Acta Universitatis Danubius
ŒCONOMICA

Exploring Requisite Competency Profiles for an Automated Cement Factory: A Study of Selected Robolab Cement Factories in South Africa

Annah Manganye[1], **Ifeanyi Mbukanma**[2]

Abstract: Objective: The objective of this study was to explore the requisite competencies that are required for optimal operation of the Robolab system to maximize cement product and minimize human errors. Approach: To achieve this objective, a qualitative research method was employed, which provided an ample approaches that help in addressing the research objective of this study. Data was collected from Robolab operators as well as employers of selected cement production factories in South Africa. Thematic method of data analysis was employed to analyse the qualitative data that was gathered through interview questions. Result: The findings of the study revealed that requisite competencies such as technical, behavioural, professional, innovative and creative competencies are key for optimal operation of Robolab system in a cement production factory. Implication: Competency challenges and difficulties exist in the operation of Robolab system as technological innovations in the cement manufacturing industries has grown in recent time from the conventional methods (where manual skills were majorly used) to an automated Robolab system. Recommendation: It was recommended that stakeholder within the Robolab cement production factories in South Africa should employ the Integrated Robolab Competency-Profiling Model, which advocates for competency literacy among the employers and users of Robolab system.

Keywords: Competency Profile; Robolab System; Cement factory; South Africa

JEL Classification: E23; E24; O14; O15; O32

1. Introduction

In today's knowledge-based society, most companies have prioritized the recognition, acquisition and recruitment of skilled workers in order to meet their

[1] MBA Student NWU Business School, Faculty of Economic and Management Sciences, North-West University, Republic of South Africa, Address: Private Bag X2046, Mmabatho, 2745, Republic of South Africa, Corresponding author: annmanganye@gmail.com.
[2] Postdoctoral Research Fellow (Economics Sciences), NWU Business School, Faculty of Economic and Management Sciences, North-West University, Republic of South Africa, Address: Private Bag X2046, Mmabatho, 2745, Republic of South Africa, E-mail: 27662047@nwu.ac.za.

organizational objectives (Vaiman *et al*., 2012). It is common knowledge that personnel's are the most important asset a company uses to ensure that operational efficiency is sustained and that productivity is achieved. A certain standard of competencies are however required of employees in order for an organization to achieve its objectives. Thus, organizational competency profiles have been established to improve the sustainability of peak efficiency among personnel's (Liu *et al*., 2016). Similarly, in a period of globalization and rapid technical transition, strategic competence adherence at all workforce levels is a primary success metric for human resource management (Liu *et al*., 2016; Srividya & Basu, 2015). As such, today's organisations are indeed concerned about competencies; gone are the days when organisations used to talk about skill sets that would make their organisations competitive. Organisational focus has therefore shifted from planning to survive competition to sustainable, excelling productivity (Duran & Mancha-Navarro, 2018; Baral & Pokharel, 2017). Major industries that utilize automated systems as an engine of artificial intelligence are among other companies that are currently experiencing socio-technological transformations and are expected to employ a competence profile that will have a significant effect on corporate value creation for personnel's. Therefore, the continuous advancement of automated system in the organisation makes competency profiling a fundamental task that must be adhere to if production sustainability is to be maintained.

2. Problem Statement

Previous studies found that demand for cement is growing and will continue to rise in South Africa and around the world (Shafeek, 2014; Rosenthal, 2007). According to Uzzaman *et al*. (2016) and Heyns (2013), the demand for cement is influenced by the growth of the middle-class population. As the population increases, there is an increased demand for the basic needs of survival, such as housing, and cement is the major ingredient in the building materials. In order to meet this demand, more sophisticated equipment has been incorporated into the production system, with which operators are required to familiarise themselves. To this end, it obvious that the recent industrial transformation has driven industries to shift from a commodity-based economy to a knowledge-based economy (Yigitcanlar & Bulu, 2015; Nilson & Ellström, 2012). As such, organizations are driven to source for personnel's who can handle the complex nature of work and organizational structural changes, which are informed by industrial revolution towards sustaining optimal productivity within an organization (Thinnisses *et al*., 2013).

In essence, effective organizations are continually acquiring scientific understanding, disseminating it across the entire organisation, and integrating new technology for optimum productivity (Whelan *et al*., 2010). Consequently, in the field of automation professionals, there are also a general shortage of skilled

operational personnel, which cannot be overlooked as it affects the general output of an automated organisation (Gavin, 2012). Thus, a properly implemented competency profile in an organization that has an automated system has the additional advantage of providing guidance on operational skills and flexible structures. Hence, the motivation for this study is therefore to exploit the requisite competencies that are required for optimal operation of the Robolab system to maximize cement production in South Africa. It was also expected that the findings of this study will assist in integrating and reconciling the most uncertainties surrounding the operational inconsistencies within the Robolab system operation currently experienced in a South African cement factories.

3. Competency Profile and Its Concepts

In determining the meaning of competency profile, it is important to define competency first, as it has been given many, sometimes conflicting, meanings (Shippmann *et al*., 2000). McClelland (1973) delivered the first definition of competency, defining it as "a personal trait or set of attitudes that leads to more efficient or superior job performance". Gervais (2016) says very simply that "it is something that describes how a job might be done excellently. Although competency does not define how the job can be done, it outlines the intellectual, managerial, social, and emotional competence of an employee. Shippmann *et al.* (2000) defines competency as "A mixture of knowledge, skills, abilities, motivation, beliefs, values and interest".

Similarly, Kock and Weeks (2015) and Vakola *et al*. (2007) define job-related skills as the underlying set of employee's behavioural patterns, which are related to effective and superior work performance, both individually and collectively, and provide a sustainable competitive advantage to the organisation in which they are implemented and applied.

For the purpose of this study, competency is defined as the ability to apply a set of relevant expertise, skills and abilities needed to perform critical work functions successfully in a defined work environment. Given this definition of competency, a competency profile is a document capturing and identifying the competencies for a given work function. Prikshat *et al*. (2018) and Janani and Gomathi (2015) define competency profile as a set of organisational operation guideline, standards and values that enhance excellent performance in a particular job context. It therefore involves the process of identifying, defining and measuring those skills believed to enhance higher employee job performance in a particular workplace within the context of professionalism.

The purpose of competency profiling is to identify the skills, knowledge and ability required to perform and organise the job, role, shared function or occupation in an

easily accessible and useful manner. Competency profiles are the basis for the development of a comprehensive performance that spells out exactly what the employee has to do in order to perform successfully on the job (Prikshat *et al*., 2018 & Moustroufas *et al*., 2015). Thus, the benefits of competency profiling in an organisation include but are not limited to providing the basis for recruitment and selection; identifying employees' skill, strengths and gaps; targeting development skills and gaps; creating development plans for employees; developing training programmes that address the skills needed to succeed in an organisations; and Identifying overlapping job roles.

Although there are difficulties in actualising competency profiling in most organisations, the benefits are manifest, as it enhances the competitive advantage of an organisation. Organisations usually start the process of competency profiling by identifying the key roles within their organisations where profiles of competencies can deliver the greatest benefits.

The key concepts in competency profiling include a combination of operational guidelines on the skills, knowledge, attitudes and abilities that enhance an employee's job performance. There are four important concepts that make up the definition of a competency.

These concepts were suggested by human resource experts in a conference on competencies held in Johannesburg, South Africa in 1995 (Mitra *et al*. 2008:11). The authors emphasise that a competency profile should include the combination of skills, knowledge and attitudes that have an influence on a major part of an individual's job; that it should have proven good relationships, with excellent job performance; and also it can be measured by using accepted methods and standards; and that it should be able to improve through training and development. Curnow (2015) agreed with the above concept of competency, but added that the concepts of competency include the employee's motives, traits, attitudes, values, knowledge, cognitive ability and that these characteristics can be measured to distinguish top achievers and those that are not. Table 1 provides a synthesis of the core concepts and dimensions of competency in the literature.

Table 1. Concepts and Dimension of Competency

Authors	Dimensions	Competency Concepts
Boyatzis (1982)	Efficient personal skills	The characteristics that an employee possess that enable the performance of the required job.
UK National Vocational Council for Vocational Qualification (1997)	Effective personal ability	The ability to carry out the job as per the outlined employment requirement.
Dubois (1998)	Efficient personal knowledge and skills	Knowledge, skills and mindsets that, when used by an employee, can result in successful performance.
LeBoterf (1998)	Personal ability	The ability to perform excellently in a job context.
Marrelli (1998)	Human capabilities	Human capabilities that are needed to be able to perform work effectively. These capabilities should be measurable.
Treasury Board of Canada Secretariat (1999)	Personal knowledge, skills, abilities and behaviours	Knowledge, skills, abilities and behaviours that an employee applies in performing his or her work.
Intagliata *et al*. (2000)	Employees' skills and capacity	Employee's skills and capacity to achieve organisational goals.
Perrenaud (2000)	Efficient capacity	A capacity to mobilize diverse cognitive resources to meet a certain type of situation.
Selby *et al*. (2000)	Personal ability	An ability expressed in terms of behaviour.
Jackson and Schuler (2003)	Effective personal skills, knowledge, ability and attitudes	The skills, attitude, knowledge, abilities and other characteristics that an employee would need to effectively perform a job.
Gartner Group (2019)	Personal skills, knowledge and attributes	A set of characteristics, including skills, knowledge and attributes, that enable the performance of the required job.

From Table 1, it is evident that most competency concepts are based on the knowledge, skills, abilities and attitudes of an employee. However, some authors perceive competency as a behavioural expression that leads to excellent job performance. The concept of competency was referred to by Moore *et al*. (2002) and Shippmann *et al*. (2000) as a combination of knowledge, skills, abilities and other individual characteristics (often called KSAOs, which include but are not limited to motives, personality traits, self-concepts, attitudes, beliefs, values and interests) that can be reliably measured and shown to differentiate individual job performance.

Developing an organisational competency profile has many benefits for both the organisation and its employees (Basmawi & Usop, 2016 & Connor, 2016). Hence, it provides a comprehensive structure for organisational development and performance. Although there are difficulties in actualising competency profiling in most organisations, the benefits are manifest, as it enhances the competitive advantage of an organisation. Organisations usually start the process of competency profiling by identifying the key roles within their organisations where profiles of competencies can deliver the greatest benefits.

4. Competency Profiling in an Automated Factories

The Robolab in the quality assurance department consisted of high-tech equipment and a robotic arm controlled with IT software. The operators of this Robolab needs to possess and maintain a specific level of competence to operate the system and to be able to troubleshoot and clear errors as they occur. It has been observed that the most successful high-tech factories are the ones that always seek to acquire new knowledge, be it new technology, new products or new ways of doing things, and ensuring that all of the company's employees are kept competent (Scrivener *et al*., 2016; Amrina & Vilsi, 2015). Indeed, many companies have come to understand that their success depends on the performance of their employees, as the development of employees with up-to-date operational technology enhances optimal production sustainability (Van Vuuren *et al.*, 2018; Amrina & Vilsi, 2015).

The new buzz word for the recent era of technology, which is commonly known as the fourth industrial revolution has influenced most areas of automation in many organisations, which in turn has influenced automated job execution. Latest technical advances, including cyber-physical systems such as sensors, the Internet of Things (IoT) or smart networks and robotic machines, have intensified the need for competent employees in automated factories around the world to meet the demands confronting the world today. These include the rise of resource and energy efficiency, production, demographic changes, to mention but few. Because of these developments, in 2009, the Automation Federation, in association with the Employment and Training Administration (ETA) of the US Department of Labour (DOL), launched the Automation Competency Model (the first produced by the DOL). Leaders of the automation industry and ETA staff worked together to develop this comprehensive competency model for automation careers, to help and increase the number of those who pursue careers in this vital profession.

The Automation Competency Model clearly states the skills an employee needs to effectively perform the tasks required in automation careers. However, the process of implementing this model, which is an example of organisation competency profiling, has been identified as the lifeline that could integrate these concepts into a

practical context (Longo *et al*., 2017; Shah, 2016). Most developed nations have adopted competency profiling to identify the specific skills, knowledge, attitudes, and behaviours needed to accomplish an operational task in automated factories (Emami, 2017; Vladova *et al*., 2017). In reality, the concept of competency profiling in automated factories is diverse, as different factories perform differently.

5. Conceptualizing Competency Profile in a Robolab Cement Factories

The analysis of competency profiling in automated factories, as discussed in this section of this study, reveals that competencies are twofold, respectively technical and behavioural competencies. It shows the functional and technical interaction between the competence profiling of Robolab and the job performance of the workers as seen in Figure 2. In essence, the aim of competency profiling for the Robolab system in the cement factory is to maintain a high standard and to improve employees' competency level for excellent professional performance (Cooney *et al*., 2018 & Tafazoli & Gómez Parra, 2017). The organisation should be aware that improving the competency of the Robolab operators will also improve the behaviour of the operators.

A conceptual framework was used in this study to synergise the relationship between the needed competency structure for Robolab in the cement factory and professionalism in operation amongst employees. The conceptual framework is the researcher's synthesis of the literature to explain the concept (Ravitch & Riggan, 2012). It demonstrates an understanding of how variables connect with each other in the study. Strong conceptual frameworks capture real ideas in a manner that can be easily remembered and applied (Eldridge *et al*., 2016). The competencies required for a Robolab operator in the cement factory inform the competency profiling within the factory. However, a competency profiling structure is different in different automated factories (Tafazoli & Gómez Parra, 2017). The output of competency profiling produces variables that enhance employees' operational ability, skills, attitude and experience (Basmawi & Usop, 2016; Hoffmann, 1999). Since there is limited literature in the area of competency profiling in Robolab, Figure 1 provides a theoretical framework of competency profiling in the Robolab cement factory. Hence, the holistic integration of the competency profiling of Robolab operators in the cement factory not only enhances the organisational ability of the Robolab to achieve company objectives, but also helps the employees improve their technical and operational skills. During this process the managers of the Robolab in the cement factories play a role in achieving organisational goals, as well as the operators (Cooney *et al.*, 2018). Nevertheless, there are some concerns regarding the various strategies to achieving Robolab competence profiling (Tafazoli & Gómez Parra, 2017). It makes it difficult for policy makers to be concerned about the cycle of increasing professionalism and optimum performance by Robolab operators. The

aim of this study is therefore to identify the specific profile of competence that enhances the professional operation of Robolab system.

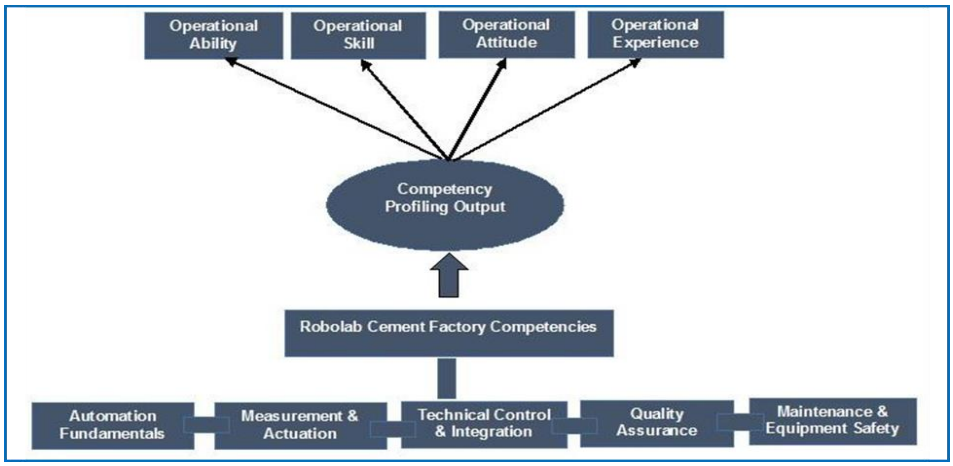


Figure 1. Conceptual Framework of Robolab Competency Profiling in a Cement Factory

While competence profiling in Robolab increases the efficiency of personnel, it has also been identified that there is a beneficial connection between competence profiling and the improved position of the Robolab program in the cement factory environment (Cooney *et al*., 2018; Tafazoli & Gómez Parra, 2017).

6. Research Method

This study adopted a qualitative approach with an exploratory case study design as the study focused on a real-life situation within the context where little knowledge was readily available (Robolab system). An exploratory case study research design includes an up-close, in-depth and detailed examination of the phenomenon under study (the case of the Robolab and its operators) and its related contextual conditions (Zainal, 2007). In addition, this study adopted a purposive and convenient (non-probability) sampling method with a targeted population of companies that are using the Robolab system within their operations. This study collected data from willing participants who had the knowledge and experience of using a Robolab system within their organisations, through interviews with open-ended and semi-structured questions. Thematic analysis was employed using ATLAS-ti version 8 as an analysis instrument to identify the requisite competencies as themes from the data collected.

7. Data Analysis and Presentation of Findings

This part of the paper presents data analysis and the findings as it relates to exploring requisite competencies required by Robolab operators. Thus, the presentation of the findings was structured to address the research objective of the study. In accordance with the research methodology employed in this study, thematic data analysis was carried out, which aid in the identifying requisite competencies for Robolab operation from the qualitative data collected from participants. However, data was analysed based on the data collected from thirteen participants (with Pseudonyms RO1- RO13) that includes seven factory managers, five operators and one supervisor. Using the thematic system of data analysis, five different steps were followed to present the findings namely, data organising, review of transcripts, stage one coding, stage two coding and representation of data. Consequently, participants revealed their experiences with the Robolab system and the requisite competencies which could enhance the operation of the Robolab system. Thus, several themes emerged from the participant's responses, which was grouped into behavioural, technical, educational qualifications and operational experiences. In addition, themes on competency challenges, which hinders the optimal operation of the Robolab system was also identified as well as the benefits and the way forwards of effective Robolab operational system.

8. Themes of Requisite Competencies of a Robolab Operator

Participants was asked to state the requisites competencies required to operate the Robolab system and their responses were grouped into different themes as presented below with the aid of ATLAS-ti network. Thus, this is in line with the earlier definition of competency as it encompasses the ability to apply a set of relevant expertise, skills and abilities needed to perform critical work functions successfully in a defined work environment. According to Prikshat *et al.* (2018) and Gervais (2016) behavioural competency refers to the behavioural features and personal traits qualities that a person may possess, which informs how they perform successfully in their job environment. Figure 2 shows the requisite behavioural competencies as stated by participants, this was based on their understanding of the required behavioural competencies that would enhance the operation of a Robolab. The following excerpts were extracted from the transcript of participant's comments on the behavioural competencies required by a Robolab operator:

Table 2. Excerpts of Requisite Behavioural Competencies Theme for Robolab Operators

Sub-themes	Illustrative Quotes
Creative and judgement	RO2: Operators need to give input on the improvement of the equipment and system.
	RO4: Many modifications on the system were done because of the suggestions from the operators.
Care and skilled attitude	RO3: The operator need to exercise care and high skill for the equipment.
	RO4: The operator need to care for the equipment and love it enough to do simple daily maintenance of it.
	RO6: A Robolab operator must possess both positive and learning attitude towards machine problem-solving, as well as the ability to champion team and change leadership.
Encourage team spirit	RO6: Breakdown can really demoralize the operators, so the operators must be able to work as a team, share ideas and encourage each other.
Performance orientated	RO1: The operator must set high standard and be proactive.
	RO3: The operator need to be results orientated
Understanding Issues	RO7: The operator need to be able to identify and recognize any change in the sound and smell in the Robolab system.

In a follow-up question, participants were asked to state the requisite technical competencies that are required by a Robolab operator to exercise efficiency in Robolab operation. This question is in line with the effective operation of an automobile machine, which demands that an operator must have required skill needed to perform effectively in a specific job function. The analysis of this theme revealed that, for efficient and effective operation of Robolab, an operator must possess a great percentage of these technical competencies. It also emerged that companies interviewed had less positions classed as Robolab operator; at most the operators are known as laboratory analysts or process analysts, and the responsible manager is known as laboratory manager, quality manager or principal chemist. Some excerpts from the transcription of participant's responses are documented below:

Table 3. Excerpts of Requisite Technical Competencies Theme for Robolab Operators

Sub-themes	Illustrative Quotes
Knowledge of cement process	RO4: The operator in the cement production laboratory need at least basic knowledge of the product produces.
	RO7: The operator need to have basic knowledge of cement process.
Knowledge of chemistry	RO4: It is important to note that the Robolab operator is a laboratory analyst; the laboratory methods and chemistry understanding is paramount to them.
	RO9: Because the operator gives chemical results through the Robolab system, then they need to understand chemistry.
Deal with challenges	RO2: The system has many challenges that the operator must deal with.
Laboratory methodology	RO11: You must have knowledge of laboratory test; it will be good advantage to know how to prepare samples and laboratory solutions.
Care for details	RO1: Have the ability to attentively look, listen and feel any changes in the Robolab.
Work under pressure	RO13: Pressure mount easily during the breakdown, the production does not stop and the operators need results to make quality changes. The operator need to be calm during this time.

Accordingly, educational qualifications was also identified as part of requisite competencies from previous literatures required by Robolab operators. Thus, to identify the qualifications that a Robolab operator should have to inform these competencies, participants were asked to state the required educational qualification that would enhance the competency of a Robolab operator. Some excerpts from the participants' responses are presented in Table 4.

Table 4. Excerpts of Requisite Educational Qualifications for Robolab Operators

Sub-themes	Illustrative Quotes
Science qualification	RO2, RO4, RO5: Maths and science
Analytical chemistry	RO1, RO3: Is of advantage if the Robolab operator have national diploma in analytical chemistry.
	RO2, RO3 and RO4 elaborated that, even though education is important, any person with matric with maths and science can be trained in the laboratory process and be trained to operate the Robolab system.

In a follow-up question, participants were asked to give their views on the requisite operation job experience for effective operation of Robolab system. Their responses are presented in the ATLAS- network diagram in Figure 2.

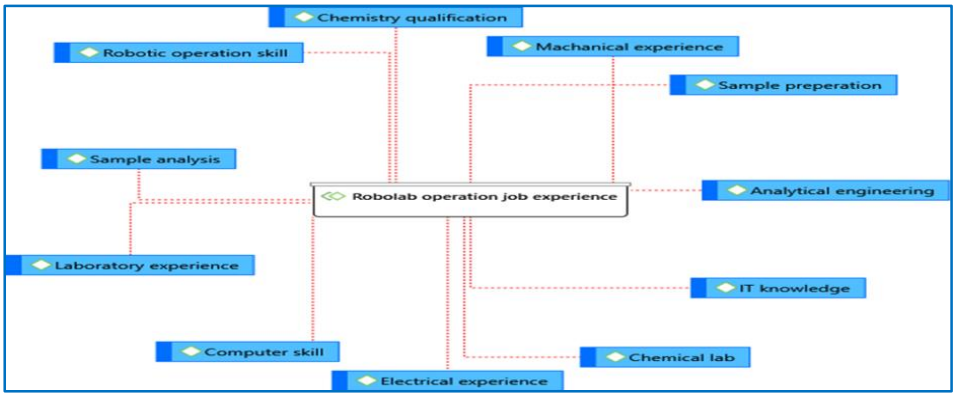


Figure 2. Requisite Robolab Operation Job Experience

Figure 5 provides the responses from participants with respect to the job experience required to enhance the operation of a Robolab system. Requisite job experience such as mechanical experience, sample preparation, analytical engineering, IT knowledge, chemical laboratory, electrical experience, computer skills, sample analysis, laboratory experience, robotic operation skills and chemistry qualification were named as the core job experience for a Robolab operator. Some excerpts from the participant's responses are provided below:

Table 5.Excerpts of Requisite Operation Job Experiences for Robolab Operators

Sub-themes	**Illustrative Quotes**
Computer skills	All participants emphasize on the need for the Robolab operator to have computer skills.
Robotic operation skill	RO4: Although this skill is not readily available, it will be advantageous to have the Robotic operation skills.
IT knowledge	RO7: The system is an automated running with IT software; the operator need to have understanding of how the IT system works.
	RO9: The operator must have an understanding of the error codes and the programming of the equipment.
Analytical laboratory	RO8: I did not experience in operating the Robolab, but in our company a person must have experience as a sample processor to get experience in sample preparation and sample analysis.
Sample analysis	RO11: You must have knowledge of laboratory test; it will be good advantage to know how to prepare samples and laboratory solutions.

However, the participants suggested that it would be desirable to have an experienced Robolab operator, but Robolab has modern technologies, so expertise is not readily accessible. Employing operators with the necessary expertise, however,

would provide Robolab cement factories with a potential workforce that can improve their cement productivity.

9. Themes of Competency Challenges of a Robolab System

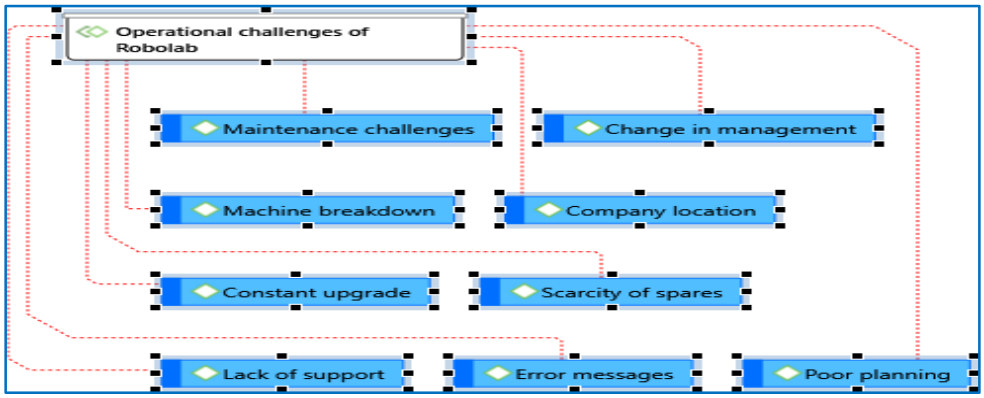
The nature of Robolab system is understand to be latest and growing technology, most especially in cement factories in South Africa. As such, there are growing competency challenges that confronts the users. This part of the study examined the participant's understanding of the competency challenges of a Robolab system. This theme is in line with the study objective to identify the gaps and challenges that affect competency profiling in a Robolab system. Participants were asked to state the work challenges for a Robolab operator as it is important to note that the effective and efficient operation of Robolab system is not only the product of the operators competencies, the management are also required to play a role to this success. Thus, Table 6 provides the views of respondents on the work challenges of a Robolab operator.

Table 6. Excerpts of Work Challenges for Robolab Operators

Sub-themes	**Illustrative Quotes**
Lack of competent support	RO3: Robolab is a new technology with rare skill to run and maintain the system.
	RO12: Not having competent people to fix and maintain the equipment on site
Poor training:	RO11: The initial training was too short and too fast; we are just doing what we can. It will be best to get a competent Robolab operator to train.
Maintenance problems	RO12: The fact that there is no service plan for the equipment is one big challenge.
	RO10: I do not think there is any service or maintenance plan because always the system is fixed when there is a breakdown.
Mechanical issues	RO11: Mechanical issues and maintenance problem of the system. This equipment can have errors the whole shift, making it difficult to report results on time.
Error messages	RO5: Error, alarms, error and even more errors. The moment I walk onto the laboratory and see red error message, then I know my shift will not be nice at all.
Equipment breakdown	RO9: No engineering personnel dedicated to attending the system errors and breakdowns.
	RO8: Machine breakdown and error message from the robotic machine is my worst nightmares. In addition, the breakdowns: We have no one on-site to attend to our breakdowns fast; everyone is busy on other big plant equipment, and it takes long to fix them.

Participants were asked a follow-up question on the operational challenges of Robolab system, which deals with support unit for optimal operation of Robolab

system. Their responses revealed a great number of shortfalls experienced in the operation of Robolab system. The responses are presented in the ATLAS-ti network diagram in Figure 3.



Some excerpts from the comments about the operational challenges of a Robolab system are provided below:

Table 7. Excerpts of Operational Challenges for Robolab Operators

Themes	**Illustrative Quote**
Change management	RO6: Change management. New system need a change in mind and continuous breakdowns of machine slows production down.
Company Location:	RO9: Whenever there is a big breakdown that need the service provider to fix, it takes long because we are in a remote area and the service provider at most need to come from Johannesburg.
	RO10: Sometimes the breakdown takes long because the service provider is too far from us.
Constant upgrades	RO3: The system and software need to be upgraded. When you mention a problem, the supplier will want to sell you an upgrade.
Scarcity of Spares	RO7: Spares for the machine are not readily available
	RO3: The service provider of the system does not keep spares in the country. All spares are orders from overseas and take a good number of weeks to get to the site
Poor Planning	RO10: I will say poor planning because there is always no money to fix the breakdown. The company did not do proper investigation on issues such as efficiency, the cost of operating the system, maintenance planning, and how they will train those who will be operating it. As I mentioned before, I am a laboratory analyst expected to operate the Robolab system.

10. Themes on Benefits and Way Forward of Effective Robolab Operation System

Finally, the research obtained the participant's opinion on the benefits and the way forward for an effective Robolab system. This theme is therefore in line with the study's objective to recommend ideas for the competency profiling needs in a Robolab factory. Participants were asked to give their opinion on the benefits of having a fully operational Robolab system. It was identified that enormous benefits are attributed to fully operational Robolab system. Excerpts from their responses are provided below:

Table 8. Excerpts of Benefits of a Fully Operational Robolab System

Themes	Illustrative Quote
Quick results reporting	RO1: The use of Robolab reduce response time (turnaround time) to correct for process quality and increase output of samples.
	RO6: It also help in faster turnaround time of sample results.
Quality sampling	RO2: Robolab helps in improving quality results, quality sample preparation and analysis.
Sample management	RO8: Our section handle a lot of samples and the Robolab can manage them
	RO4: We manage not less than 250 sample per shift. Without the Robolab, we would have to hire a serious number of analysts to handle them manually
Less human error	RO9: It minimize human error
	RO6: Using the Robolab system, helps to reduce human error during sample preparation and analysis.

In line with the quest to obtain recommendation, participants were asked to suggest a way forward for an effective Robolab system. These suggestions was expected to help improve the competency profiling of a Robolab factory. The extract of their responses are presented in Table 9.

Table 9. Excerpts of the Way Forward for Effective Robolab System

Sub-themes	Illustrative Quotes
Competent maintenance team	RO1: The use of Robolab reduce response time (turnaround time) to correct for process quality and increase output of samples.
Research	RO6: It also help in faster turnaround time of sample results
Good initial planning	RO2: The system is a very helpful system, the company need to put measures in place to ensure that the system can continue to run: things like maintenance team, and technicians from the suppliers, and of course all these need finances.
Stock of spares	RO7: Make the parts stock items
Staff training	RO9: I suggest and advise that the company hire a competent person to come and operate the equipment and we as laboratory analyst learn from him/her; maybe like for a period of 6-12 months. I think this will help to develop our skills better on operating the system.
Maintenance technician	RO4: Have dedicated maintenance team for the equipment; it's a robotic system: breakdowns are inevitable
Proper maintenance	RO13: The company must have a good maintenance plan for the equipment and budget enough to service the system.
Budget for Maintenance	RO7: Sufficient budget and good initial plan and support from management.

It is however identified that as much as the Robolab system contribute greatly to an efficient and effective production and operational process, there are still more to do especially from both the management, service providers and the operators.

11. Contribution of the Study

The contribution of this research can be seen from the outcomes of data analysis. Indeed, the main aim of research was to fill a gap in the body of knowledge that had not been explored before. Accordingly, the main reason for identifying Robolab competency variables that enhance Robolab operation and productivity was to proffer an academic contribution that could be used to improve competency profiling for the Robolab system in the cement factory.

Reflection on the gap in the literature revealed that the interface between the Robolab system structure and the required factory competencies has been neglected. To bridge this gap, this study identified that competency literacy and profiling should be incorporated into the cement company's organisational structure for effective and efficient operation of Robolab system. The contribution of this study is therefore an integrated Robolab competency-profiling model, built from the findings of the empirical analysis. The content of the model was taken from the core themes for

Robolab requisite competencies that were suggested to bridge the interface between the Robolab system structure and the required factory competencies, is grouped into technical focus, behavioural concern, professional traits, innovation and creativeness. Table 10 presents the Integrated Robolab Competency-Profiling Model.

Table 10. Integrated Robolab Competency Profiling Model

Technical Focus	*Chemical analytical knowledge *Skills in laboratory analysis *Equipment maintenance skills *Robotic operation skills *Electrical knowledge *Knowledge of ISO *Computer skills *Risk reduction skills*IT skills
Behavioural Concerns	*Ability to communicate *Ability to interpret documents*Technical confidence *Willingness to learn *Ability to work under pressure *Logical thinking *Accountability * Focus*Creativeness *Team worker
Professional Traits	*Sample preparation skill *Results driven*Feedback *Mechanical qualification *Analytical qualification *Chemistry qualification *Electrical qualification *Robotic error management
Innovation and Creativeness	*Strategic oriented *Business-driven *Performance- oriented *Innovative *Downtime management *Analytical engineering *Positive change initiatives *Attentiveness to patterns

The Integrated Robolab Competency-Profiling Model presented in Table 9 is a coherent combination of extracts from previous literature and the results of empirical data analysis of this study. It is important to note that individual competencies can only improve the company's productivity when they are developed in line with the company's goals and objectives. The model takes this into consideration when providing a profiling standard that will help bring out the best in the Robolab operators and the entire company management.

The first theme in the model is a technical focus, which should form a standard for pre- recruitment and further development of Robolab operators. Technical skills and knowledge have been identified as crucial factors that enhance operator expertise in a mechanised factory. Under the technical focus, sub-themes such as chemical analytical knowledge, skills in laboratory analysis, equipment maintenance and robotic operation, electrical knowledge, knowledge of ISO 9001, computer skills, risk reduction skills and IT skills should be profiled for effective and efficient Robolab operation. Behavioural concerns, listed in the second theme, play a great role in optimising Robolab operation. As such, from the onset of an operator's recruitment, companies should take into consideration behavioural attributes like the ability to communicate, ability to interpret documents, technical confidence,

willingness to learn, ability to work under pressure, logical thinking, accountability, focus, creativeness and team spirit.

The third theme of the model focuses on the traits that are required for professionalism in Robolab operation. To achieve this professionalism in the cement factory's Robolab operators, it is necessary to maintain the special standards and traits that promote professional traits such as sample preparation skills, result-driven, feedback, mechanical qualification, analytical qualification, chemistry qualification, electrical qualification and robotic error management skills. In the quest to improve professionalism in Robolab operation, concerned management should also encourage operators by providing them with both academic courses and training courses that will enhance their Robolab operational skills. Competency profiling also helps employees to identify the job-specific positive attributes they possess. Thus, the fourth theme of the model focuses on innovation and creativeness of operators. Sub-themes such as strategic oriented, business-driven, performance-oriented, innovative, downtime management, analytical engineering, positive change initiatives and attentiveness to patterns should be profiled to promote excellence in the Robolab operation in the cement factory. It is believed that incorporating the integrated Robolab competency-profiling model into the Robolab structure of the cement factory will promote professionalism within the organisation. Thus, the company can only succeed in having competent Robolab operators if it puts together a training programme for the operators, and takes note of the recommended way forward for an effective Robolab system.

12. Policy Implications and Key Findings

Managerial implications and key findings are outlined to informed key decisions-making. Management within the cement factories where a Robolab is used should understand the following as it could leverage the effective and efficient operation of the Robolab:

a. Previous literature provided positive theoretical arguments about the importance of competency profiling for Robolab operators in cement factories;

b. Competencies that were relevant to the operation of Robolab system in a cement factory were identified using standard analytical tools;

c. Competency profiling was ascertained to be essential for the development of professionalism in the operation of a Robolab system in cement production companies;

d. Behavioural and technical competencies were also identified as a core concern for competency profiling in Robolab factories;

e. Qualifications in analytical chemistry, electronics, maths, mechanics and science were identified as relevant for Robolab operators;

f. Experience in analytical engineering, chemical laboratory work and IT were also identified as necessary for Robolab operators;

g. The Robolab system is normally operated by laboratory analysts in cement factories;

h. Since the skill to operate the Robolab is not readily available in the talent pool, a proper training plan is essential and

i. Although the benefits of a Robolab system in a cement production company are enormous, the operational and cost challenges demand careful consideration before acquiring the system.

13. Recommendation and Conclusion

It is recommended that a competent maintenance team should be on standby for any breakdown in the factory. Secondly, stakeholder involvement in operations and maintenance issues is advantageous as well as research on the machines will provide operators with better knowledge. In addition, there should be an info-laboratory system available for further diagnosis of machine errors. Also training of the current staff is a key to consistent competency standards and technological upgrades, a maintenance plan, available spares, and financial budgeting for the system are key to the effective and efficient operation of Robolab system. Companies should take into consideration the trend of the fourth industrial revolution for most industrial production processes to adopt a hi-tech medium and strategies for production. It is important to adapt to the trend because previous studies have established that hi-tech and mechanised processes of production and manufacturing enhance professionalism and optimise productivity. Accordingly, profiling the competencies required for Robolab operations becomes inevitable, as core competencies are required for the operation of the robotic machine to maximise productivity. This study was conducted in this context and identified those required competencies, as well as more effective and efficient ways to use a Robolab system. Thus, the findings of this study recommend the use of The Integrated Robolab Competency-Profiling Model. It is expected that this model will assist the management of cement production companies that use Robolab systems as well as setting a profiling standard for professionalism in Robolab operation.

References

Amrina, E. & Vilsi, A. L. (2015). Key performance indicators for sustainable manufacturing evaluation in cement industry. *Procedia Cirp*, 26, pp. 19–23.

Baral, N. & Pokharel, M. P. (2017). How sustainability is reflected in the S&P 500 companies' strategic documents. *Organization & Environment*, 30(2), pp. 122–141.

Basmawi, N. A. H. B. & Usop, H. (2016). The impact of technological change as mediator on employee competency profiling in selected industries in Kuching, Sarawak: A structural equation modeling approach. *Journal of Cognitive Sciences and Human Development.* Vol, 1, p. 2.

Boyatzis, R. E. (1982). The Competent Manager: A Model for Effective Performance. *Wiley, New York, NY.*

Connor, A. M. (2016). *An Investigation into the Use of Competency Frameworks for Recruitment and Selection in a Financial Services Organisation in Dublin*. Doctoral dissertation, Thesis Submitted to the National College of Ireland, August.

Cooney, M.; Yang, C.; Padi Siva, A.; Arunesh, S. & David, J. (2018). Teaching robotics with robot operating system (ROS): A behavior model perspective. In *Workshop on Teaching Robotics with ROS*, European Robotics Forum 2018, Tampere, Finland.

Curnow, C. (2015). Competency Modeling & Job Analysis. https://home.ubalt.edu/tmitch/651/competency%20modeling%20trendspdf.

Dubois, D. D. (1998). *"Preface", the Competency Casebook: Twelve Studies in Competency-Based Performance Improvement. Amherst*. MA: HRD Press.

Duran, F. F. M. & Mancha-Navarro, T. (2018). The economics sustainability in medium and small companies in Colombia (SMEs). In *Handbook of Research on Intrapreneurship and Organizational Sustainability in SMEs*, pp. 342-367). IGI Global.

Eldridge, S. M.; Lancaster, G. A.; Campbell, M. J.; Thabane, L.; Hopewell, S.; Coleman, C. L. & Bond, C. M. (2016). Defining feasibility and pilot studies in preparation for randomised controlled trials: Development of a conceptual framework. *PloS one*, 11(3), pp. 1-22.

Emami, F. (2017). *Application of Competency Management System in Safety Performance: A Case Study of a Canadian Structural Steel and Erection Industry*.

Gartner Group. (2019). *Building the Right Environment to Improve Quality Staff Competencies*. ID: G00706204. Analyst(s): Quality Research Team. https://www.gartner.com/en/documents/3913177.

Gavin, M. (2012). *Plant Engineering*. http://www.plantengineering.com/home/single-article/developing-automation-talent/38f0186f36be36dee9e95b7521ec2212.html.

Gervais, J. (2016). The operational definition of competency-based education. *The Journal of Competency-Based Education*, 1(2), pp. 98–106.

Heyns, R. (2013). Cement in South Africa. *Kagiso Asset Management Research*, pp. 8–12.

Hoffmann, T. (1999). The meanings of competency. *Journal of European Industrial Training*, 23(6), pp. 275–286.

Intagliata, J.; Ulrich, D. & Smallwood, N. (2000). Leveraging leadership competencies to produce leadership brand: creating distinctiveness by focusing on strategy and results. *Human Resource Planning*, Vol. 23 No. 3, pp. 12–23.

Jackson, S. E. & Schuler, R. S. (2003). *Managing Human Resources through Strategic Partnerships*, 8th ed., Southwestern, Mason, OH.

Janani, J. & Gomathi, S. (2015). Formulating and implementing competency modelling, profiling and mapping'at Private Limited, Ranipet, Vellore. *Mediterranean Journal of Social Sciences,* 6(1), p. 23.

Kock, T. & Weeks, W. (2015). Job-related competencies desired by those who hire international development consultants. *Journal of International Agriculture and Extension Education,* 22(1), pp. 21–34.

LeBoterf, G. (1998). Evaluer les compétences, quels jugements? Quels critères? Quelles instances? *La Compétence au Travail*, 135(2), pp. 143–151.

Liu, H.; Wei, S.; Ke, W.; Wei, K. K. & Hua, Z. (2016). The configuration between supply chain integration and information technology competency: A resource orchestration perspective. *Journal of Operations Management*, 44, pp. 13–29.

Longo, F.; Nicoletti, L. & Padovano, A. (2017). Smart operators in industry 4.0: A human-centered approach to enhance operators' capabilities and competencies within the new smart factory context. *Computers & Industrial Engineering*, 113, pp. 144–159.

Marrelli, A. F. (1998). An introduction to competency analysis and modeling. *Performance Improvement,* 37, pp. 8–17.

McClelland, D. C. (1973). Testing for competence rather than for "intelligence". American Psychologist, 28(1), pp. 1-14.

Mitra, S.; Bangia, S. & Mitra, J. (2008). 18 Management Competencies Business Professionals Cannot Ignore. *New Delhi: Sterling Publishers*.

Moore, D. R.; Cheng, M. I. & Dainty, A. R. J. (2002). Competence, competency and competencies: performance assessment in organisations. *Work Study,* 51(6), pp. 314– 319.

Moustroufas, E.; Stamelos, I. & Angelis, L. (2015). Competency profiling for software engineers: Literature review and a new model. In *Proceedings of the 19th Panhellenic Conference on Informatics* pp. 235–240. ACM.

Nilson, S. & Ellström, P. E. (2012). Employability and talent management: Challenges for HRD practices. *European Journal of Training and Development*, 36(1), pp. 26-45.

Perrenaud, P. (2000). *10 Novas competencias para ensen˜ar*. Portoalegre: Ed. ArtMed

Prikshat, V.; Kumar, S.; Nankervis, A. & Khan, M. M. S. (2018). Indian HR competency modelling: profiling, mapping and an investigation of HRM roles and competencies. *The Journal of Developing Areas,* 52(4), pp. 269–282.

Ravitch, S. M. & Riggan, M. (2012). Reason & Rigor: How Conceptual Frameworks Guide Research. *Thousand Oaks CA: Sage Publications*.

Rosenthal, E. (2007). Cement industry is at centre of climate change debate. *New York Times*, 26, p. 24.

Scrivener, K. L.; John, V. M. & Gartner, E. M. (2016). *Eco-efficient cements: Potential economically viable solutions for a low-CO2 cement-based materials industry*.

Selby, S. C.; Roos, I. & Wright, L. (2000). Investigation of the application of frontline management training in the community services and health industry: a progress report. Paper presented at the

Victorian Community Services and Health Industry Training Board Conference, Melbourne, 22 June. *Fundamentals and New Directions in Sample Preparation*. Vol. 37: Elsevier.

Shafeek, H. (2014). Continuous improvement of maintenance process for the cement industry: A case study. *Journal of Quality in Maintenance Engineering,* 20(4), pp. 333- 376.

Shah, C. R. (2016). *Competency Mapping and its impact on Organization Effectiveness with special reference to Sales Staff of Pharmaceutical Industry of Ahmedabad Region*. Ahmedabad, India: Gujarat Technological University.

Shippmann, J. S.; Ash, R. A.; Batjtsta, M., Carr, L., Eyde, L. D., Hesketh, B., Kehoe, J., Pearlman, K., Prien, E. P., & Sanchez, J. I. (2000). The practice of competency modeling. *Personnel Psychology*, 53(3), pp. 703–740.

Srividya, N. & Basu, R. (2015). Competency Mapping Correctional Officers. *SCMS Journal of Indian Management*, 12(1).

Tafazoli, D. & Gómez Parra, M. E. (2017). Robot-assisted language learning: Artificial intelligence in second language acquisition. *Current and Future Developments in Artificial Intelligence,* p. 370.

The UK National (and Scottish) Vocational Qualification System. (1997). State of the art or in a state? *International Journal of Training and Development,* 1(4), p. 242.

Thinnisses, P.; Boselie, P. & Fruytier, B. (2013). A review of talent managemnt: 'infancy of adolescence? *International Journal of Human Resource Management,* 24(9), pp. 1744–1761.

Treasury Board of Canada Secretariat (1999). Framework for Competency-based Management in the Public Service of Canada. Report of joint initiative between the *Treasury Board of Canada Secretariat and the Public Service Commission*.

Uzzaman, I.; Rahman, M.; Alam, M. & Alam, S. (2016). Simulation of cement manufacturing process and demand forecasting of cement industry. *Global Journal of Researches in Engineering: G Industrial Engineering*, 16(2).

Vaiman, V.; Scullion, H. & Collings, D. (2012). Talent management decision making. *Management Decision*, 50(5), pp. 925–941.

Vakola, M.; Eric Soderquist, K. & Prastacos, G. P. (2007). Competency management in support of organisational change. *International Journal of Manpower*, 28(3/4), pp. 260–275.

Van Vuuren, D. P.; Stehfest, E.; Gernaat, D. E.; Berg, M.; Bijl, D. L.; Boer, H. S.; Daioglou, V.; Doelman, J. C.; Edelenbosch, O. Y.; Harmsen, M. & Hof, A. F. (2018). Alternative pathways to the 1.5 C target reduce the need for negative emission technologies. *Nature Climate Change,* 8(5), p. 391.

Vladova, G.; Ullrich, A. & Sultanow, E. (2017). Demand-oriented competency development in a manufacturing context: the relevance of process and knowledge modeling: *Proceedings of the 50th Hawaii International Conference on System Sciences 2017*. http://hdl.handle.net/10125/41699.

Whelan, E.; Collings, D. G. & Donnellan, B. (2010). Managing talent in knowledge- intensive settings. *Journal of Knowledge Management*, 14(3), pp. 486–504.

Yigitcanlar, T. & Bulu, M. (2015). Dubaization of Istanbul: Insights from the knowledge- based urban development journey of an emerging local economy. *Environment and Planning A,* 47(1), pp. 89–107.

Zainal, Z. (2007). Case study as a research method. *Journal Kemanusiaan*, 5(1).