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Technology adoption improvement using Kotter's, Lewin's and ADKAR's change management model in mining industry

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ABSTRACT

Introduction: Change management plays a huge role in technology adoption improvement in mining industry process implementation. Most organizations try hard to find innovative approaches to stay ahead of the competition and adapt to shifts in client needs, which are connected to improvements in technology and customer satisfaction. The major reasons are a lack of information about alternative change management strategies and an improper implementation of these methods. The aim of the paper is to improve technology adoption in the mining industry using comparative Kotter's, Lewin's and ADKAR's change management model and propose key success factor that ensure end users adoption. It is simple to manage phases and factors in subsequent implementations when they are well-defined or understood. A collection of change management models, including crucial success variables for the technology implementation process, is provided by the literature review. A questionnaire that was distributed to the junior, middle, and upper management was used to achieve the case study. The literature review's background data aided in the creation of questionnaires to determine the relevant mode. The results indicates that when technology is implemented, the crucial steps are end user involvement and buy-in from top management and must be prioritized for adoption and value realization.

Keywords: Change management, technology management, implementation, technology adoption, change management model. .

INTRODUCTION

Individual end users respond to the technological transformation in a variety of ways during the technology deployment process. End-users are those that make use of the implemented technology daily, they tend to encounter challenges with technological change as it produces distinguished job insecurities. While some users embrace changes, but do not immediately adopt it, others may support it but find it difficult to adapt since it may conflict with their customs [1]. The change management model is an approach used by companies to direct change implementation process, it requires proper administration since it might be the deciding factor of the success of the new technology implementation process [2]. Nonetheless, there are models to aid in the minimization of change resistance arguments [3].

The last three years have seen the mining industry embarking on a technology implementation path, during which end users adopted the technologies at a fairly low rate [4]. While value realization in technology implementation is concerned with making sure that investments in technology yield measurable company advantages through return on investment maximization, impact measurement, and alignment with strategic goals. Operations systems were put in place with the goal of user acceptance and value realisation, which encourages organisations to put close focus on how change management should be administered. End users of the various technologies and the support of upper management are the primary sources of the value that the organization will receive [5]. Change management is implemented by organizations with good intentions, but end users frequently react negatively and resist the change [6].

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The Project Management Institute (PMI) reports that inadequate information collecting by management is the reason behind 47% of project failures [7]. It was emphasized that 75% of organizations concur that inadequate communication, inadequate upskilling, and a failure to support and maintain the technology in use result in subpar outcomes and low project value realization [8]. This indicates that for high-quality project outputs, stakeholder communication is crucial throughout the transformation process [9]. Furthermore, if resistance and upskilling problems occur, it is imperative to have teams and resources ready to facilitate the transition [10]. With more attention being channelled to the rate of the change process, the same resources will make sure that resistance is as low as feasible during the process [11].

The likelihood that the implementation of a new technology adoption project can fail, due to resistance to change, change management can be found to be a contributing factor [12]. There are influences like top management buy-in, and end-user involvement that result in the technology adoption implementation project being a success [13]. Despite the fact that new technologies may be observable throughout the organization, their rate of value realization is still low [14].

In order to determine best practices for the change management model process idea and its crucial success aspects in deploying new technologies, involved a review of the literature. Additionally, the mining industry's analytics of the existing use of change management for the introduction of new technologies inside an organization were explored in the paper. The phenomena and its environment were thoroughly described using the qualitative research approach. The lived understandings, perceptions, and reasoning of persons involved in the subject matter were used to gather data.

To comprehend how change management (CM) was being used, it was essential that the study include research on the change management implementation process. Through this study, organizations can comprehend change and the problem being undertaken to implement technology in an adaptable and valuable manner.

The use of change management techniques while introducing a technology in a mining context was covered in the literature review. Both the process's significance and critical success factors (CSF) of implementation in the mining sector were examined. The research approach employed in this study helped increase the rate at which technologies are adopted for value realization

The conclusions of the literature review painted limitations like loss in cost of implementation and resistance from end-users and benefits like competitiveness locally and globally, ease of end-user’s day-to-day activities and safety when change management is properly applied.

By bridging the gap between organizational change management theories and their real-world implementation in the mining industry's technology adoption initiatives, this research makes a significant contribution. The study offers a thorough, multifaceted framework designed for the particular difficulties faced by the mining industry, including resistance to change, safety culture, hierarchical structures, and technological conservatism, by combining Kotter's 8-Step Model, Lewin's 3-Stage Model, and the ADKAR model.

The objective of the study is to investigate and record the installation of a new technology, its key success factors for adoption, and the realization of its value through the coordination of the change management process.

To be competitive in today's digital environment, businesses need to constantly implement innovative technology. However, one of the main causes of unsuccessful technology implementations is inadequate change management, which frequently leads to low engagement, employee resistance, and tool underutilization. Organizations may navigate the transition process with the help of organized frameworks offered by effective change management models. This study looks at three popular models—Kotter's, Lewin's, and ADKAR—and shows how to use them to boost productivity and improve the results of technology adoption.Figure 1 shows the structure of the paper from literature review to the best practice for mining technology implementation.

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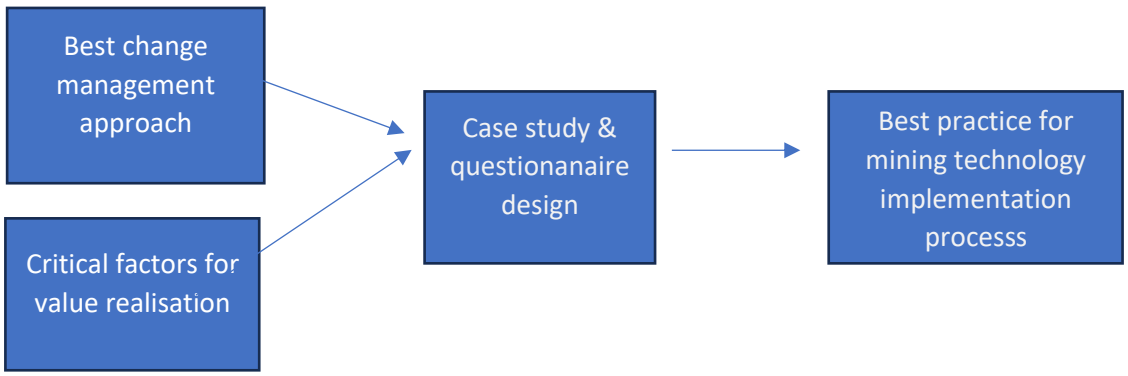

Figure I: Research design

LITERATURE REVIEW

This section reviews literature on change management, with an emphasis on best practices for change management, which is activities or models, adoption and value realization when introducing new technology through assessing their crucial success criteria.

A. Evaluation of change management models

The phenomenon of change management

According to [15], new prospects, such as creative items or market ideologies, new ideas, new activities, and new operational methods, are all examples of change. The change approach moves people, groups, and organizations from where they are now to where they want to be in the future [16].

For individuals engaged, the process of change doesn't have to be a torment. When seen from a distance, the success percentage of change management activities is as low as 10% [17], when the important success elements are properly recognized and controlled, and the appropriate change model is applied. External and internal stakeholder involvement, internal communication involving people, technology, processes, and organizational culture, and, finally, a strategy covering the change team to manage the change, knowledge and skills transfer process, and the benefits or value later on are all critical success factors [18].

B. Categorization of organizational transformation

[19] classified organisational change in three ways namely, developmental, transitional and transformational.

i Developmental transformation generates skills, improves performance, and considers overall organizational progress. Using short-term mining planning software, for instance, can expedite the planning process.

ii The process of moving organizational operations from one state to another using a methodical approach that progressively dismantles the existing method in order to arrive at the new, desired process is known as transitional transformation. For instance, putting in place a new fleet management system to increase mining process productivity frequently involves significant changes.

iii It is acknowledged by transformational change that an existing situation cannot be changed. It requires a complete change in thinking, behaviour, and culture in order to succeed. The future isn't always clear-cut or predictable. For instance, implementing mining regulations and taking environmental concerns into consideration while switching from underground to open-pit mining.

Change management models

Various philosophies are used in change management approaches, based on the culture of the organization and the individual. Understanding and awareness of the key stakeholders are essential to change success [20]. The principles of change management—Kotter's change model, Lewin's change model, and ADKAR's change management model—

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are reviewed in the following three parts. Furthermore, a comparison of each model's crucial success elements is provided.

Putting people and organizational transformation first is the strategic component of change management. Additionally, supporting every employee at every level of the company—especially those affected by the change—is the primary goal of change management. [21].

Change according to Kotter

The eight phases of change proposed by John Kotter were the first change management model to be identified. Eight crucial phases are necessary for a change to be effective in an organization, according to Kotter's book "Leading Change" [22]. With an emphasis on organizational change, Kotter's change management model emphasizes that senior managers are the primary forces behind change, meaning that it is pushed from the top down rather than the bottom up. [23] suggested that positive outcomes are achieved when leaders buy in. [24] backed up the idea that change can only be implemented from the top down if senior management supports it. Before implementing a change, he advised organizations to make sure that people who have the power to influence end users are on board.

Change according to Lewin

After researching human behaviour, German American psychologist Kurt Lewin presented his three-step theory of change [25]. The activities included organizational and individual adoption of change, as well as motivation, execution, and promotion, in each of his model's three phases. The concept is explained by comparing it to the way an ice cube changes form [26]. [27] emphasized that before implementing the first stage of Lewin's CM model, which is unfreezing the organization, organizations must first use an analysis form to reflect on the gap between the planned change and the present organizational culture.

Change according to ADKAR

The ADKAR's model was designed in 1998 by Jeff Hiatt to advise individuals and organisations on change management [28]. ADKAR is an acronym that summarizes the five objectives that an organisation needs to attain for effective change: awareness, desire, knowledge, ability and reinforcement [29].

Applying Kotter's, Lewin's and ADKAR's change management model

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Model	Focus	Phases	Change management application explanations	Identifed Gaps	References
Kotter's 8-step change model	Top management buy-in	8	Top management buy-in to influence the subordinates Allow those who will be affected by change to understand what is expected of them Share the advantages, strategy, vision, and mission. Empower the end-users by giving them the necessary support(training) Celebrate minor triumphs to show appreciation for those who have adapted successfully to change. Integrate the adjustment into the organization's culture to ensure ongoing assistance.	Limited adaptation in agile or fast-paced workplaces. Long-term momentum is difficult to maintain.	[30][32]
Lewin's CM model	End user's involvement and dedicated change team	3	Conduct current and proposed change assessment Gather information and communicate the change strategy Maintain a backup plan in case the change team encounters issues during implementation, such as opposition. Give end-users training and awareness Be open to both compliments and criticism. Once stability is achieved, keep becoming better.	Does not address the requirement for flexibility in dynamic contexts. Insufficient for managing continual or iterative changes prevalent in modern companies.	[23][32]
ADKAR's CM model	End user's involvement and dedicated change team	5	Inform the group of the impending change. End-users should have the chance to raise questions, particularly about the change's financial effects. Include all relevant facts or comprehension of the change. Raise awareness to encourage complete comprehension and support.	Does not completely incorporate individual changes into the larger organizational framework. There is less information on how to link individual change with organizational	[33][34]

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			Technology education and skill development for end users	strategy and culture.	
			To prevent resistance, reinforce the change by establishing control mechanisms through technological sustainability and maintenance.		

Table I: Application of three CM models

It is evident from the CM application comparison in Table 1 that each model has two of the three elements listed by [23]. The first one, Kotter's 8-step model, focuses more on the significance of comprehending how crucial it is to include top management early on in order to get support and control end users with regard to resistance and the guarantee of value realization. The significance of making sure the organization is aware of the change by integrating it into its culture or way of life is the second element that can be observed in Kotter's.

The evaluation of the organization's existing status and culture is crucial to comprehend under Lewis' approach. People are involved in the implementation of change using the information gathered from the evaluation. Finally, projects are used to continuously enhance the organization as it becomes more stable. Clarification and understanding of the impending change, which affects the organization and individuals involved in the CM process, are the first steps in the ADKAR model. After that, it ends by tapping the control mechanisms for future sustainability and upkeep. ADKAR is an effective change management methodology for the mining sector that emphasizes individual behavior and adoption, which is critical for assuring safety, compliance, and operational consistency. Its people-centric, step-by-step approach makes it adaptable to both modest and large changes, while also delivering concrete results by ensuring staff are aware, motivated, trained, capable, and reinforced in new practices. Kotter's paradigm will be discontinued due to its inability to accommodate minor departmental or sectional change; instead, it focuses primarily on organizational transformation [35]. Supporting that, [36] asserted that Kotter's eight-step approach prioritized top management authority above the impacted stakeholders.

Comparison of changes in the critical success factors

The aforementioned three models illustrate various stages of change implementation for value realization. Different activities or crucial success elements are included in each model.

Table II: CM models CSF/Gaps

Factors	**Kotter's CM Model**	**Lewin's CM Model**	**ADKAR CM Model**	**References**
Change management crew				
A well-planned strategy and a change program	**X**			[37]
Skilled CM team	**X**		**X**	
Communication in change management				
Communicate proper purpose and objectives	**X**	**X**	**X**	[38]
Management of Change involving customers, suppliers and regulators				
Involvement of customers, suppliers, regulators and consideration of competitors	**X**			[39]

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Factors	Kotter's CM Model	Lewin's CM Model	ADKAR CM Model	References
Consideration of customer needs, market change, global competition, government regulation	X			
Change management internally - people, processes, organisational culture and technology				
Top management support (knowledge and resources)	X			[30][31][40]
Inform others that something must be done regarding change.		X	X	
integrating people, technology, and procedures (people's engagement)	X	X	X	
Change management knowledge and skills transfer				
Transfer of knowledge and skills	X	X		[39][38]
Knowledge sharing	X	X	X	
Acceptance by users and project team members	X	X	X	
Understanding the existing state, need for change with change benefits		X	X	
Diagnosis, data gathering, and action planning		X		
New behaviour, measurement and evaluation		X		
Technological change benefits				
Motivate individual requirements for improvement	X	X	X	[41]
Along with using technology to streamline their daily tasks, people recognize the value of their jobs.			X	

Following a careful examination of the three models, it was concluded that while each model has a distinct number of steps that must be taken in order to execute change successfully, all three models are correlated. The various associated elements that must be considered for each model to succeed are displayed in Table II on the CM Model CSF. The stages listed in Kotter's model provide clarity on how change should be implemented. In order to facilitate the adoption of certain technologies by all stakeholders, it is essential to include customers, suppliers, and regulators.

Making ensuring management is on the change committee is crucial. Implementing technology enables organizations to go on with their regular operations during the process. Although they should assist the designated change team rather than do it alone, daily line managers are typically expected to execute change despite their hectic commitments. To ensure that message is heard and trickled down to all employees, the appointment of a change team

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is still crucial. Until the change is fully implemented, a strategy outlining how it will be implemented, and management support continue to be top priorities.

It was discovered that ADKAR can be the best model to use when implementing new technology because it defines each change step, gives end users the information they need for change to occur, and is applicable to individuals. An open channel of communication that covers both positive and negative feedback throughout the implementation process will allow excitement and interest from the stakeholders.

METHODOLOGY

The quantitative methodology was chosen as the research method because it would help people understand each other's experiences and happenings [42]. The application of a case study examines a topic of interest and uses several cases to generalize the findings [43]. In order to gather data, a questionnaire was chosen. To gather various viewpoints on change management and the procedure that the company used, a survey was created and distributed to the twenty-five project managers, engineers, and techs.

Questionnaire was created and distributed to managers of project, engineers, and techs in order to get various viewpoints on change management and the organization's procedure.

To demonstrate how similar the stages are, Figure 1 maps the three distinct models while table 3 displays a solitary arrangement of the phases that were taken from the three models in order to create the questionnaire and identify procedures that the circumstance organization used throughout the process of change. Even while some models lack specific phases, Figure 2 clearly demonstrates how comparable the steps are.

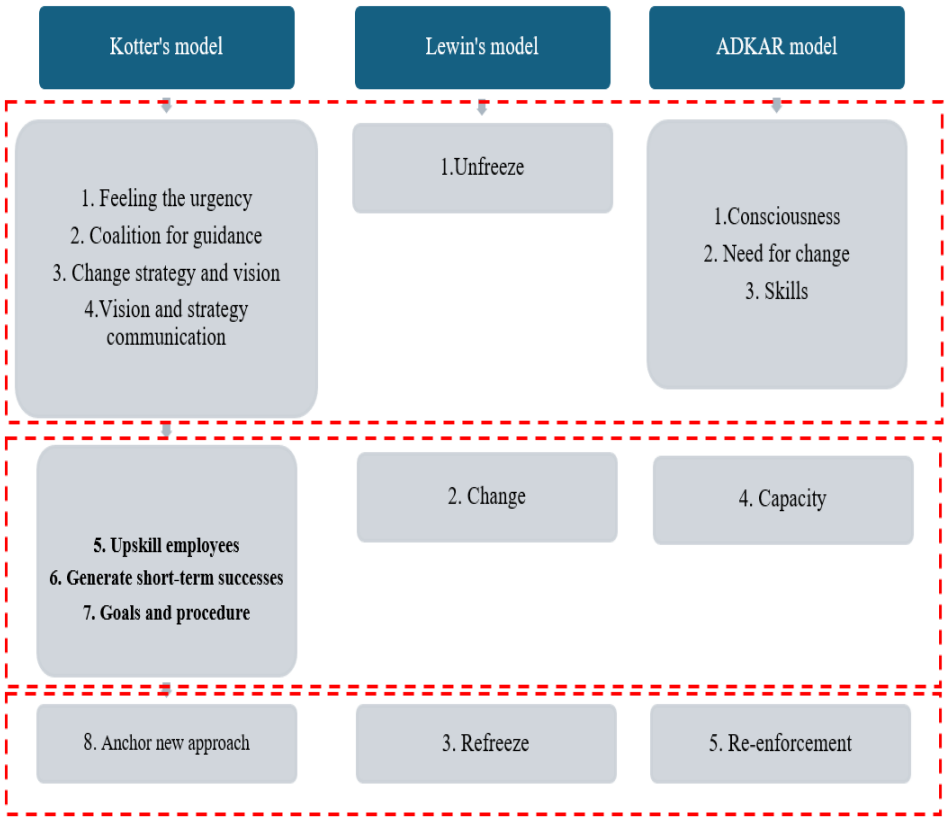

Figure II: Questionnare design

Mapping and other actions amongst the models that were introduced in literature are displayed in Table 3 below. Each activity's place in the three models should be noted, as well as the connections between some of the activities. The purpose of the charting was to identify a specific set of questions that would concentrate on the actions that enabled user implementation rather than just management support.

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Table III: Change management application models mapping in literature

	Kotter model	**Lewin model**	**ADKAR model**
Top management came on board with influencing the subordinates.	Yes		
Before the initiation procedure, I knew what was required of me and the shift that was going to occur.	Yes		Yes
The benefits, strategy, mission, and vision were conveyed.	Yes	Yes	
I rejoiced in little accomplishments both throughout and after the process of change.	Yes		
Training was offered for the new technology.	Yes	Yes	Yes
The coordination of transition process by specialized team.		Yes	
I had a chance to provide both positive and negative feedback and ask questions.		Yes	Yes
Control procedures were put in place to make sure that the change was accepted and that no one returned to the previous methods.			Yes
The organizational culture was altered to encourage ongoing support and development.		Yes	

A total number of 48 workers from different organizational departments made up the sample size. Emails alerting participants to the impending survey were sent out beforehand. Using mathematical equation, gathered data was analysed based on their classifications, to assemble a list of the essential success elements and change management tasks. With data that could be ranked using the questionnaire results from the information gathered from the literature, the study used a quantitative research methodology.

The following formula was used to determine the weighted score [44] to model a scenario with three alternatives (A1, A2, A3) Kotter's, Lewin's and ADKAR's and five criteria (C1, C2, C3, C4, C5) using a weighted score system with ratings ranging from one to five, we can use the weighted score formula of Likert scale choice.

$$\omega_a = \frac{\sum(\omega_{x1} * 1 + \omega_{x2} * 2 + \omega_{x3} * 3 + \omega_{x4} * 4 + \omega_{x5} * 5)}{\text{Total number of respondents}(\eta TR)} = \frac{\omega_T}{(\eta TR)} \quad (1)$$

Where each Likert scale choice has the following weighted factor strongly disagree ($\omega x1$) = 1, disagree ($\omega x2$) = 2, neutral ($\omega x3$) = 3, agree ($\omega x4$) = 4, strongly agree ($\omega x5$) = 5. The assigned weights to the criteria are $\omega x1$=0.3 (C1 is the most important), $\omega x2$=0.2, $\omega x3$=0.15, $\omega x4$ 0.25, $\omega x5$ =0.1 respectively, sum up to 1.

The ratings for each alternative against each criterion be:

Alternative A1: r11= 4, r12=3, r13=5, r14=4, r15 = 3

Alternative A2: r31=3, r32= 5, r33= 4, r34= 3, r35 = 5

Alternative A3: r21=5, r22 = 4, r23 =3, r24 =5, r25 = 4

For each alternative A_i and criterion C_i , the weighted rating WR_{ij} is calculated as:

$$WR_{ij} = r_{ij} * w_j \quad (2)$$

The total weighted score for each alternative $A_i$is the sum of its weighted ratings across all criteria:

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$$WS(A_i) = \sum_{j=1}^{5}(r_{ij} * w_j) \quad (3)$$

The best alternative is the one with the highest weighted score. From the calculations above:

$WS(A_1) = 3.85, WS(A_2) = 3.75\ \ WS(A_3) = 4.4,$

Thus, A3 is the best alternative with the highest weighted score of 4.4.

RESULTS AND DISCUSSIONS

From 48 members of the team at the company, 50% of people who were questioned responded. Twenty-one percent (5) of the twenty-four respondents were line managers, seventeen percent (4) were professionals in training, seventeen percent (4) were technicians, and seventeen percent (4) were engineers. 17 out of 24 respondents, or 72% of all responses, were at management level, Specialist/professionals in training, technologists, and section engineers, as shown in Figure 3.

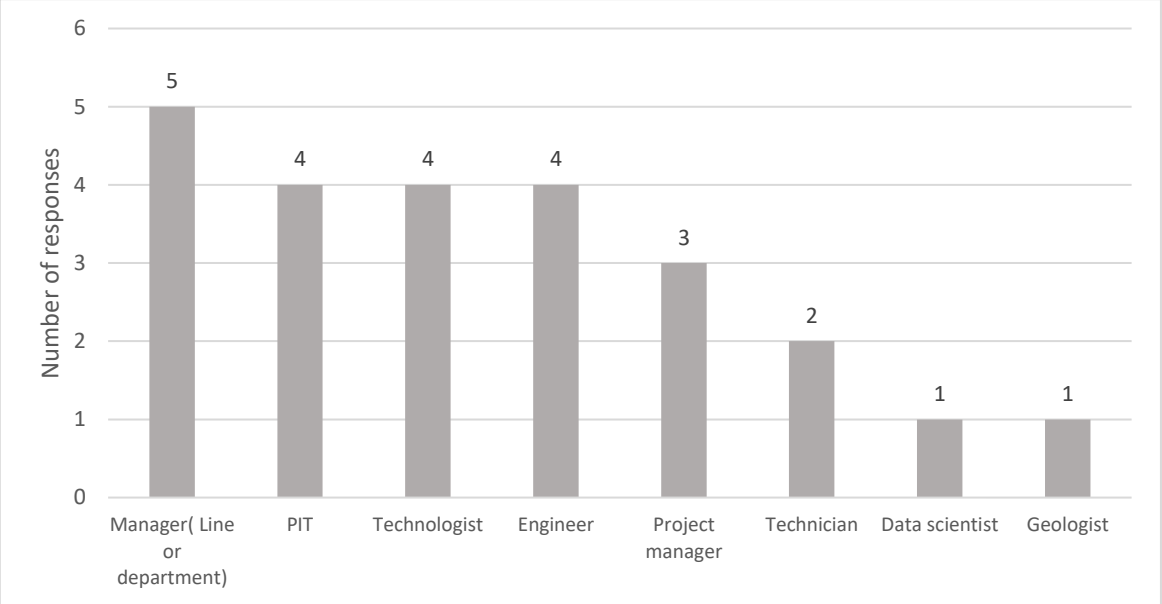

Figure III: Role during technology implementation process role

As recommended by [44], the weighted averages and scores for each scale component were used to analyse the gathered data. The data was ranked from 1-5 as shown in table 4.

Table IV:Agreement Colour scale rating

Agreement level			
	dis-agree		**agree**
Average weights	0-3.58	3.59-3.99	4-5

Table 4 displays the colour scale used to indicate the level of agreement between disagree and agree. Activities that require minimal attention are ranked 1 and 2, those that demand moderate attention are ranked 3 and 5, and those that require very careful attention for successful and worthwhile execution are ranked 4-5.

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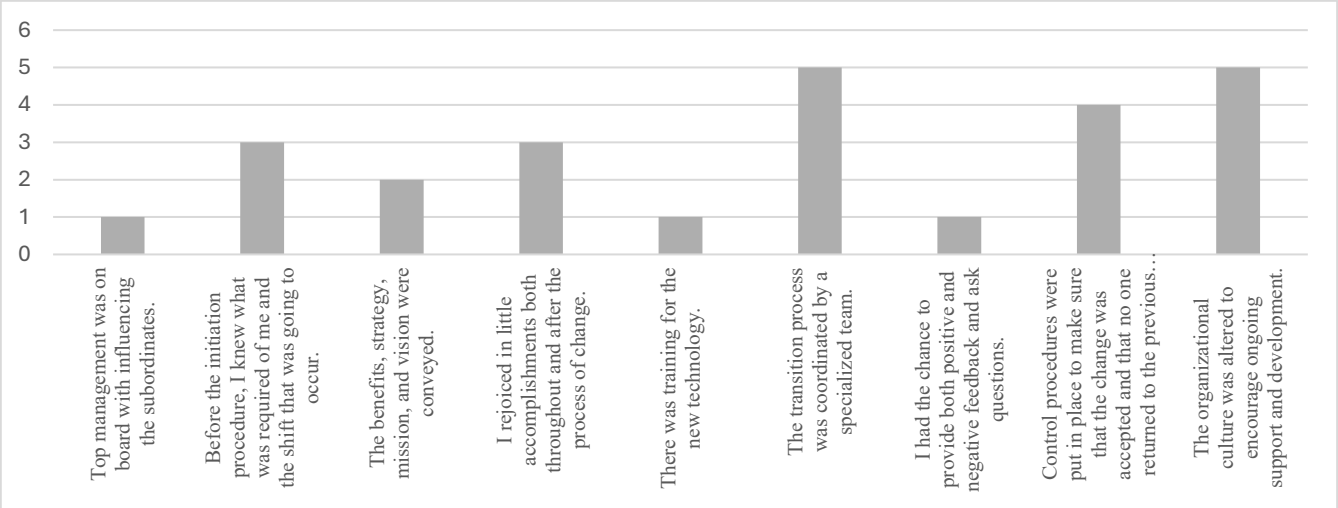

Figure IV: Change management application question ranking

The statements that follow are extracted from the application questionnaire for change management. The responses show that change happened in a top-down manner; the first step, getting support from high management, is ranked first, indicating that it was considered and doesn't need any further work. The Kotter change model is believed to have focused on top management buy-in as a first phase, even if it is not a critical stage for Lewin's and the ADKAR models.

Additionally, it demonstrated that training was given for the new technology and that the respondents were told about the strategy, vision, purpose, and advantages. They were also encouraged to ask questions and offer both good and negative feedback as a result of this knowledge. These activities were given the unimportant rankings of 1 and 2.

Prior to the start, understanding change and celebrating modest triumphs were ranked third, indicating that future efforts should concentrate on those areas. However, since this activity is ranked number five, special attention should be paid to the commitment of the team that will concentrate on guaranteeing transformation. Setting control mechanisms to make sure that change is accepted and that no one reverts to the old methods should be carefully considered. Finally, it is important to remember that change should be ingrained in the organizational culture, which is ranked number five.

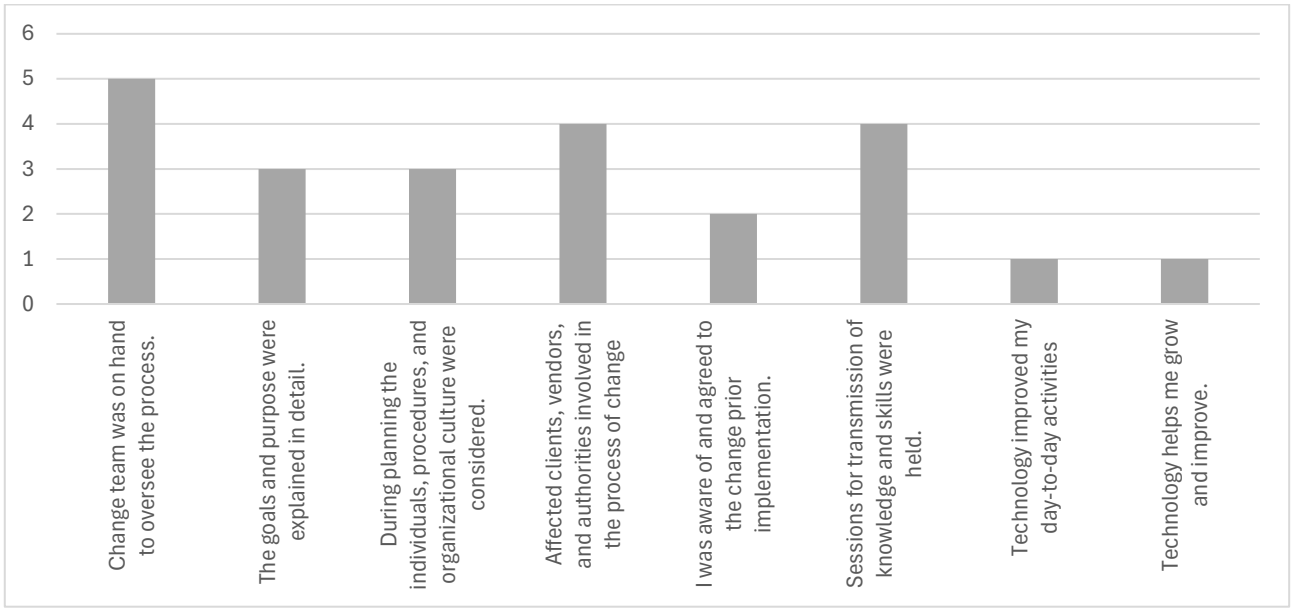

Figure V: Change management critical success factors responses ranking

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Figure 5 demonstrates how the respondents profited from the technology, which improved their daily tasks and met their particular demands. Respondents welcomed the change before the initiation phase (ranked 2), despite the fact that they only partially got clear explanation of the goals and purpose (ranked 3). The elements rated 4-6 require more attention because they are all essential for adoption and value realization, even though some factors were considered.

Since it is one of the crucial success elements, the fact that the affected customers, suppliers, and regulators received a ranking 5 indicates that the participants do not agree, and that more attention is needed. The simplification of daily tasks is cited as one of the justifications for adopting new technology. The statement being ranked 1 in figure 6 indicates that respondents agree that their daily activities were made easier or better after implementation.

Organizations use a variety of change management techniques, as detailed in the literature review summary. Out of the three models that were chosen, Kotter is geared toward upper management, while Lewin and ADKAR are focused on end users. The research indicates that when technology is adopted, the crucial steps that must be prioritized for adoption and value realization actually reveal gaps that require careful consideration.

Lewin's model is a straightforward three-step model with the drawback of not specifying how the human or end-user component must be handled during change. ADKAR and Lewin were the two models that best suited the study's objectives which was to find the best model for technology implementation. This turns into a process limitation. However, ADKAR places a comparatively greater emphasis on employee and end-user acceptability; hence, the procedures are sufficiently detailed to manage change.

The change team is an important step in Lewin's model, even if it is not necessary for Kotter and ADKAR models; its ranking of 5 shows that no team was established expressly to handle change. The literature describes it as a crucial task to think about, particularly in a setting or organization whose top executives have busy schedules. The primary goal of having a committed team is to guarantee that change is completed without obstacles or delays. Additionally, the team's technological expertise and abilities are valuable, as top management may lack them [45].

According to the questionnaire analysis, the organization has or uses a change management model, but it does not address end users; instead, it concentrates on top management, which lacks end-user buy-in and the necessary value for technology implementation. Three different change management models were used to implement the change, and only two of them focused on end-user buy-in. The data gathered indicates that the activities from the two models require careful consideration, as their levels of agreement range from neutral to disagreement. Although the buy-in from top management is an activity from Kotter's model, respondents agreed that it must be executed correctly, as this will facilitate concentrating on end-user involvement and buy-in.

CONCLUSION

Conclusions on the use of mining technology are made in light of the case study and literature review findings. Organization has shown that it understands procedures that must be shadowed throughout a change process, even though it is for top management buy-in rather than end-user adoption. Some actions should be listed as standard change implementation practices, as they are occasionally taken into consideration. Integrating cultural change is not given any thought at all, despite the fact that continuous improvement is a crucial component of the implementation's longevity.

Engagement and buy-in from end users are key to a change process's effectiveness. The results of the process depend on the kind of change being made and the team involved. The adoption of the technology by end users is impacted by concentrated knowledge and skill transfer sessions.

FUTURE STUDIES

The study can be beneficial to other industries such as rail and automotive in South Africa.

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