods of executing business processes. Despite this, the possible benefits provided by new technology are not achieved when ineffective and outdated business processes are reapplied to execute business operational activities even though technology provides alternative ways of executing business processes.

The purpose of this research is to confirm why the benefits provided by new technology are not achieved when technology is implemented without correctly reengineering existing business processes. The research investigates if there are any gaps in the BPR methods applied in power plants during new technology implementation. The research also establishes which BPR success factors are not successfully incorporated when new technology is implemented.

The research uses two case studies within the same organisation to evaluate how BPR is conducted during new technology implementation. The research found that if business processes are not reengineered according to best practices and all success factors are not successfully incorporated during new technology, the benefits that the technology provides are not achieved.

Keywords - Business process reengineering; technology; power plants

1. Introduction

The South African State Owned Entity (SOE), Eskom Ltd, has embarked on a capacity expansion program to increase the capacity of the installed power generation units (Koko & Singh, 2016). The capacity increase program also entails the introduction of new technology to improve plant performance and reliability, extend operational life expectancy, increase performance, implement a condition monitoring system, incorporate energy efficiency systems and improve system efficiency and compliance with the latest standards and specifications (Moodley, 2008; Volk, 2012; Eskom Integrated Report, 2015; Masango, 2015).

Technology implementation often requires changes in organisational structures, policies and human resource requirements (Davenport & Stoddard, 1994). Organisational changes in relation to introduction of new technology often results in employee resistance, which can drastically influence project success and subsequently inhibit redesigned processes and prevent them from being effective (Bovey & Hede, 2001).

Business process reengineering (BPR) involves the identification and removal of inadequate processes that fundamental impact the company's performance and efficiency (Hammer, 1990; Sturdy, 2010; Martin, 2014; Aboulaid et al., 2016; Jha et al., 2016). BPR is a radical change process where existing processes are 'obliterated' and replaced with new innovative processes with the objective to improve performance (Hammer, 1990; Jha et al., 2016). Davenport (1995) states the rock to all reengineering success is people. Often new technology is introduced to improve business performance, however, people are often ignored and expected to accept the new technology and processes (Schumacher, 1997; Attaran, 2004).

Barnes (2007) expresses implementing technology without changing business process has little impact and improvements on business performance. In addition, implementing technology without reengineering related processes will not result in full utilisation of capabilities provided by technology (Harps, 2005). Therefore, before any implementation of new technology, existing business processes should be extensively analysed, reviewed, redesigned and streamlined (Tyre, 1991; Al-Mashari & Zairi, 1999; Scholl, 2003). In this paper, the aim is to confirm benefits provided by technology are not achieved when technology is implemented without correctly reengineering existing business processes.

The rest of the paper is structured as follows. The next section outlines what other researchers have discovered regarding BPR and technology implementation. Section 3 provides an overview of case studies, data collection and analysis protocols used in the research. Section 4 presents the results, and Section 5 discusses research findings. And, finally Section 6 concludes the research and recommends future studies to improve BPR success during technology implementation.

2. Literature review

Technology benefits are not achieved as a result of reapplying ineffective and outdate processes, misalignment of business processes and technology and the lack of understanding of existing processes and technology being implemented (Decker, 2010; Khatri, 2010; Menard, 2013). Khatri (2010) mentions that the key to having a sustainable business is to ensure processes and technology are aligned to achieve a competitive advantage. However, other researchers have mentioned that BPR projects mainly focuses on implementing technology solutions instead of focusing on improving processes (Harvey, 1999). Therefore, organisations should conduct a thorough review of business processes, with the objective to understand the impact of technology on existing processes instead of focusing mainly on technology implementation (Harps, 2005; Menard, 2013).

In order to achieve research objective, literature review focuses on methods used to reengineer business processes during technology implementation. This involves, defining BPR, the identification of BPR methods and evaluation of BPR success factors during technology implementation.

2.1 Business process reengineering

BPR is systematic methodology that is used to analyse, rethink, breakdown, and redesign existing processes, with the objective to improve company productivity by making business processes more efficient (Martin, 2014). BPR comprises of tools that enable organisations overcome challenges and achieve a business strategic and competitive advantage (Aboulaid et al., 2016).

2.2 Business process reengineering methodologies

Literature identified and reviewed methodologies by Hammer and Champy, Davenport, Manganelli and Klein (Schumacher, 1997; Chronaki, 2013). The identified the methodologies have specific advantages and benefits which are essential for business process reengineering success. However, applying the methodologies individually to facilitate changes in business processes during technology implementation is not sufficient to achieve intended benefits. This is due to each approach specifically focusing on specific elements of business process reengineering where:

- Hammer and Champy – Focuses on clean slate approach;
- Davenport – Focuses on information technology and prototype processes; and
- Manganelli and Klein – Focuses on technical and social design.

Even though each methodology has advantages, the application of each methodology individually excludes some focus elements which are essential for business process reengineering success. The research proposed a combined BPR approach to achieve research objectives. The combined approach integrates the three methodologies to form one comprehensive methods taking into consideration advantage and benefits of each methodology.

Figure 1 outlines the overview of the combined BPR approach and focus elements associated with business process reengineering success.

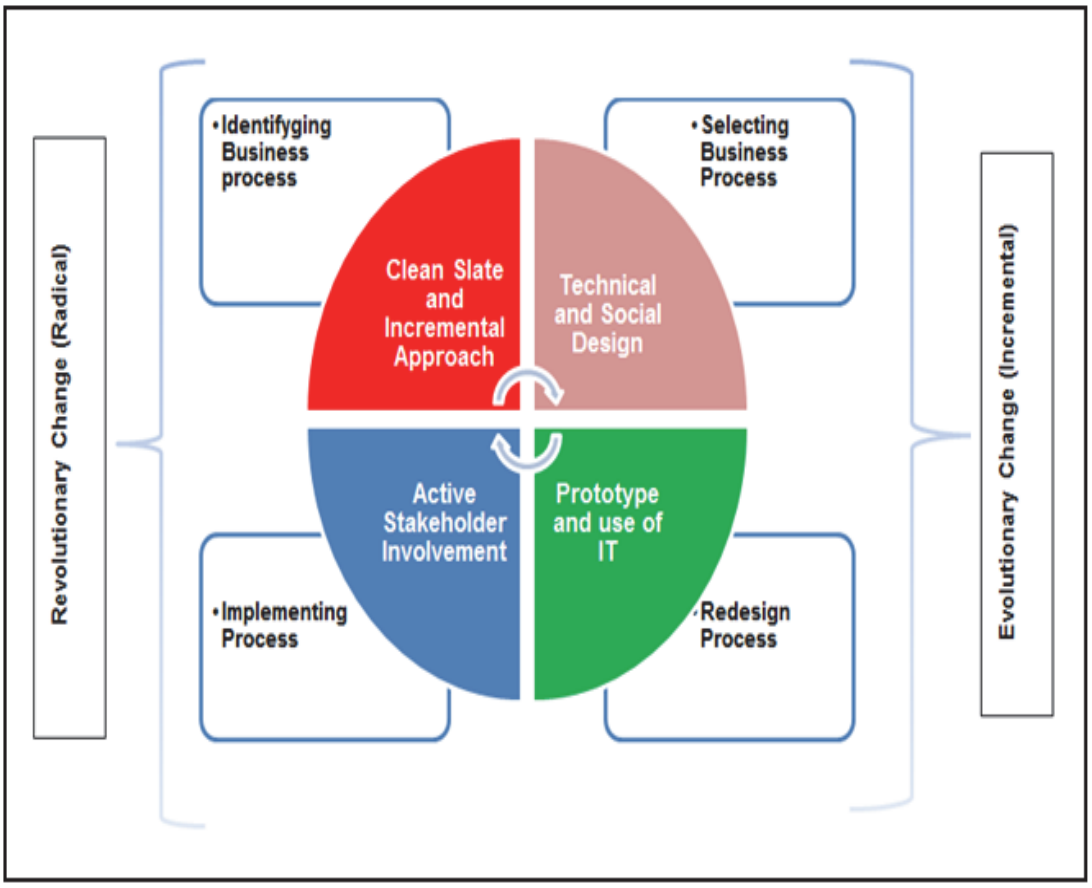

Figure 1: Combined BPR approach

The elements for the combined BPR approach are (Schumacher, 1997; Chronaki, 2013):

- Identification of business processes;
- Early involvement and active participation of plant personnel;
- Evaluation of new technology impact on existing processes;
- Performance evaluation of identified processes;
- Analysis of new technology impact on organisational cultural;
- Development of prototype processes prior to implementation; and
- Implementation of reengineered processes.

2.3 Business process reengineering success factors

Literature review also identified BPR success factors that are critical for achieving reengineering success. The success factors comprises of hard and soft issues that are essential for reengineering success. Al-Mashari & Zairi (1999) and Darmini & Hanafizadeh (2013) identified and categorised success factors as indicated below:

- Change Management – focuses on management of change;
- Management competency and support – focuses on active management and strong leadership;
- Organisation Structure – focuses on work integration;
- Project Planning and Management – focuses on strategic alignment of corporate strategies; and
- IT infrastructure – focuses on information systems and software tools capabilities.

The research uses the combined BPR approach and success factors to evaluate if business processes are reengineered correctly and also to establish if BPR success factors are adequately incorporated during technology implementation.

3. Research method

Case studies focus on a contemporary event or phenomenon, with the objective of gaining an in-depth knowledge of the research unit of analysis, which is BPR during new technology implementation (Easton, 2010; Noor, 2008). Therefore, the selected cases involve power generation plants and the role BPR plays when technology is implemented. The objective is to establish how BPR activities are conducted within the power generation industry. The research evaluates two cases within the same organisation. The study evaluates business reengineering activities when new technology is implemented in the following situations:

Case Study 1: New power plants where new technology is implemented to provide new methods of conducting business processes; and

Case Study 2: Existing power plants where new technology is implemented to replace old technology and aims to introduce new methods of conducting business processes within an established environment.

Documentation and interview data are multiple sources of evidence used as data collection protocol (Noor, 2008; Yin, 2013). Project documentations were evaluated to establish how BPR steps are utilities within the power generation units. Interviews were conducted with power plant engineers responsible for new technology implementation and reengineering of business processes.

Documentation analysis evaluated project documents used to reengineer business processes during new technology implementation since both cases are within the same organisation. The organisation uses standardised documents across the entire power generation fleet to implement technology projects in the organisation. Predetermine themes based on the combined BPR approach in figure 1 are used to categorise document findings.

The qualitative quick guide by Morrison (2014) is used to evaluate open-ended question responses which analysed the application of BPR steps. Interview data is captured, categorised into themes and analysed to identify patterns and commonalities within the cases. A five point Likert level agreement scale is used to capture closed-ended question responses (Vagias, 2016). The scale establishes levels of agreement and disagreement with the application of BPR success factors. In order to analyse and interpret participant responses, the weighted average is calculated to determine the level of agreement or disagreement with the success factors (Tavana, 2014). Thereafter, the success factors are ranked with the highest weighted average score success factor being ranked first and the lowest weighted average score success factor being ranked last.

Cross-case synthesis is applied to establish similarities between the case studies, since the research aims to provide evidence that the same phenomenon occurs between the two cases. Triangulation is applied during the data analysis to increase validity of the study, where the researcher aims to establish the converging lines of enquiry of the research findings.

4. Data analysis and research findings

This section discusses results and findings from document analysis and in-depth interviews. Documents are analysed to identify BPR processes adopted when new technology is introduced in power generation plants. Thereafter, open ended interview data is analysed to determine similarities and differences between the participant responses and closed ended question responses are also analysed to establish levels of agreement and disagreement with the application of BPR success factors. Predetermined themes are used to categorise document findings. These themes are derived from the combined BPR approach described in figure 1 in section 2.2 which outlines BPR steps.

Interviews were conducted with 11 of the 12 participants originally selected for the research. One participant requested to be omitted from the study and that resulted in a response rate of 92%. For **Case Study 1,** Introduction of new technology in new power plants, 6 participants agreed to be interviewed. For **Case Study 2,** Introduction of new technology to replace old and aging equipment in existing power plants, 5 participants agreed to be interviewed.

Table 1: Participant distribution

Power Plant Categories	**Engineers**
New build power plant	6x project engineers
Existing old power plant	5x project engineers

Table 1 shows the distribution of participants selected for interviews. The selected participants are project engineers within the organisation responsible for overseeing the implementation of technology and reviewing business processes. The participants have experience regarding the processes followed when new technology is implemented and are actively involved during the implementation process.

Since the research aims to provide evidence that the same phenomenon occurs between two cases, cross-case analysis compares the results of the two case studies. And data triangulation is also applied to establish the converging lines of enquiry between document analysis and interview questionnaire data.

4.1 Document analysis

Project documents were analyse to establish how the predetermine themes are incorporated within the documents. Table 2 indicates if the predetermine themes are incorporated within the documents.

Table 2: Documentation analysis summary

Predetermine themes	**Predetermined theme addressed (YES / NO)**
Identification of business processes	YES - Existing processes are identified to be reengineered.
Early involvement and active participation	NO - Plant personnel are not involved early when business processes are reengineered.
Evaluation of new technology impact on existing processes	YES - Technology impact on existing processes is evaluated.
Performance evaluation of identified business process	NO - Performance of existing processes not evaluated.
Organisational and cultural evaluation	NO - There is no formal process to evaluate how technology impact on culture is conducted.
Development of prototype processes	YES - Prototype processes are developed to simulate and test new technology performance.
Implementation of reengineered processes	YES - Plant personnel are actively involved during the implementation of reengineered processes.

The analysis revealed that the following predetermine themes are not covered in project documentation:

- Early involvement and active participation.
- Performance evaluation of identified business process.
- Technology impact evaluation on organisational culture.

The first finding shows that plant personnel are not involved early in the process of defining processes to be reengineered during new technology implementation. Plant personnel are only involved during the implementation phase of the project. The second finding shows that there is no defined documented information which clearly states how the performance of the processes identified for reengineering should be evaluated and measured. The third finding shows that there is no formal evaluation of technology impact on organisational culture during reengineering. Technology impact evaluations are mainly focused on plant performance, safety and environmental risk prevention interventions.

4.2 Interview analysis

Open and close ended interviews were conducted with 11 of the 12 participants selected for the research. Interview questionnaire responses were analyses to establish themes and patterns within the two cases studies. Table 3 outlines the cross-case analysis of open-ended questions themes for the two cases. The research findings outline how BPR steps are conducted during technology implementation.

Table 3: Cross-case analysis – BPR steps

Research findings	**Case study 1**	**Case study 2:**
Finding 1: Identification of business processes	√	√
Finding 2: Early involvement and active participation of plant personnel in the process	***X***	***X***
Finding 3: Evaluation of new technology impact on existing processes	√	***X***
Finding 4: Performance evaluation of identified processes	***X***	**X**
Finding 5 Analysis of new technology impact on organisation cultural issues	***X***	***X***
Finding 6 Development of prototype process prior to implementation	√	√
Finding 7 Plant personnel involved during implementation of reengineered processes	√	√
Finding 8 Technology benefits achieved	***X***	***X***

√ - Denotes process step is adequately addressed
X –Denotes process step is not adequately addressed
The first pattern indicates that existing business processes are identified to be reengineered when new technology is implemented. This corresponds with literature requirements to successfully reengineer business processes

The second pattern indicates that plant personnel are not involved in the initial phase of BPR. People are often ignored and not involved due to project schedule constrains and to avoid conflict. Plant personnel become involved at the commissioning phase of the project.

The third pattern indicates cultural evaluation is not considered as a priority during technology implementation. Technology replacement projects are mainly driven by the desire to improve plant performance and efficiency.

The fourth pattern indicates that prototype processes are developed to mimic new process conditions. Prototype processes are also used for training employees to acquire the necessary skills knowledge before technology is commissioned.

The fifth pattern indicates that technology is implemented to improve business performance, but the benefits provided by new technology are not achieved. Technology benefits are not achieved as ineffective and redundant methods of executing business processes are still reinforced and applied even though technology provides new methods to effectively execute business process activities.

Table 4 outlines the cross-case analysis of closed-ended questionnaire results. The weighted average calculation results were analysed and used to establish how effectively BPR success factors are incorporated during technology implementation.

Table 4: BPR success factors

Change management systems and culture	**Case study 1**	**Case study 2**
BPR activities are effectively communicated	√	√
Sufficient and adequate training and education is provided regarding new reengineered processes	√	***X***
Plant personnel are adequately empowered during reengineering process	√	***X***
Plant personnel are actively involved during BPR	***X***	***X***
Plant personnel are rewarded and recognised during reengineering process	***X***	***X***
Management competence factors	**Case study 1**	**Case study 2**
There is continuous management and evaluation of risk associated with reengineering	√	***X***
During reengineering management provides active support, strong leadership and commitment	√	***X***
Organisational structure factors	**Case study 1**	**Case study 2**
During BPR activities a cross-functional team approach is followed	√	√
The project team is highly skilled on conducting business process reengineering activities	√	***X***
The roles and responsibilities for all stakeholders involved are effectively allocated	√	***X***
BPR Project management factors	**Case study 1**	**Case study 2**
The new reengineered business processes are aligned with organisational corporate strategies	√	√
BPR consultants provided sufficient knowledge and assistance	√	√
BPR planning strategies and project management techniques are adequately applied	√	√
BPR vision is clearly understood and communicated	√	***X***
The identified business process are effectively redesigned	√	***X***
BPR is integrated with other improvement techniques	***X***	***X***
IT Infrastructure Factors	**Case study 1**	**Case study 2**

New business processes are effective alignment with organisational IT capabilities	√	***X***
The organisation ensured there is sufficient IT investment prior to conducting business reengineering	√	***X***
IT software application are used during business process reengineering	√	***X***

√ - Denotes BPR success factor is successfully incorporated
X – Denotes BPR success factor is not successfully incorporated

The first common pattern indicates that the following success factors are not incorporated during new technology implementation:

- Plant personnel are actively involved during BPR.
- Plant personnel are rewarded and recognised during reengineering process.
- BPR is integrated with other improvement techniques.

The pattern indicates that plant personnel are not empowered, rewarded and recognised during reengineering. Plant personnel are also not actively involved during the reengineering of business processes. Literature identified that ignoring employees during reengineering results in BPR failures.

In addition, the identified pattern indicates that BPR methods are not integrated with other business improvement techniques. It is important that reengineering processes are continuously monitored and assessed to ensure the new processes are effectively integrated and optimised.

The second common pattern indicates that the following BPR success factors are adequately incorporated during new technology implementation:

- BPR activities are effectively communicated.
- The new reengineered business processes are aligned with organisational corporate strategies.
- BPR consultants provided sufficient knowledge and assistance.
- BPR planning strategies and project management techniques are adequately applied.

The patterns indicate that BPR activities are communicated effectively and aligned with corporate strategies. The pattern also indicates that consultants provide sufficient assistance during reengineering and project management is successfully incorporated during the reengineering of business processes.

5. Discussion

Data triangulation was conducted to validate the research findings and establish the lines of convergences which outline why technology benefits are not achieved when business processes are not correctly reengineered. Table 5 identifies common patterns from document and interview analysis to support research findings.

Table 5: Data triangulation of common patterns

Findings	**Document analysis**	**BPR steps**	**BPR success factors**
Identification of business processes	√	√	√
Early involvement and active participation of plant personnel in the process	X	X	X
Evaluation of new technology impact on existing processes	√	X	√
Performance evaluation of identified processes	X	X	
Analysis of new technology impact on organisation and cultural issues	X	X	
Development of prototype processes prior to implementation	√	√	X
People involvement during implementation phase of reengineered processes	√	√	X

√ - *Denotes BPR step is adequately addressed*
X – Denotes BPR step is not adequately addressed

The results show that technology benefits are not achieved when the following BPR steps are not adequately addressed:

- When plant personnel are not actively involved and participate during the early phase of BPR when processes to be reengineered are identified.
- When performance of identified processes to be reengineered are not measured and evaluated.
- When technology impact on culture is not evaluated.

The results indicate that if people are not actively involved during the reengineering of business processes, it often leads to organisations implementing technology and not realising the promised benefits. As a result, cultural consideration and active employee involvement during new technology implementation are paramount in achieving technology benefits.

6. Conclusion

The research findings provide evidence which confirms the research problem and states that the benefits provided by new technology are not achieved when technology is implemented without correctly reengineering existing business processes.

The research identified the following BPR requirements as the main reason for organisations not achieving technology benefits:

- Limited early involvement and active participation of plant personnel during BPR.
- Lack of performance evaluation of identified processes to be reengineered.
- Lack of analysis of technology impact on organisational cultural issues.
- Lack of plant personnel reward and recognition during reengineering process.
- Limited BPR integration with other improvement techniques.

In order to successfully reengineer business processes, organisations must ensure that plant personnel are involved early, rewarded and recognised when business process are reengineered. Sufficient resources should be allocated to evaluate technology impact on people and culture within the organisation. And finally, identified processes performance must be evaluated and measured to establish if the existing processes are performing according to expectations.

The research findings provide knowledge and insight regarding the requirements to successfully reengineer business processes during technology implementation. The findings are applicable to power plants introducing new technology to improve performance and effectiveness of business process activities.

Future research is suggested to improve BPR success by prioritising technology impact evaluation on organisational culture, people, performance, and final establishing how performance of identified processes will be measured and evaluated during technology implementation.

References

Aboulaid, H., Jardini, B., Sedqui, A., Elkayl, M., Britel, M.R., Amri, M. and Lyahyaoui, A., Process re-engineering and success of integration projects of information technologies case study: Process modeling of a cross docking platform of a car manufacturer. *In Logistics Operations Management (GOL), 3rd International Conference on*, pp. 1-6, November 2016.

Al-Mashari, M. and Zairi, M., BPR implementation process: an analysis of key success and failure factors, *Business process management journal*, 5(1), pp.87-112, 1999.

Attaran, M., Exploring the relationship between information technology and business process reengineering, *Information & Management*, 41(5), pp.585-596, 2004.

Barnes, J., Implementing the IBM rational unified process and solutions: A guide to improving your software development capability and maturity, Pearson Education, 2007

Bovey, W.H. and Hede, A., Resistance to organizational change: the role of cognitive and affective processes, *Leadership & Organization Development Journal*, 22(8), pp.372-382, 2001.

Chronaki, A. P., Establishing core competencies for implementing successful construction projects in trading companies, 2013.

Darmani, A. and Hanafizadeh, P., Business process portfolio selection in re-engineering projects, *Business Process Management Journal*, 19(6), pp. 892-916, 2013.

Davenport, T.H. and Stoddard, D.B., Reengineering: Business Change of Mythic Proportions*?*, *MIS Quarterly*, vol. 18, no. 2, pp. 121-127, 1994.

Davenport, T.H. The fad that forgot people, Fast Company, No. 1, pp. 70-4,1995.

Decker, C., Failure to Communicate: The challenge of implementing new technology on the business process, d-Wise Technologies, pp. 1-11, 2010

Easton, G., Critical realism in case study research, *Industrial Marketing Management*, 39(1), pp. 118-128, 2010.

Eskom Integrated Report, Available: http://www.eskom.co.za/IR2015/Documents/EskomIR2015spreads, 2015.

Jha, M., Jha, S. and O'Brien, L., Combining big data analytics with business process using reengineering, *In Research Challenges in Information Science (RCIS), IEEE Tenth International Conference* on, pp. 1-6, June 2016.

Khatri, A., Evolution of future electrical network in Eskom, *In 62nd AMEU Convention*. pp. 113-118, 2010.

Koko, M and Singh Y, Overview of the Eskom and South African new build program, VGB PowerTech *International Journal for Electricity and Heat Generation*, Available:

http://www.eskom.co.za/AboutElectricity/FactsFigures/Documents/VGB_PowerTech2016-01-02.pdf, February 1, 2016.

Hammer, M., Reengineering work: don't automate, obliterate, *Harvard business review*, 68(4), pp.104-112, 1990.

Harps, L.S., Supply chain technology: Integrating the old and new, Available http://www.inboundlogistics.com/cms/article/supply-chain-technology-integrating-the-old-and-new, 2015.

Harvey, S. & Millett, B., OD, TQM and BPR: A comparative approach, *Australian Journal of Management and Organisational Behaviour*, 2(3), pp. 30-42, 1999.

Martin, Making Your Business More Competitive with Business Process Reengineering (BPR) Available: https://www.cleverism.com/business-competitive-business-process-reengineering-bpr, 2014.

Masango, J.F., Critical path method as a project modelling technique in coal refurbishment projects, PhD dissertation, University of Johannesburg, 2015.

Menard, M., 3 Steps To Effective Technology Adoption, Available:
http://www.hvacrbusiness.com/effective-technology-adoption.html, 2013.

Moodley, B, Engineering skills shortage in Eskom: an analysis of the situation and assessment of the impact of current and proposed interventions, PhD dissertation, University of KwaZulu-Natal, 2008.

Morrison, B.K., Analysing qualitative data: Quick guide, *Office of Assessment of Teaching & Learning*, Washington State University, 2014.

Noor, K. B. M., Case study: A strategic research methodology, *American Journal of Applied Sciences,* 5(11), pp. 1602-1604, 2008.

Scholl, H.J., E-government: a special case of ICT-enabled business process change, *In System Sciences, Proceedings of the 36th Annual Hawaii International Conference on*, pp. 12-pp. IEEE, 2003.

Sturdy, G.R., Business process reengineering: strategies for occupational health and safety, *Cambridge Scholars Publishing*, 2010.

Schumacher, W.D., Managing barriers to business reengineering success. BPR Online Learning Center. Available: http://www. prosci. com/w_0. Htm, 1997.

Tavana, M., Healthcare Informatics and Analytics: Emerging Issues and Trends: *Emerging Issues and Trends*, 2014.

Tyre, M.J., Managing the introduction of new process technology: *International differences in a multi-plant network, Research policy*, 20(1), pp.57-76, 1991.

Vagias, W.M., Likert-type Scale Response Anchors, Clemson International Institute for Tourism. & Research Development, Department of Parks, Recreation and Tourism Management, Clemson University, 2016.

Volk N, Opportunities and considerations for power plant refurbishment and upgrades, Available: http://www.energy.gov.za/files/4thEUSouthAfricaCleanCoalWorkingGroup/Eskom%20Refurbishment%20N%20Volk.pdf, 2012.

Yin, R. K., Case study research: Design and method, Sage, 2013

Biographies

Thamsanqa Buthelezi has an Engineering Management Master Degree and a Bachelor's Degree in Electrical and Electronic Engineering from the University of Johannesburg, South Africa. He is a registered professional engineer

(Pr. Eng) with the Engineering Council of South African (ECSA) and member of the South African Institute of Electrical Engineers (SAIEE). He has 9 years' experience working in various industries, including power generation, petro-chemical, manufacturing and telecommunications.

Annlize Marnewick is an associate professor at the Postgraduate School of Engineering Management in the Faculty of Engineering and the Built Environment, University of Johannesburg, where she focuses on the supervision of research masters and doctoral students. Before joining the academia she was involved in industry with a technical record of 15 years in architecture, design and the implementation of system and software engineering projects with specialisation in requirements engineering. She is a registered professional engineer (Pr Eng) with ECSA.